# A Resident-Led QI Project to Improve Dental Health at a Primary Care Pediatric Practice

Lauren T. Roth, MD
Laura Robbins-Milne, MD
Dana Sirota, MD, MPH
Mariellen Lane, MD

## ABSTRACT

**Background** Dental caries are the most common chronic condition of childhood and have significant medical, psychological, and financial consequences. The American Academy of Pediatrics (AAP) recommends primary care physicians apply fluoride varnish (FV) every 3 to 6 months from tooth emergence through age 5.

**Objective** Through a resident-led quality improvement (QI) project, we aimed to provide FV to 50% of patients ages 1 through 5 who did not have a dental visit in the preceding 6 months or receive FV elsewhere in the past month.

**Methods** From May 2017 through April 2018, we conducted 7 monthly plan-do-study-act cycles to improve our primary outcome measure (FV application), secondary outcome measure (percentage of patients who had routine dental care), and process measure (percentage of dental referrals). Balancing measures included time taken away from other clinical priorities and reimbursement rates.

**Results** Fluoride varnish application improved from 3.6% to 44% with a 54% peak. The percentage of patients under 6 who had seen a dentist in the past 6 months increased from 30% to 47%. The percentage of dental referrals increased from 17% to 33%.

**Conclusions** Application of FV is a quick, cost-effective way for primary care providers to improve dental health. This resident-led QI project increased rates of FV application, dental referrals, and dental visits while meeting ACGME guidelines for experiential learning in QI. By adapting to state-specific guidelines and workflows of each clinic, this QI project could be nationally reproduced to improve adherence to AAP and United States Preventive Services Task Force guidelines.

## Introduction

Dental caries are the most common chronic condition of childhood.[1] In addition to increased risk of hospitalization, caries have been associated with poor growth, irritability, poor school performance, and school absences.[2,3] Fluoride varnish (FV) has been well studied as a means to reduce dental caries, with reduction rates as high as 25% to 45%.[4] The American Academy of Pediatrics (AAP) and the United States Preventive Services Task Force recommend that primary care physicians (PCPs) apply FV every 3 to 6 months from tooth emergence through age 5.[5,6] Since almost 90% of infants and toddlers are up-to-date with the pediatrician, compared with only 1.5% with the dentist, PCPs can have an early impact on dental health and health care savings through application of FV.[7,8]

Practice-based learning and improvement is a core competency for residents, recommended by the Accreditation Council for Graduate Medical Education (ACGME). Many residency programs have incorporated quality improvement (QI) curricula to meet this competency in various forms, but experiential learning has been shown to be most effective in improving knowledge and effecting practice change.[9–16] For our resident-led QI initiative, we chose to implement FV application at our primary care clinic.

Based on resident experience and consensus, our primary aim was to increase FV application from 3.6% to 50% of patients ages 1 through 5 over the 2017–2018 academic year. Additionally, we aimed to increase the percentage of patients who had seen a dentist in the preceding 6 months from 30% to 50%, and to increase the percentage of dental referrals for patients who were overdue from 17% to 60%.

## Methods

### Setting

This study took place at the New York Presbyterian (NYP) Broadway Practice, 1 of 4 resident-led continuity clinics in Columbia University's Ambulatory Care Network (ACN), during the 2017–2018 academic year. In addition to weekly continuity clinic, all residents participate in a month-long ambulatory rotation. During this rotation, residents provide patient care in addition to leading the clinic's QI project.

DOI: http://dx.doi.org/10.4300/JGME-D-19-00959.1

## QI Curriculum

As part of our resident-led QI curriculum, residents vote on an annual improvement project for their clinic site and participate in planning, implementation of plan-do-study-act cycles, data collection, and sustainability efforts. The senior resident on the ambulatory rotation leads the QI team, which includes residents, the clinic's designated QI attending, and the ambulatory director. At the end of the month, the residents report their efforts to the entire practice team, and the next month's team resumes the next phase of the QI process.

## Population

The NYP Broadway Practice is a community-based clinic in the Inwood neighborhood of Manhattan. We see an ethnically diverse patient population with a total of 4804 pediatric patients and 1866 patients ages 4 and under. The clinic sees approximately 13 000 patients yearly.

