

**Improving Pediatric Oral Health in Children Under Five with Fluoride Varnish Application:
An Evidence-Based Practice Project**

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Abstract

Purpose: The United States Preventive Services Task Force has described dental caries as being the leading chronic disease in children in the US. The purpose of this project is to introduce preventative pediatric fluoride varnish in a family practice setting.

Analysis and Synthesis of Support: Recommendations expressed in the literature included the following: proper education for providers, frequent clinical reminders, and education for patients and families.

Project Implementation: The evidence-based practice project was implemented in a low-income safety net family practice during a three-month period. Primary care providers and medical staff were educated on the workflow and given resources by doctoral students throughout the implementation phase.

Evaluation Criteria: Progress of the implementation was measured by compliance with proper documentation of oral health assessment and billed diagnostic and procedural codes.

Outcomes: After twelve weeks, 61.9% of children ages 12, 18, 24 and 30 months had documentation of fluoride varnish application. This met the project's initial goal of 50% of children receiving preventative fluoride varnish application.

Recommendations: This project showed feasibility and sustainability within the family practice setting. Sustainability of implementation was displayed through buy-in from providers, medical and dental office staff and through financial reimbursement for fluoride varnish application. Based on the outcomes of the project it is recommended that a larger sample size be considered. Limitations included parental buy-in and lack of knowledge regarding fluoride varnish application.

Keywords

Family practice; oral health; children; fluoride varnish application

Clinical Inquiry

To determine the feasibility of implementing the United States Preventive Services Task Force guideline on fluoride varnish application to children under five years of age within the family practice setting.

Background and Significance

Primary prevention of dental caries is critical in the pediatric population. Oral health in children is a concern for both overall pediatric health and public community health in the United States (US). The United States Preventive Services Task Force (USPSTF) has described dental caries as being the leading chronic disease in children in the US (Davidson et al., 2021). Approximately 1 in 4 children ages 2-5 years old experience dental disease at some point in their growth and development (Clark et al., 2020). Children of lower socioeconomic status are most at risk, making up roughly 70% of children who experience dental decay globally, however the issue is more significant in the US. Children in the US with low socioeconomic backgrounds account for 80% of all children who experience dental disease (Clark et al., 2020). Children of Mexican American backgrounds are at highest risk, accounting for 33% of overall prevalence of dental caries in the US, with children from Black descent accounting for 28%. This is significant compared to their White counterparts accounting for 18% of overall prevalence (USPSTF, 2021). Social determinants of health and health disparities including race, health beliefs, access to care, diet and oral hygiene demonstrate the importance of pediatric oral health (Clark et al., 2020).

The pediatric population is especially vulnerable to the development of dental caries for numerous reasons. Not only do children need adult assistance with brushing their teeth and flossing, but they also depend on their parents or caregivers for adequate nutrition and routine dental care. When there is a lack of oral health maintenance, there is an increased risk of the development of dental caries. Dental caries in early childhood has many adverse outcomes and are often associated with decreased quality of life from increased pain, tooth extractions, delayed growth and development, underperforming in a school setting, and increased risk of developing

future dental cavities (Davidson et al, 2021). The American Academy of Pediatric Dentistry (AAPD) shares that untreated dental caries can lead to pulpitis, gum disease, and abscess formation, which can cause severe pain and tooth loss (AAPD, 2022). When children experience tooth pain from dental caries, there is associated pain with chewing, eating, and drinking, which can cause nutritional deficiencies and even failure to thrive, weighing less than 80% of their ideal weight for their age (AAPD, 2019). Childhood growth and development is stunted from a deficit in nutritional needs commonly seen in patients with dental caries. Additionally, their overall health is impacted due to inadequate and deficient sleep patterns. When children experience great pain from cavities, there is often a disruption in their sleep patterns, which can also interfere with their height and weight requirements (AAPD, 2019). Oftentimes, access to treatment for dental caries can take weeks to months, causing long term suffering related to pain. This can cause long-term suffering for the child due to physical pain and disruptions in their growth and development. Children across the US lose on average 50 million school hours per year on dental disease treatment, management, and follow-up care, leading to poor school performance (Davidson et al, 2021). School performance is also impacted by self-esteem and psychological distress. When children experience dental decay, their teeth are often discolored, misshapen, or even missing. This can cause the child to experience great insecurities regarding their smile and speech patterns, or even place them in a vulnerable position for social pressure and bullying (AAPD, 2019).

