

## ORIGINAL RESEARCH

## Prevalence and Associated Factors of Fluoride Varnish Application

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**Objectives:** To determine rates of fluoride varnish (FV) application at a tertiary care center between 2018 and 2021 and factors associated with receipt of FV application in the medical setting.

**Design:** A retrospective chart review and case-control study, matching children who had received FV application and those who had not during a well-child examination, were conducted.

**Measures:** Current Procedural and Dental Terminology and International Classification of Diseases codes from an electronic medical record were used to determine the rates of FV application.

**Analytic Strategy:** Bivariate and multivariable analyses were conducted to determine factors associated with FV application.

**Results:** The rate of fluoride applications was low but increased significantly from 0.1% in 2018 to 1.6% in 2020 ( $P < .0001$ ). Among White, Black, and Hispanic subjects, 39.5%, 65.2%, and 68.9%, respectively, received FV application during well-child exams. Advanced registered nurse practitioners (ARNPs) and physician assistants (PAs) provided 0.05% of FV applications. Multivariable results for 788 patients identified “Black, Hispanic, or other” race and ethnicity or Medicaid insurance type as factors positively associated with receipt of medical FV.

**Discussion:** This study showed an increase in FV application rates, which may be attributed to a quality improvement project and provider advocates. The prevalence was low and analyses show race and ethnicity and insurance factors associated with the receipt of FV application.

**Conclusion:** The associated factors suggest medical clinicians may evaluate race and ethnicity or insurance type to determine FV recipients. The results showed ARNPs and PAs may be underutilized clinicians for this preventive treatment. (J Am Board Fam Med 2024;37:826–832.)

**Keywords:** Case-Control Studies, Child Health, Fluoride Varnishes, Oral Health, Prevalence, Primary Health Care, Retrospective Studies, Tertiary Care Centers

## Background

Dental caries is prevalent in children, is the most common chronic childhood disease in the United States, and can negatively impact a child’s quality of life through pain, difficulty eating, or missed school

days.<sup>1–3</sup> The prevalence of caries experience in the United States is 21.4% in children aged 2 to 5 years and 50.5% in children aged 6 to 11 years.<sup>3</sup> The naturally occurring mineral, fluoride, is a proven preventive treatment for this disease and is available in many products. Fluoride varnish (FV) treatment is one method which can be used to apply fluoride to the tooth surfaces of children of any age.<sup>4</sup> A systematic review of topical fluoride treatments from 9 months to age 6 years demonstrated that 5% sodium FV applied every 6 months prevented a substantial portion of early childhood caries.<sup>5</sup> FV needs to be applied by a health care professional, typically in a medical or dental setting.

The US Preventive Services Task Force (USPSTF) recommends application of FV by primary care clinicians on all teeth in children starting when the first primary tooth erupts.<sup>6</sup> Beginning in 2015, the Affordable Care Act (ACA) required

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private insurers to cover FV applications provided by primary care clinicians.<sup>7</sup> This law, in combination with the USPSTF recommendations, allows for primary care clinicians to be reimbursed in most cases for the application of FV in the medical setting. Since it is recommended that children be seen by a medical provider at least 3 times a year during the first 3 years of life for well-child exams, this is a visit where they could receive this preventive treatment.<sup>8</sup>

The literature for prevalence of FV use in the medical setting is limited with only a few studies describing this practice.<sup>9–14</sup> A retrospective cohort study in North Carolina evaluating that state's "Into the Mouth of Babes" program utilized Medicaid data for children enrolled in kindergarten during the 2005 to 2006 school year to determine the number of decayed, missing, and filled teeth (dmft) and untreated caries (dt/dmft) for those children having received preventive services by a medical provider before 3 years of age.<sup>14</sup> Findings for the 5,235 children demonstrated those with multiple primary care provider or dentist visits with FV application had a similar overall mean dmft in kindergarten, but those with only primary care provider visits had a higher proportion of untreated dental decay.<sup>14</sup> Another study using Medicaid claims and enrollment databases evaluated the effectiveness of South Carolina's Medicaid FV policy by studying 2 types of clinicians, medical and dental.<sup>9</sup> From the study population of 52,841 Medicaid enrolled children, FV rates per child-year were 1% for those with physician FV application compared with 23% for dentist applications.<sup>9</sup>