## Inclusion Criteria

Patients were included in this study if they were ages 1 through 5, eligible for FV, and had a well care or follow-up appointment. Sick visits were excluded. Patients were eligible for FV if they had not visited a dentist in the preceding 6 months and did not have FV applied by another provider within the past month.

## Collection of Baseline Data

As part of standard QI methodology, we collected baseline data via chart review from May through August 2017. Included in our electronic health record are dental screening questions to identify children due for a dental appointment. We added features to document whether patients were referred to a dentist and whether FV was indicated and given at the visit. Each month we analyzed all eligible patient charts over the course of 1 week.

During this 4-month period, only 29% of patients (47 of 163) were up-to-date with dental appointments. Of those patients due for a dental appointment, only 17% (27 of 163) had a dental referral made and only 4% (4 of 112) had FV applied.

## Improvement Activities

We utilized the Model for Improvement to implement changes aimed at improving our rates of FV application. The first QI team determined the aims of the project, ascertained the key drivers, or factors that contribute directly to achieving those aims, and suggested interventions that might improve those factors (FIGURE 1). The interventions were focused on the following key drivers that are summarized in the TABLE.

**What was known and gap**
Dental caries is a common chronic condition in childhood and can be prevented through the application of fluoride varnish (FV).

**What is new**
A resident-led quality improvement (QI) project that aimed to provide FV to 50% of primary care patients ages 1 through 5 who did not have a dental visit in the preceding 6 months or receive FV elsewhere in the past month.

**Limitations**
There are no data on the project's sustainability past 1 year.

**Bottom line**
This resident-led QI project increased rates of FV application, dental referrals, and dental visits while meeting ACGME guidelines for experiential learning in QI.

*Key Driver No. 1: Provider Education and Identification of Children Eligible for FV:* Columbia University dental residents provided face-to-face lectures using the AAP oral health curriculum to all the clinic's preceptors who then led sessions for the residents during continuity clinic.[17]

*Key Driver No. 2: Provider Buy-in for the Importance of FV Application:* We surveyed providers to identify obstacles that prohibited their ability or desire to apply FV, notably insufficient time, workflow concerns, patient or family refusal, and uncertainty regarding how to educate and counsel families. By engaging physicians in this exercise and beginning to address these barriers, buy-in significantly improved. We sent monthly email updates about the project and placed reminder cards on all the computer desktops. We also distributed report cards informing each provider of their personal rates of FV application.

*Key Driver No. 3: Ease of Application of FV During Well Child Visits:* One major barrier was that providers had to leave the patient room to collect FV before applying it. Based on chart reviews of patients' dental homes, we learned that only 33% (14 of 42) of our patients ages 1 to 3 had been to a dentist in the past 6 months, compared to 64% (25 of 39) of patients ages 3 to 6. Because of this discrepancy, we decided to prioritize our efforts on the younger population. We recruited medical assistants (MAs) to supply FV to providers prior to all visits for patients ages 1 to 3, serving as a reminder for providers to apply FV while making the process more efficient.