Additionally, dental caries can be challenging to treat. Some children require additional interventions for the treatment of dental caries, such as surgical management with general anesthesia and potential hospitalization. Treatment of severe tooth decay can cost \$10,000 per child and up to \$25,000 in severe cases, especially if the child needs to be hospitalized and treated under general anesthesia (AAPD, 2019). This is alarming as surgeries come with increased risks as well as an increase in overall health care costs. Some risks of pediatric dental surgery include trauma to local tissues, airway obstruction, laryngospasm, and aspiration

(Campbell et al., 2018). Not only do these adverse outcomes have high risk, but they are also costly to patients and to the overall healthcare system. According to the Center for Disease Control and Prevention (CDC), the US spends \$136 billion on dental related care (CDC, 2022). The Michigan Department of Health and Human Services (MDHHS) shares that in the State of Michigan, there was an average of \$3.5 billion spent on dental services in 2009 (MDHHS, 2020). Other states such as Virginia have shocking statistics about healthcare costs associated with dental decay. It is estimated that the application of fluoride varnish (FV) would be an overall cost saving of 2 million dollars for pediatric Medicaid patients yearly in Virginia alone (Scherrer & Naavaal, 2019). Initiation of application in supplies has been shown to cost as little as \$1.10 per child for materials, with labor costs for application being as low as 0.67 cents to as much as \$4.37 (Clark et al., 2020).

The treatment of caries in the pediatric population can be very costly in a financial, physical, and emotional way. Therefore, prevention of dental caries is critical in the pediatric population. Alarmingly, in Michigan only 48.1% of children ages 1-5 have received preventative dental care visits in 2020 (MDHHS, 2020). The current USPSTF recommendation shares that PCPs should apply FV to the primary teeth once the first tooth has erupted in all children younger than five years of age (Davidson et al, 2021). The varnish would be applied to asymptomatic children ages 6 months and older during a routine medical visit. At this visit, a topical FV would be applied to all primary tooth eruptions with a small brush and a 5% sodium fluoride or 2.26% fluoride formulation every six months (USPSTF, 2021). However, the American Academy of Pediatrics (AAP) states that children at high risk would benefit from fluoride varnish application (FVA) every three months using the Oral Risk Assessment Health Tool (AAP, 2023). The benefit of applying varnish in the family practice setting has been seen to improve application to children from 14%-50% in just 18 months (Sudhanthar et al., 2019). FVA in the family practice setting gives pediatric patients preventative treatment for dental caries in which they may not have had access to.

Organizational Assessment

According to the chief medical director and the clinic's website, this primary care practice has been serving the community in this Midwestern city since 1976 and is a healthcare safety net to the local area providing primary, dental, and optical care. Since this time, the practice has provided high quality treatment to thousands of individuals both pediatric and adult patients who are either uninsured or underinsured as part of their mission and vision. The practice is home to various specialties in efforts to promote long term health and wellness for their patients both mentally and physically. All-inclusive treatment plans include specialists ranging from medical specialist, behavioral health, optometry, and dental care.

This practice is a non-profit 501(c)(3) organization that relies on donors to help in providing all necessary supplies and equipment. The nonprofit staffs medical professionals, volunteers and receives the support of many generous donors to keep their doors open to serve the community. The dental clinic began because of a \$50,000 grant from a local dental organization. Through these funds, the clinic has been able to provide services including exams, cleanings, fillings, bite splints, extractions, and education on preventative care and maintenance. Its aim is to provide preventative dental treatment to avoid emergency room visits that stem from dental infections and preventable issues.

Over the past year, the family practice clinic has treated 11,280 patients. Of these patients, 239 patients were five years old or younger. During this time 697 visits came from children meeting the criteria for this EBP project (Clinic chief medical officer, personal communication, June 6, 2023). Unfortunately, it is unknown which patients were seen for dental diagnosis associated with decay, cavities, or abscesses. The clinic sees this project being beneficial to their patient population since many come from underserved areas with lack of resources and proper education.

This FVA EBP has the backing of the staff and providers within the family medicine and dental care practices. It also has the support of the medical director and chief executive officer of the practice.

Framework

The chosen framework model for this project is the Iowa Model of Evidence-Based Practice. The Iowa Model creates a system based on “triggers,” or monumental moments that inspire the need for sustainable change. The primary steps of this framework include identification of clinical problems, evaluation of research surrounding the topic, creation, and implementation of EBP change, and dissemination of findings and application of sustainable change within the practice setting (Iowa Model Collaborative et al., 2017). *See Appendix A for graph of the Iowa Model for this EBP project.*

SWOT Analysis

An analysis of the strengths, weaknesses, opportunities, and threats of the family practice clinic in conjunction with the suggested project proposal was created by the Doctor of Nursing Practice students. *See Appendix B for detailed SWOT Analysis.*

Problem Statement

Dental caries is the leading chronic illness in children. The recommendation from the USPSTF states that at the first tooth eruption, the risk of dental decay be assessed in children under five years and receive FV applied by a primary care clinician (USPSTF, 2021). The Midwestern family practice is not currently providing these services which can improve the oral health of the children they are serving.