Researchers evaluated 328,661 privately insured 1- to 5-year-old children's FV application rates through claims-paid data during well-child visits in Maine, Connecticut, New Hampshire, and Rhode Island from 2016 to 2018.<sup>13</sup> Their findings showed that 5% had received FV applications in the medical setting.<sup>13</sup> Secondary analysis of data from a 3-year, longitudinal multisite prospective cohort study to develop and analyze a new caries risk assessment tool for medical offices, investigated the associations between fluoride applied or prescribed and caries risk variables, as well as caries development.<sup>11</sup> The study found that 25% of the 1,227 children had carious lesions by age 4 years. Children who received fluoride (applied in a medical/dental setting or prescribed) were more likely deemed to be at higher caries risk, and experience over twice the rate of caries compared with children not receiving fluoride

at ages 2.5 and/or 4 years, despite receiving the treatment.<sup>11</sup> The prevalence of FV applied in medical or dental offices was 12%.<sup>11</sup>

In a cross-sectional retrospective chart review to determine the use of FV in a midwestern tertiary academic center's clinics used dental and medical procedural codes over approximately 10 years to evaluate the use of FV in the medical setting.<sup>10</sup> The prevalence rate for receipt of FV application at this center was 0.04%, since about 88,000 well-child exams were completed in those 10 years, with only 39 FV application recipients.<sup>10</sup> Investigation of the effects of implementing an intervention for oral health promotion among medical clinicians in 8 Federally Qualified Health Centers showed FV application rates increased over 6 years, and children receiving the most FV applications had the fewest decayed, missing, and filled tooth surfaces.<sup>12</sup> This study showed a prevalence of receipt of FV application in the medical setting of 23%.<sup>12</sup>

While FV has been shown to be safe and effective in caries prevention, and despite recommendations and changes in insurance coverage allowing for FV to be applied in medical office settings, the rates for varnish applications in such settings are low based on current research.<sup>9–14</sup> These few studies demonstrate gaps in the literature focusing on the prevalence of receipt of FV application in the medical setting and associated factors. Additional research is needed to determine factors associated with the use of FV in medical settings, which could then be used in determining steps to increase the use in these settings. The objective of this study was to examine the receipt of FV applications in a tertiary care center by determining: 1) the rates of FV application during well-child exams by year from 2018 through 2021 and 2) the factors associated with the receipt of FV application in the medical setting during well-child exams.

## Methods

### Design

A case-control study using a retrospective chart review was conducted for this project. The retrospective chart review was conducted in the electronic medical record (EMR), Epic (Verona, WI), at a midwestern tertiary care academic medical center and its associated primary care clinics. The retrospective chart review period ranged from the inception of the EMR in 2009 through 2021.

However, only 4 FV applications were recorded from 2009 through 2017 for individuals at any age, so the study period focused on the later years, 2018 through 2021, when FV applications were more prevalent. With the data from the retrospective chart review, the rates of FV were tabulated. With the case-control portion of the study, the factors associated with receipt of FV were determined among children aged 1 to 6 years. The case-control portion had 2 groups, cases who received FV application and the same number of controls who did not receive FV application.<sup>15</sup> The controls were randomly selected and matched to cases by age (1 to 6 years), visit type (well-child examination), year (2019, 2020, and 2021), and department (Family Medicine or Pediatrics).

The medical Current Procedural Terminology (CPT) 99188, American Dental Association Current Dental Terminology (CDT) D1206, and International Classification of Diseases 10<sup>th</sup> Revision (ICD-10) Z29.3 procedure and diagnosis codes for FV application were searched for in Epic. The CPT 99188 describes the application of topical FV by a physician or other qualified health care provider. The CDT D1206 code describes professionally applied FV, typically for moderate to high caries risk patients. The ICD-10 code Z29.3 is for an encounter code that includes the administration of fluoride as a prophylactic measure.