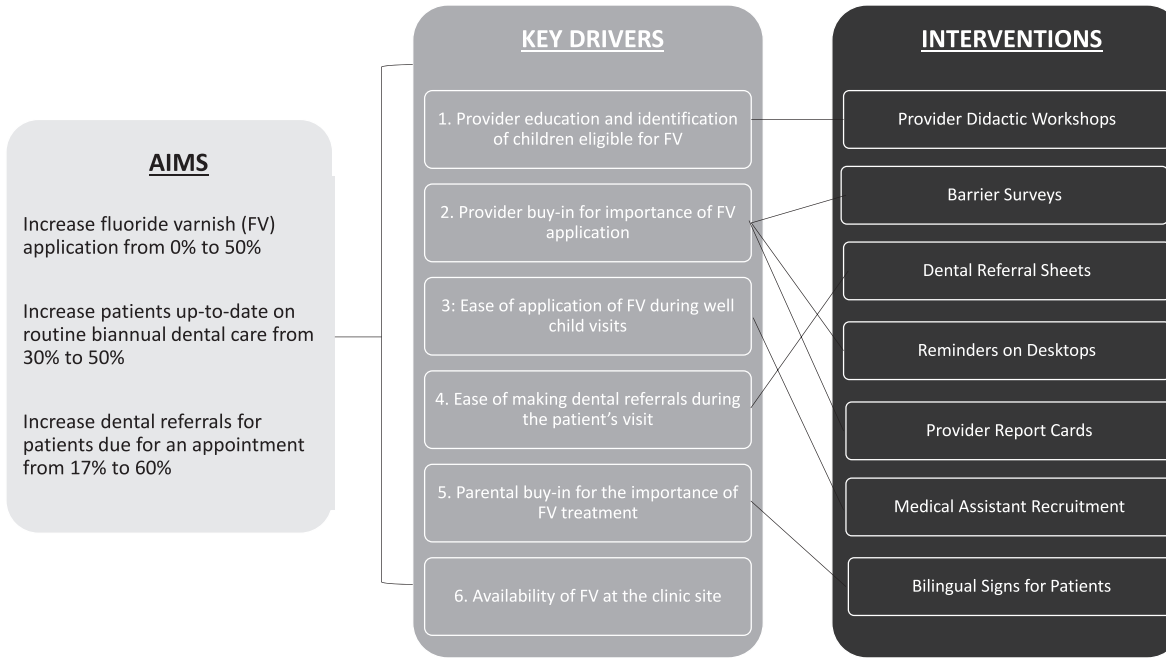


**FIGURE 1**
Key Driver Diagram Summarizing Project Aims, Key Drivers, and Interventions

***Key Driver No. 4: Ease of Making Dental Referrals During the Patient Visit:*** One of our secondary aims was to improve referral rates so our patients could establish a dental home. Despite our low baseline rate of 17% of referrals made, 85% (17 of 20) of providers believed it was important to refer to the dentist. We learned it was difficult to make referrals within the institution due to lack of appointment availability, so we partnered with the Section of Population Oral Health at Columbia to ensure there would be twice-weekly availability for urgent referrals. Our electronic health record was updated to triage referrals based on the time window in which the patient needed to be seen. We developed a bilingual community dental referral sheet, and support staff stocked these in every patient room.

***Key Driver No. 5: Parental Buy-in for the Importance of FV Treatment:*** Parents were unaware of the dental health recommendations for young children. Bilingual educational signs were placed in the waiting and patient care rooms. We included FV application instructions in after-care summaries and on the back of the referral sheets.

***Key Driver No. 6: Availability of FV at the Clinic Site:*** Quality issues with the FV temporarily limited our clinic supply, which led to decreased application rates. Within approximately 1 month, a new formulation of FV was restocked in the clinics.

### Measures

Our primary outcome was the application of FV and our secondary outcome was the percentage of patients up-to-date with dental appointments. Our process measure was the percentage of dental referrals made for patients overdue for an appointment. Balancing measures included time taken away from other clinical priorities as well as reimbursement rates; however, they were not tracked during this initiative.

This study was approved by the Columbia University Human Research Protection Office Institutional Review Board.

## Results

During this study 323 eligible patients were included with an average of 27 patients per month. The run chart documents plan-do-study-act cycles and their relation to FV application (FIGURE 2). By April 2018, we improved our primary outcome (FV application) from 3.6% to 44% with a peak of 54%. The percentage of patients under 6 years who had seen a dentist in the preceding 6 months increased from 30% to 47%, and the percentage of dental referrals increased from 17% to 33%.

Improvements in FV application were seen with each intervention, though some had greater effects than others. The improvement seen after the educational sessions gave an initial increase to 35% but was found to be short-lived. A decline in rates occurred