Synthesis of the Literature

Search Methods

Search methods included databases both PUBMED and CINAHL. Search terms used were (“Dental caries” or “dental decay”) And (“fluoride varnish”) And (“pediatric” or toddler). CINAHL (28 articles), PUBMED (22 articles). The Boolean theory was used to help guide the

search. Research was limited to the last five to seven years and only relevant studies were taken into consideration. Inclusion criteria included: English language studies performed with the United States, children under five years old. Exclusion criteria included: articles with abstracts only and articles not addressing pertinent topics. Four articles from PubMed and three articles from CINAHL were retained for analysis and evaluation. 17 articles from PubMed and 25 articles from CINAHL were excluded due to the following: study originated outside the US, did not include or target the population of interest (children less than five years old), did not target correct intervention (education program versus varnish application). The grading scale used to determine the level of evidence was the *Johns Hopkins Nursing Evidence-Based Practice Appendix C: Evidence Level and Quality Guide*. The level of evidence ranged from level 2 (cohort study, quasi-experimental) to level 5 (QI project, qualitative study).

Themes

Themes found throughout the literature review included: cost-effectiveness of FVA and training, provider training resistance and documentation inadequacies (leading to insurance difficulties), lack of accountability for performing and documenting procedures and the necessity of multiple reminders, and opportunities for reimbursement and profit benefits.

Outcomes

Outcomes of the studies included: fewer caries related visits, fewer dental anesthesia visits, increased provider compliance, increased dental referrals, additional preventive dental visits, and positive reimbursement and billing.

Recommendations

Recommendations expressed in the literature included the following: Proper education for providers (including documentation, insurance and billing protocols (Current Procedural Terminology (CPT) codes and International Classification of Diseases Tenth Revision (ICD-10) codes, trainings and certifications), frequent clinical reminders to ensure provider completion of varnish application, screening intervals occurring during well-child examinations (at 12-18-24-30

month visits) with appropriate oral risk assessment tool, referral to pediatric dentist for high-risk patients, and education for patients and families on healthy dental practices, FVA, and anticipatory guidelines.

Implementation

An EBP project was proposed to the low-income safety net family practice in this Midwestern city to increase rates of preventative pediatric FVA. The framework for the EBP project utilized the Iowa Model. *See Appendix A for a detailed view of the Iowa Model framework.* The project implemented FVA in children under the age of five performed by PCPs within the family practice setting, which aligns with USPSTF recommendations. The implementation of the EBP occurred within the family medicine suite of the family medicine clinical practice, which serves uninsured, underinsured, and high-risk populations.

Prior to FVA implementation, the doctoral students provided the staff with an educational video outlining the proposed project and the designated roles and responsibilities. Physicians and nurse practitioners completed Smiles for Life training and certification before performing FVA and received information about proper billing and coding protocols. Dental office staff received product information and coordinated with the designated provider for ordering supplies and storage. Medical assistants (MAs) prepared clinic rooms by stocking FVA packs within the room and placing a FVA pack directly in the patient's chart. Doctoral students were available within the practice to answer questions, evaluate progress, and address barriers to application. Other students and residents were excluded from project implementation.

Stakeholders for the proposed project included PCPs (specifically physicians and nurse practitioners), MAs, patients (children younger than five years of age) and their family members, dental assistants and hygienists, and insurance companies (both public and private entities). A project team was assembled for implementation of FVA consisting of the doctoral students, physicians, nurse practitioners, MAs, and office administrative staff.

The proposed clinic covered startup costs of the FV packs. The product of use was the Profluorid 5% Sodium Fluoride Varnish Single Dose individual packs with Child Dose at 0.25 ml in Melon flavor. The packs expire within one year and come with dosed FV and required applicator. They came as a set of 200 for \$280.36, equating to \$1.40 per application. The expected reimbursement per Medicaid was \$15 per application, equating to a net reimbursement of \$2785 or \$13.92 per application after startup costs. The clinic was able to fund this project through donations and local grants.