SlicerDicer is a self-service query reporting tool in Epic which allows researchers to access clinical data that is customizable by patient populations. A customized search via SlicerDicer was conducted for well-child exams in the Family Medicine or Pediatrics clinics using the ICD-10 diagnosis codes Z00.121 (encounter for routine child health examination with abnormal findings) and Z00.129 (encounter for routine child health examinations without abnormal findings), producing a database with subjects having a well-child examination with or without FV application. There were 13,692 well-child medical exams in 2018, 14,243 in 2019, 13,613 in 2020, and 14,776 in 2021. Data from subjects who received FV application were then extracted and used to tabulate the rates of FV applications among well-child examination recipients by year for 2018 to 2021.

The case control portion of this study included years 2019 through 2021, since 2018 only had 13 recipients of FV application during well-child

exams. A SlicerDicer customized search was conducted for subjects aged 1 through 6 years who had received a well-child examination in the Family Medicine or Pediatric clinics. Cases who received FV applications included 85 subjects in 2019, 158 in 2020, and 151 in 2021 were selected and matched to an equal number of randomly assigned controls who had well-child visits during these years but did not receive FV application. When a medical record number was in both the FV application data and the non-FV data, the medical record number was removed from the non-FV file.

Other data obtained from Epic included date of service for well-child examination, type of provider (physician, physician assistant (PA), or advanced registered nurse practitioner (ARNP)), medical record number, visit type (well-child examination with or without abnormal findings), and patient demographics that included date of birth, sex, race, ethnicity, and insurer. Extracted data were exported from SlicerDicer into Excel files and the files were imported into SPSS to create 1 database.

### **Analytic Strategy**

Rates of FV applications per year at well-child exams were calculated as the number of FV applications applied out of the total number of well-child exams conducted in the Family Medicine and Pediatrics departments in 2018, 2019, 2020, and 2021. Descriptive statistics were used to characterize data for both subjects who received FV in 2019, 2020, and 2021, as well as matched randomly selected subjects who did not receive FV. A one-way analysis of variance was conducted to assess possible differences among the rates of FV applications for the years 2018, 2019, 2020, and 2021.

Bivariate and multivariable analyses were conducted to assess factors associated with receipt of FV application during a well-child examination including sex, race, ethnicity, provider, and insurance type. Bivariate analyses were conducted using chi-square ( $\chi^2$ ) and Fisher's Exact tests with a significance level of 0.05. Insurance type was examined separately as Medicaid, private, and none. The no insurance category was too small for statistical models so Medicaid and none were combined. Provider types were collapsed into 2 groups, ARNP and PA versus physicians. In the medical record, Hispanic was recorded in 3 different ways: 1) recorded both in race and ethnicity; 2) recorded only in ethnicity; and 3) recorded only in race. We

used the collective category of race and ethnicity as 1 variable. Race was recorded as Asian, Black, Hispanic, White, and Other (American Indian, Multiracial, Native Hawaiian, and declined). A multivariable backward stepwise logistic regression analysis was conducted with the independent variables sex, race and ethnicity, and insurance type. The provider type was not included because there were no FV applications reported by ARNP or PA clinicians during well-child exams. The level of statistical significance was 0.05 for the multivariable analysis. Two-way interactions were not assessed. The study was approved by the University of Iowa Institutional Review Board ID# 202203317.

## Results

The number of well-child exams remained steady during the study period, with the majority conducted in Pediatric clinics each year (see Table 1). Similarly, more FV applications were documented in the Pediatrics clinics than in the Family Medicine clinics, with 241 applied in Pediatrics during 2021 compared with 39 in Family Medicine. The rate of FV applications increased significantly ( $P < .001$ ) from 2018 through 2020. There were rates of 0.1% in 2018, 0.8% in 2019, 1.6% in 2020, and 1.9% in 2021 (see Table 1).

Three hundred and ninety-four patients received FV application from 2019 through 2021. With matched controls, analysis of factors associated with receipt of FV application in the medical setting

found statistically significant ( $P < .001$ ) associations between receipt of FV application and race and ethnicity (see Table 2). In addition, the multivariable analysis results showed a significant ( $P = .013$ ) association between race and ethnicity and receipt of FV during well-child exams (see Table 2). In the race and ethnicity category, Hispanic, Black, and other children were significantly more likely to receive FV application compared with their White counterparts. Among Hispanic children, 68.9% and Black children, 65.2% received FV application compared with 39.5% of White children.