**TABLE**
Summary and Timeline of Interventions and Lessons Learned

| Test of Change | Key Driver | Intervention Month | Intervention | Lessons Learned |
|---|---|---|---|---|
| Provider didactic workshops | No. 1: Provider education and identification of children eligible for FV | August 2017 | All providers were educated on the importance of fluoride, indications for administration, and methods for applying FV utilizing the AAP-endorsed "Smiles for Life: A National Oral Health Curriculum." | Most providers were unaware of the AAP recommendation for primary care physicians to apply FV but understood the importance of FV for dental health. Initial feedback suggested that providers were resistant to changing their practice. |
| Barrier surveys | No. 2: Provider buy-in for importance of FV application | September 2017 | Providers were surveyed regarding barriers they felt prohibited application of FV and referrals to local dentists. | The majority of barriers cited were insufficient time, workflow concerns, patient or family refusal, and uncertainty how to educate and counsel families. There were limitations in appointment availability at our partner dental site and providers knew little about other local dentists. |
| Dental referral sheets | No. 4: Ease of making dental referrals during the patient visit | October 2017 | A bilingual dental referral sheet was developed to provide to families that included community dentists' contact information, patient age range, and willingness to accept children with behavioral concerns. | Ease of making dental referrals significantly improved by having a physical document present in all patient care rooms to provide to patients. |
| Reminders on desktops | No. 2: Provider buy-in for importance of FV application | January 2018 | Cards were posted on all desktop computers in patient care areas to remind providers to apply FV to eligible patients and to document and bill for the service. | Providers needed to be actively reminded to apply FV given the multitude of tasks required of a health care maintenance appointment. |
| Provider report cards | No. 2: Provider buy-in for importance of FV application | February 2018 | Feedback in the form of email progress reports were sent to all providers informing them of their personal rates of FV application. | It was important to provide personalized feedback to improve individual provider buy-in and serve as a reminder for the ongoing initiative. |
| Medical assistant recruitment | No. 3: Ease of application of FV during well child visits | March 2018 | Medical assistants were recruited to supply FV to providers when they had an appointment scheduled for a patient ages 1 to 3. | Patients ages 1 to 3 were significantly less likely to have an established dental home than older patients.<br>Collaboration of clinic staff and providers improved workflow efficiency and overall buy-in for FV application. |

**TABLE**
Summary and Timeline of Interventions and Lessons Learned (continued)

| Test of Change | Key Driver | Intervention Month | Intervention | Lessons Learned |
|---|---|---|---|---|
| Bilingual signs for patients | No. 5: Parental buy-in for the importance of FV treatment | April 2018 | Bilingual signs that contained educational information regarding dental health and FV application were placed in the waiting room and all patient care rooms. | Many patients were unaware of the recommendation for young children to see the dentist and did not know FV was available at the clinic. Visible signs increased awareness and encouraged active participation of families in their child's dental health. |

Abbreviations: FV, fluoride varnish; AAP, American Academy of Pediatrics.

when the quality of FV made it unusable, and during the holidays when fewer residents were present in clinic, as they were the early adopters and more likely to apply FV than attendings. The interventions with the greatest impact were providing performance feedback report cards to providers and recruiting MAs to supply FV for patients ages 1 to 3. These 2 interventions increased FV application from 21% to 54%. As a result of this study, all continuity clinics within our ACN were stocked with FV, and FV application became part of routine patient care.

## Discussion

After 12 months of QI interventions, we improved our rates of FV application from 3.6% to a peak of 54%. Resident-led QI initiatives can lead to significant change in primary care practices and improved resident knowledge in QI methodology, which has been well documented in the literature.[10,11,13,14] Through this longitudinal QI curriculum, our residents have been engaged and enthusiastic about QI, particularly when applying evidence-based medicine and guidelines such as the AAP's recommendation for PCPs to apply FV. By providing residents with the tools and support to develop and implement a QI project such as this one, they can improve their knowledge and skills through experiential learning and impart meaningful clinical change.

One of the interventions with the greatest impact on FV application was recruiting MAs because it improved efficiency and overall staff buy-in for the