The process of FVA occurs at 3–6-month intervals at regularly scheduled appointments for well child examinations per the USPSTF guidelines. The proposed application of FV for the EBP occurred at well child examinations for children aged 12 months, 18 months, 24 months, and 30 months. This project took place from late October 2023 through the end of January 2024. Students evaluated the total number of FVAs with a goal of one FVA per child within designated age intervals, and 50% of all eligible children receiving FVA once during the three-month period. Providers educated patients and family members on the importance of FVA and provided anticipatory guidance. MAs provided the PCPs with FVA packs within the chart and within the clinic rooms. Providers applied the FV as part of the well child examination prior to any recommended vaccinations. They utilized smart-phrases application within the electronic health record (EHR) for documentation of oral health assessment and FVA. The implementation strategy used for the EBP included a Plan-Do-Study-Act (PDSA) cycle. *See Appendix C for reference of this model used during the EBP project.*

Progress of the implementation was measured by evaluation of PCP compliance with proper documentation of oral health assessment and correctly billed ICD-10 codes Z41.8 or Z29.3 and CPT code 99188 with every FVA. Doctoral students retrieved chart data monthly to ensure provider compliance with proposed FVA and to address barriers to application. Data was obtained, deidentified, and provided to the doctoral students for evaluation of project success. After 12 weeks of project implementation, it was expected that 50% of children ages 12, 18, 24

and 30 months would have documentation of one FVA. Barriers addressed prior to implementation included the role of the MAs, the process of reminding providers to apply FV and documenting correctly, the role of education and anticipatory guidance in patient/parent compliance, and the cost of the FV packs.

Data was obtained and provided to the doctoral students by the lead provider. At the end of a twelve-week period, 50% of children ages 12, 18, 24 and 30 months should have documentation of FVA.

The proposed EBP was approved by the faculty project advisor, community partner, privacy officer, College of Nursing, and University Institutional Review Board. The start date of in-office FVA was on 10/23/2023 with an end date of 1/23/2024. Periodic meetings were arranged with faculty project advisors and the family medicine clinic to discuss progression of the implementation and areas for improvement.

Integration with Clinical Expertise and Patient/Family Preferences

Patient and family experience were vital to the success of this project. For a patient to have received the FVA from the clinic, a level of understanding and buy-in from the families was required. Integration of clinical expertise was highlighted through completion of training from providers and education given to patients and families during the well child visits. Parental and family values were considered when evaluating the need for FVA for their children. Areas of discussion included risk factors, autonomy, implications of refusing FVA, and overall health and well-being.

Evaluation of Outcomes

Data on the total number of FVAs and the total number of eligible patients seen was collected by the chief medical director via EHR review by extracting billing and coding data (such as ICD-10 code Z41.8 and/or Z29.3, and/or CPT code 99188). *Figure 1 displays a graph comparison of the total number of FVAs versus the total number of eligible patients by age. Figure 2 displays FVAs received versus total eligible candidates. Figure 3 displays total FVAs with*

respect to the designated age intervals. Figure 4 represents the number of children who received the FVA during each month of the implementation process.

The clinic did not perform FVA prior to the EBP project implementation. After the three-month implementation time frame, the results showed 13 total FVAs out of the 21 total eligible patients. The expected outcome of this EBP project anticipated that 50% of all eligible patients would receive the preventative FVA once during the 3-month period. As a result of the implementation of the EBP, 61.9% of those eligible based on the designated age criteria received the FVA. The sample size of the total FVAs was too small to demonstrate statistical significance despite exceeding the project's expected outcome.

The clinic's reimbursement per FVA averaged \$7.46 for patients with Medicaid health insurance. Only one recipient of the FVA was privately insured, which generated a reimbursement of \$11. After accounting for provider service time based on the average salary of a family medicine physician in this urban city of \$218,809, the calculated total return on investment was \$36.82 for the two-minute FVA application process including supplies to the 13 eligible recipients (ZipRecruiter, 2024). The project was deemed financially sustainable for future practice. The clinic will continue to sustain necessary resources to provide FVA to all eligible patients that meet USPSTF guidelines.

Implications for Practice

Areas of development

One area of development that was discovered in the implementation of the FVA was the need for educational resources to provide to family members of patients. Parents were interested in reading about the proposed benefits, potential risks, and treatment plans of caries prevention. The students provided resources to the clinic to share with patients and their family members about the FVA.

Limitations

While there were three eligible providers to administer FVA, the data showed that only one provider was successful in doing so. Provider A completed all 13 eligible FVA, despite the clinic seeing 21 total eligible patients. Provider B and C completed 0 FVAs. Limitations for all providers of FVA included parental buy-in, lack of knowledge regarding FVA, patients coming from split families, patients who had already received it from their home dental offices, and limited patients meeting age criteria for project implementation.