Bivariate analyses also indicated statistically significant ( $P < .001$ ) associations between type of provider and insurance type and receipt of FV application (see Table 2). In addition, multivariable analysis results showed a significant ( $P < .001$ ) association between Medicaid-insured children and receipt of FV during well-child examination (see Table 2). Among Medicaid-insured children, 66.3% received FV application compared with 38.0% of privately-insured children. Children who received a well-child examination from a physician were significantly more likely to receive FV application compared with children who received the examination from an ARNP or PA, with 51.3% and 0.0% of children, respectively (see Table 2).

## Discussion

Prevalence of FV application in the Pediatrics and Family Medicine clinics at this tertiary care center was shown to be low despite recommendations

**Table 1. Numbers and Rates of Fluoride Varnish (FV) Application During Well-Child Exams by Year at a Tertiary Care Academic Medical Center<sup>1,2</sup>**

	Year			
	2018	2019	2020	2021
Total Number of FV Applications	13	110	222	280
Family Medicine Clinics	3	13	54	39
Pediatric Clinics	10	97	168	241
Total Number of Well-Child Exams	13,692	14,243	13,613	14,776
Family Medicine Clinics	3,211	3,266	2,934	3,205
Pediatric Clinics	10,481	10,977	10,679	11,571
Rate FV applications during well-child exams	0.09%	0.77%	1.63%	1.89%
Family Medicine Clinics	0.09%	0.40%	1.84%	1.22%
Pediatric Clinics	0.10%	0.88%	1.57%	2.08%

<sup>1</sup>All ages.

<sup>2</sup>Many individuals had multiple FV application in a year or subsequent years.

Abbreviation: FV, Fluoride Varnish.



**Table 2. Bivariate Analyses and Multivariable Analysis of Factors Associated and Not Associated with Fluoride Varnish (FV) Application During Well-Child Exams (n = 788)**

Factor	Fluoride Varnish Application		Bivariate Analyses <i>P</i> -value	Multivariable Analysis	
	Yes	No		Odds Ratio (CI)	<i>P</i> -value
	n (row%)	n (row%)			
Sex			0.199 <sup>1</sup>		
Female (n = 376)	179 (47.6)	197 (52.4)			
Male (n = 412)	215 (52.2)	197 (47.8)			
Race and ethnicity			<0.001 <sup>1</sup>		<0.001
White (n = 428)	169 (39.5)	259 (60.5)		Reference	
Asian (32)	9 (28.1)	23 (71.9)		0.532 (0.237, 1.198)	0.128
Black (n = 141)	92 (65.2)	49 (34.8)		1.632 (1.021, 2.609)	0.041
Hispanic (n = 132)	91 (68.9)	41 (31.1)		2.321 (1.477, 3.647)	<0.001
Others (n = 55)	33 (60.0)	22 (40.0)		1.908 (1.057, 3.443)	0.032
Type of provider <sup>2</sup>			<0.001 <sup>3</sup>		
ARNP/PA (n = 20)	0 (0.0)	20 (100.0)			
MD (n = 768)	394 (51.3)	374 (48.7)			
Insurance type			<0.001 <sup>1</sup>		<0.001
Private (n = 453)	172 (38.0)	281 (62.0)		Reference	–
Medicaid/none (n = 335)	222 (66.3)	113 (33.7)		2.34 (1.63, 3.34)	<0.001

<sup>1</sup>Chi-Square test.<sup>2</sup>Provider type not included because no FV reported by nurse practitioner or physician assistant clinicians.<sup>3</sup>Fisher's exact test.

Abbreviations: ARNP, Advanced Registered Nurse Practitioner; PA, Physician assistant; MD, Doctor of Medicine; CI, Confidence interval.

by many professional organizations and insurance coverage provided by certain insurers. Most studies demonstrate similar findings of low rates of receipt of FV application among children in the medical setting.<sup>9–11,13</sup> The study did, however, find that rates of FV application increased in each subsequent year.