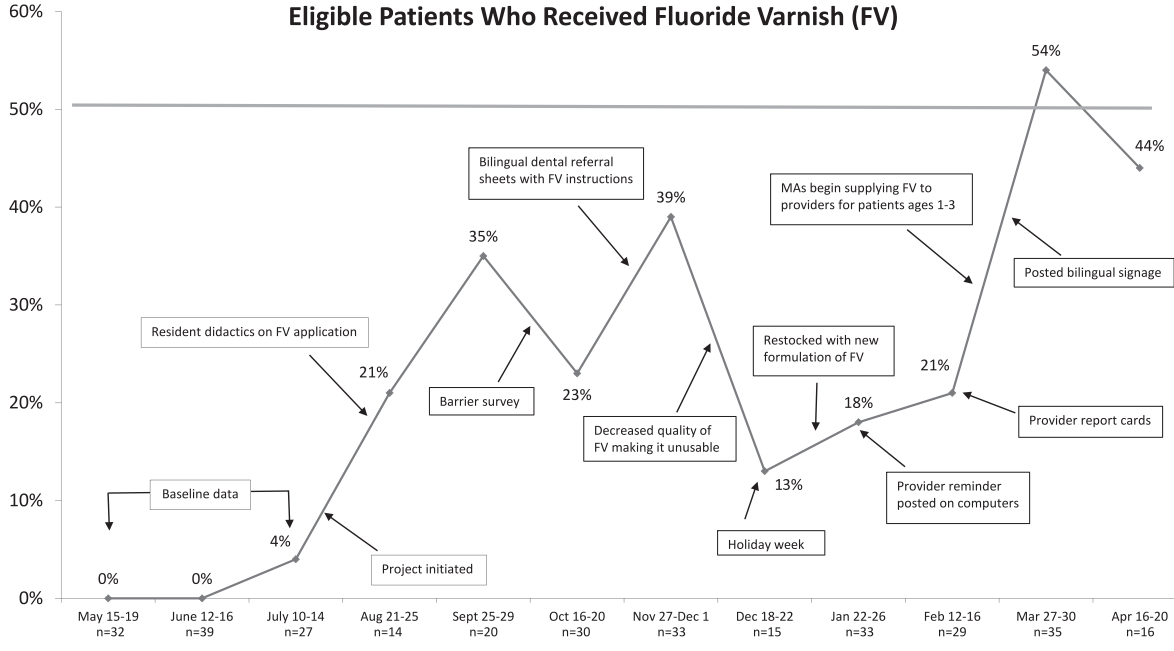


**FIGURE 2**
Run Chart of Percentage of Eligible Patients Receiving FV Relating to Monthly PDSA Cycles (May 2017–April 2018)
Abbreviations: FV, fluoride varnish; MAs, medical assistants; PDSA, plan-do-study-act.

project. We hypothesize that expanding this initiative to have MAs or nurses apply FV rather than physicians may further increase rates of application, but laws dictating which providers can apply FV vary by state. Additional lessons learned from each intervention can be found in the TABLE.

One of our balancing measures is reimbursement, and we found that applying FV in the primary care setting can be cost-effective. Each FV applicator cost approximately $1, and Medicaid reimbursement rates range from about $15 to $40 per application.[18] Additionally, preventing hospitalization for severe dental caries can have significant cost savings for the family, the hospital system, and state health care programs.[8]

We do not have data on this project's sustainability past the 1-year time frame, though we have attempted to ensure its acculturation by stocking FV in all our ACN clinics and training interns in FV practices. We also use the process measure of making a dental referral in place of clinical outcome data. Future efforts should determine whether these interventions result in biannual routine dental care and reduction in dental caries.

## Conclusions

This resident-led QI project increased rates of FV application, dental referrals, and dental visits while meeting ACGME guidelines for experiential learning in QI. Medical assistants supplying fluoride to providers for patients ages 1 to 3 was the most effective intervention. By applying FV and increasing the percentage of young children who have established a dental home, PCPs can have a meaningful impact on their patients' dental health.