Implications for Organization

Implications from this project showed feasibility of FVA within the family practice setting. The organization saw a reasonable return on investment through financial means, educational opportunities with patients and families, and the hopeful prevention of childhood caries in their patient population. One major contributing factor to the success of the FVA project was the associated dental office within this organization. This is attributed to the trouble-free accessibility of fluoride-based products, as well as educational materials about their use.

The systematic process was redefined throughout the implementation process to fit the needs of the clinic using the Plan-Do-Study-Act model (PDSA). *See Appendix C for reference of this model used during the EBP project.* This organization will need to develop future quality improvement measures to keep the FVA process sustainable long-term.

Due to the nature of this low-income safety net clinic, donations and grants are required to sustain growth and clinical operations. The clinic received a local grant to support the efforts of FVA and prevention of childhood caries. The grant included educational materials for providers, parents, and patients, as well as other resources such as toothbrushes, toothpaste, floss, dental-related toys, coloring books, and pamphlets about pediatric oral health. The clinic will need to seek out other educational resources when supplies become depleted.

Implications for General Practice

The EBP project brought awareness to the importance of overall oral health and hygiene to the local communities, as well as the practicality of PCPs performing FVA within the family practice setting. Clinical practices that utilize EHRs have the benefit of potential templates embedded within their documentation systems to notify providers of patient risk, to perform oral health assessments, and verify billing and coding. Clinicians state that FVA is quick and easy to perform, taking less than two minutes to complete. FVA were embedded into each well child visit, making it practical to complete during this visit since they already had scheduled appointments to see the provider.

Access to fluoride-based products is variable by city, state, and federal guidelines. Having a connection with a local dental office made this process easier to obtain needed products. Because it is not a requirement for clinical practices to have an associated dental office, FV packs can be purchased from a distributor in many forms.

The USPSTF guideline does not apply to patients who have a regular dental home. Children receiving fluoride from their dentist are excluded from this process to reduce the risk of fluorosis. The guideline aims to promote oral health and prevention of caries in children who do not regularly visit a dentist and are at risk for developing caries.

The ability to apply FV in the US is variable state-to-state. In this Midwestern city, only PCPs can apply FV and bill to the patient's insurance provider. However, in other states, MAs can apply the FV on behalf of the primary care provider. This increases access to care by allowing additional office staff to aid in the FVA process, as they already do for immunizations, vital signs, etc. It is the responsibility of the provider to identify their state's current guidelines and limitations to applying FV.

The project has demonstrated the implications of FVA and caries prevention on a regional and national level by supporting the evidence, current guidelines, and primary prevention

measures. The FVA process can be easily transferred to other family practice and pediatric primary care settings.

Dissemination

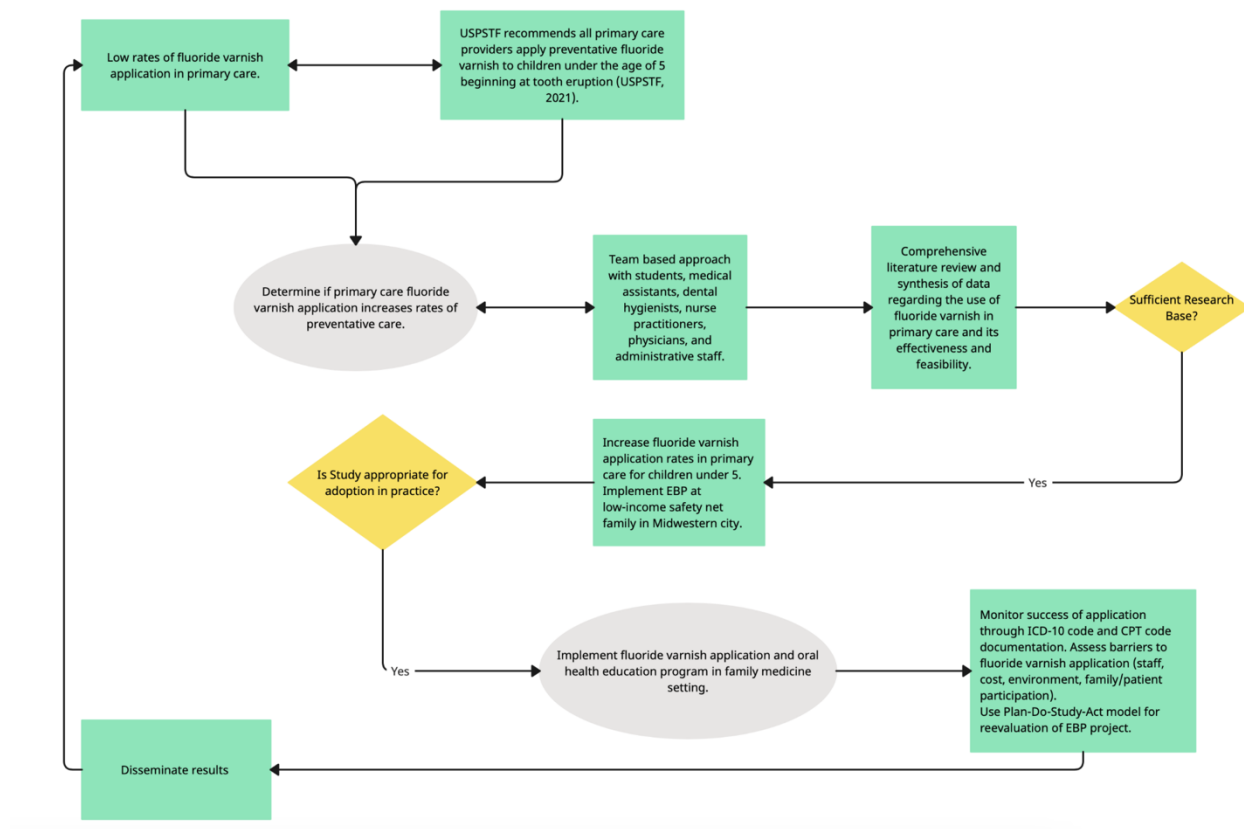
Dissemination of this EBP project was demonstrated to various outlets. The authors shared an article on the College of Nursing's newsletter that reaches the community, including students, faculty, and alumni. As a part of College of Nursing's video series, "Being a Part of Something Bigger Than Yourself," the authors were able to bring awareness to the importance of FVA in family practice at the family medicine clinic. The authors were also able to present at the College of Nursing Research Day through a poster presentation. Lastly, a digital presentation was created to share findings of this project to other Doctor of Nursing practice students, faculty, community partners, and colleagues alike in a final dissemination presentation.

Conclusion

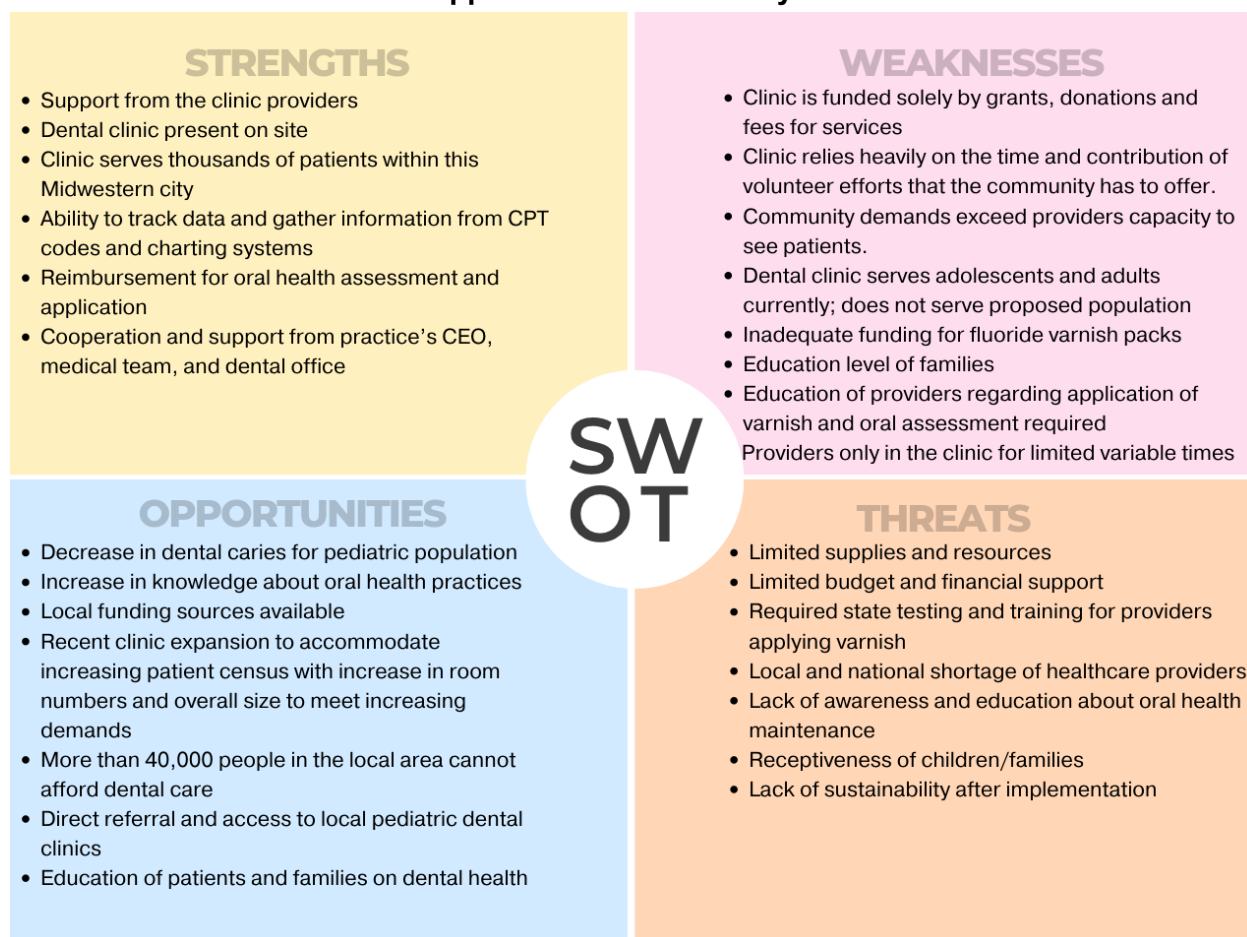
The EBP approach to FVA helped identify areas of strengths during the implementation phase of the project. The project demonstrated feasibility and sustainability within the family practice setting. Future EBP and/or quality improvement projects could examine a broader population of children to show statistical significance. The project far exceeded expectations from a clinical and educational standpoint. As a result, 61.9% of children who met the age criteria were administered FV. Family practice clinics can use this framework to help implement FVA within their own clinics as a means of primary prevention to help reduce risk of caries in children under five years of age.