## References


1. Benjamin RM. Oral health: the silent epidemic. *Public Health Rep*. 2010;125(2):158–159. doi:10.1177/003335491012500202.
2. Sheiham A. Dental caries affects body weight, growth and quality of life in pre-school children. *Br Dent J*. 2006;201(10):625–626. doi:10.1038/sj.bdj.4814259.
3. Jackson SL, Vann WF Jr, Kotch JB, Pahel BT, Lee JY. Impact of poor oral health on children's school attendance and performance. *Am J Public Health*. 2011;101(10):1900–1906. doi:10.2105/AJPH.2010.200915.
4. Bonetti D, Clarkson JE. Fluoride varnish for caries prevention: efficacy and implementation. *Caries Res*. 2016;50(1 suppl):45–49. doi:10.1159/000444268.
5. Moyer VA. Prevention of dental caries in children from birth through age 5 years: US Preventive Services Task Force recommendation statement. *Pediatrics*. 2014;133(6):1102–1111. doi:10.1542/peds.2014-0483.
6. Clark MB, Slayton RL. Fluoride use in caries prevention in the primary care setting. *Pediatrics*. 2014;134(3):626–633. doi:10.1542/peds.2014-1699.
7. American Academy of Pediatrics. Profile of Pediatric Visits. https://www.aap.org/en-us/Documents/practicet_Profile_Pediatric_Visits.pdf. Accessed August 3, 2020.
8. Scherrer CR, Naavaal S. Cost-savings of fluoride varnish application in primary care for Medicaid-enrolled children in Virginia. *J Pediatr*. 2019;212:201–207.e1. doi:10.1016/j.jpeds.2019.05.026.
9. Morrison LJ, Headrick LA. Teaching residents about practice-based learning and improvement. *Jt Comm J Qual Patient Saf*. 2008;34(8):453–459. doi:10.1016/s1553-7250(08)34056-2.
10. Wong BM, Etchells EE, Kuper A, Levinson W, Shojania KG. Teaching quality improvement and patient safety to trainees: a systematic review. *Acad Med*. 2010;85(9):1425–1439. doi:10.1097/ACM.0b013e3181e2d0c6.
11. Patow CA, Karpovich K, Riesenberg LA, Jaeger J, Rosenfeld JC, Wittenbreer M, et al. Residents' engagement in quality improvement: a systematic review of the literature. *Acad Med*. 2009;84(12):1757–1764. doi:10.1097/ACM.0b013e3181bf53ab.
12. Eiser AR, Connaughton-Storey J. Experiential learning of systems-based practice: a hands-on experience for first-year medical residents. *Acad Med*. 2008;83(10):916–923. doi:10.1097/ACM.0b013e31818509ca.
13. Vinci LM, Oyler J, Johnson JK, Arora VM. Effect of a quality improvement curriculum on resident knowledge and skills in improvement. *Qual Saf Health Care*. 2010;19(4):351–354. doi:10.1136/qshc.2009.033829.
14. Djuricich AM, Ciccarelli M, Swigonski NL. A continuous quality improvement curriculum for residents: addressing core competency, improving systems. *Acad Med*. 2004;79(10 suppl):65–67. doi:10.1097/00001888-200410001-00020.
15. Ogrinc G, Headrick LA, Morrison LJ, Foster T. Teaching and assessing resident competence in practice-based learning and improvement. *J Gen Intern Med*. 2004;19(5):496–500. doi:10.1111/j.1525-1497.2004.30102.x.
16. Craig MS, Garfunkel LC, Baldwin CD, Mann KJ, Moses JM, Co JPT, et al. Pediatric resident education in quality improvement (QI): a national survey. *Acad Pediatr*. 2014;14(1):54–61. doi:10.1016/j.acap.2013.10.004.
17. Clark MB, Douglass AB, Maier R, Deutchman M, Gonsalves W, Silk H, et al. Smiles for Life: A National

Oral Health Curriculum, 3rd ed. www.smilesforlifeoralhealth.com. Accessed July 20, 2020.
18. American Academy of Pediatrics: Section on Oral Health. Caries Prevention Services Reimbursement Table (State Specific Medicaid Payment Information). https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Oral-Health/Pages/Oral-Health-Practice-Tools.aspx. Accessed August 3, 2020.

**Lauren T. Roth, MD,** is Instructor of Pediatrics, Montefiore Medical Center/Albert Einstein College of Medicine; **Laura Robbins-Milne, MD,** is Assistant Professor of Pediatrics, Columbia University Irving Medical Center; **Dana Sirota, MD, MPH,** is Assistant Professor of Pediatrics, Columbia University Irving Medical Center; and **Mariellen Lane, MD,** is Associate Professor of Pediatrics, Columbia University Irving Medical Center.

Funding: The authors report no external funding source for this study.

Conflict of interest: The authors declare they have no competing interests.

Part of this work was presented at the Pediatric Academic Societies Meeting, Baltimore, Maryland, April 24–May 1, 2019.

Corresponding author: Lauren T. Roth, MD, Children's Hospital at Montefiore, Division of Academic General Pediatrics, 1525 Blondell Avenue, Suite 102, Bronx, NY 10461, 718.405.8090, ext 2606, fax 718.405.8091, laroth@montefiore.org

Received December 18, 2019; revisions received June 19, 2020, and July 6, 2020; accepted July 9, 2020.