Appendices

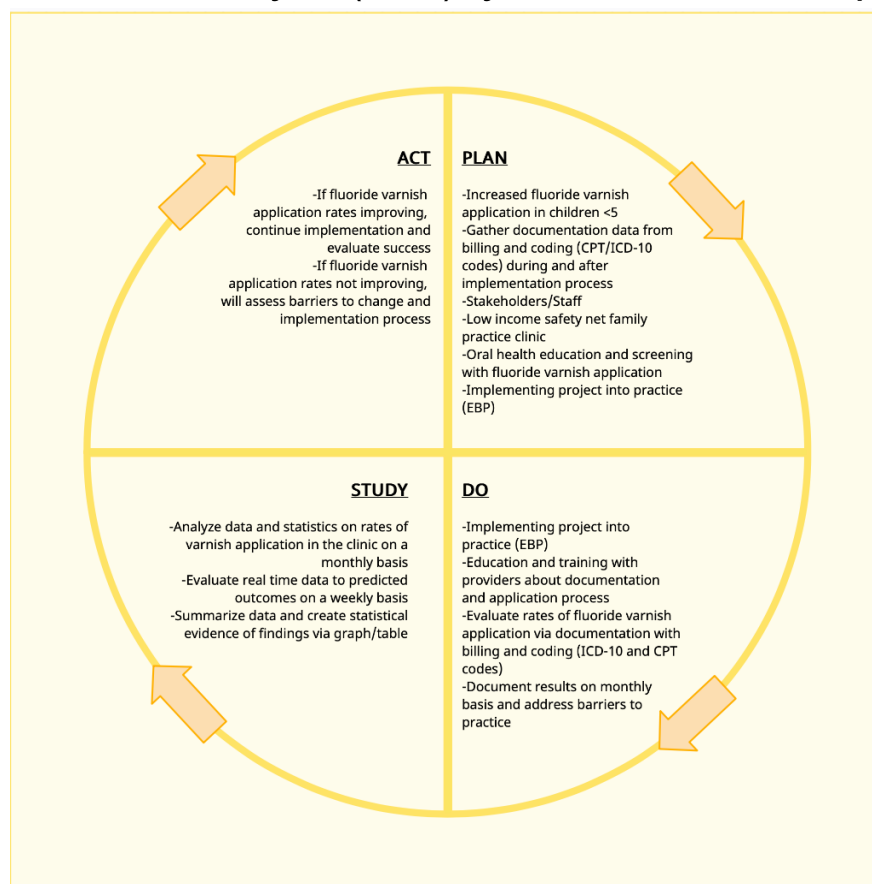
Appendix A - Iowa Model for Fluoride Varnish Application



Appendix B - SWOT Analysis



Appendix C - Plan-Do-Study-Act (PDSA) Cycle for Fluoride Varnish Application



Figures

Figure 1 - Comparison of Fluoride Varnish Applications

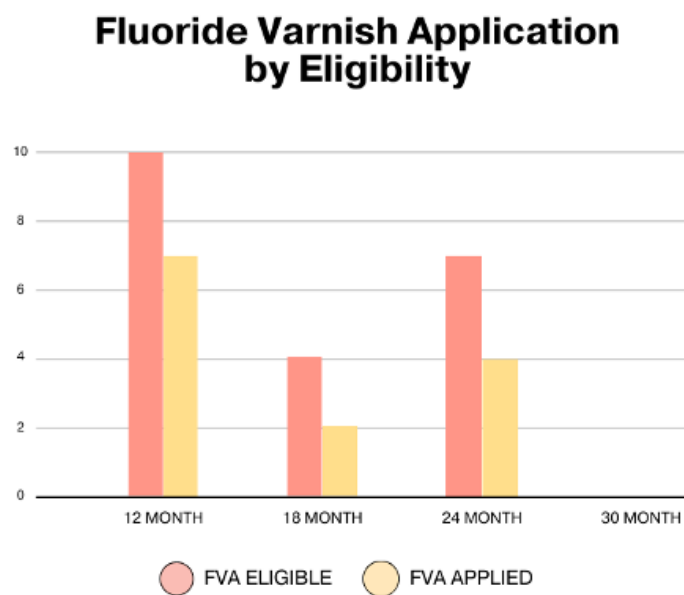


Figure 2 - Total Fluoride Varnish Applications

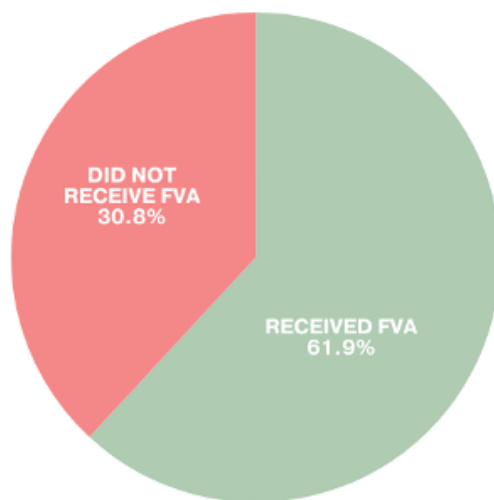
Total Fluoride Applications

Figure 3 - Fluoride Applications by Age

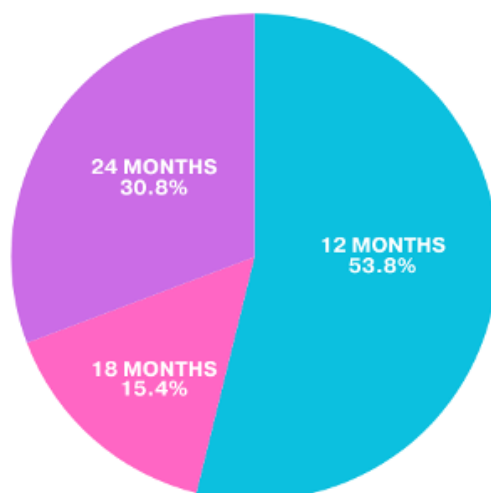
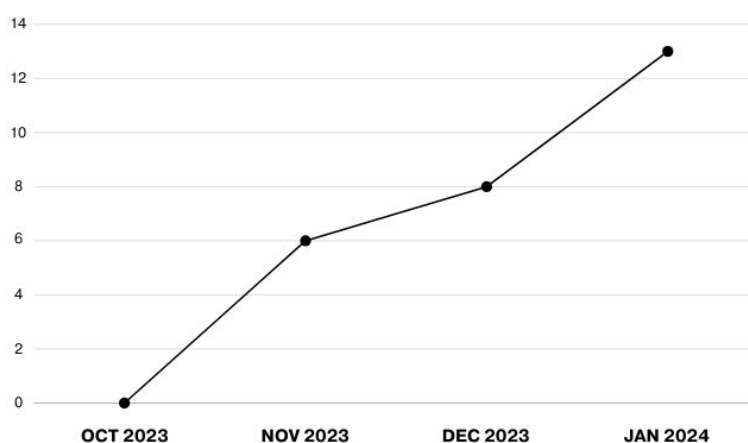
Fluoride Applications by Age

Figure 4 - Total Fluoride Applications by Month

Fluoride Applications by Month

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