Some factors were shown to be associated with the receipt of FV application in the medical setting in this study. These factors included type of well-child examination provider, race and ethnicity, and insurance type. There was no significant association between the child's sex and receipt of FV at the well-child examination shown in either the bivariate analysis or multivariable analysis of this study. This is similar to most previous research studies that demonstrated no difference in FV application rates by sex.<sup>9–14</sup> This study found that clinicians in the Family Medicine clinics applied FV at a higher rate during well-child exams compared with an earlier study of the same clinics where no FV had been applied.<sup>10</sup> From this current study's results, it can be speculated that a Quality Improvement (QI) project completed by 2 Family Medicine medical residents regarding the use of FV application increased the prevalence, especially as the project

made FV more readily available in each examination room. A few previous studies show that an initiative can increase the rates of FV application in the medical setting.<sup>10,13</sup>

Of note is that the results showed children who received a well-child examination by a physician were more likely to receive FV application, and that no midlevel clinicians (nurse practitioners or physician assistants) applied FV during well-child exams. Therefore, midlevel clinicians seem to be an underutilized clinicians for FV application in the medical setting. Additional research could evaluate the oral health curriculum for midlevel clinicians to determine the information provided on FV.

Contrary to previous research, this study showed Hispanic children were significantly more likely to receive FV application in the bivariate analysis and it remained a significant factor in the multivariable analysis.<sup>14</sup> It is important to focus on preventive measures for Hispanic children because research has shown caries experience is higher among Hispanic children compared with their non-Hispanic counterparts.<sup>16</sup> Additional research could explore if health care clinicians are biased in providing FV for children based on race and/or ethnicity. The distribution of

the children's ages when FV was applied in this study is consistent with what other studies have shown, which is that FV application rates decrease as children grow older.<sup>9,10,13</sup>

Bivariate and multivariable analyses showed Black children were more likely to receive medical FV application compared with non-Black children. This study demonstrated 65.2% of Black children received FV application compared with 39.5% of White children, which is different from the earlier study results at this tertiary care center from 2009 to 2019, where the percentage of FV recipients was the same among Black and White children.<sup>10</sup> However, results of Black children being more likely than non-Black children to receive FV application in the medical setting shown in this study is consistent with most other published studies.<sup>9,11</sup>

This study showed a statistically significant association of insurance type and receipt of FV application during well-child exams in both the bivariate and multivariable analyses. These results showed that Medicaid-insured children would be more likely to receive FV application compared with non-Medicaid counterparts, which has been demonstrated in previous research with a trend of higher rates of FV application in the medical setting among Medicaid-insured children.<sup>10,11</sup> Since children who are Medicaid-insured tend to reside in low-income households, this result may suggest that medical clinicians use caries risk factors when assessing a child for receipt of FV application.

Previous research on the use of FV in the medical setting is limited and shows the rates of use are low.<sup>9-13</sup> This study supports the findings of low rates of use despite a significant increase in rates from 2018 to 2020 at this tertiary care center. The findings from this study and previous studies suggest that medical settings are an area for improving access to this preventive measure for caries. Since it is recommended that children see a medical provider often in their first 3 years of life, but most do not see a dentist, it is an ideal opportunity to reach children at risk for early childhood caries.<sup>17</sup> The statistically significant increase in FV rates following a QI project in this study suggests that educating clinicians and offering support could help increase the use of FV in the medical setting.

The data used for this study were electronic medical record codes, which captures more accurately the rates of FV applications among children during well-child exams compared with a claims-

paid databases. Among limitations, this study was conducted in a single midwestern tertiary care academic medical center that includes many Family Medicine and Pediatrics clinics. This medical center is not representative, so rates of FV applications in other types of medical practice settings, such as physician-owned private practices or Federally Qualified Health Centers, could be very different. The factors studied were limited to sex, race and ethnicity, insurance type, and clinicians type due to the available data, but it would be beneficial to evaluate other provider, child, caregiver (education and household income), health center, family, and community factors. The type of provider was evaluated in this study, but studying clinicians knowledge, attitudes, and beliefs regarding FV application would be beneficial in future research. In addition, it would be beneficial to track the use of FV in medical settings through a national database to evaluate national trends. Retrospective and case control reviews do not provide evidence as strong as a prospective study. Ethnicity data in the medical record were in both race and ethnicity categories and sometimes missing.

## Conclusion

This study revealed that the rates of FV application in the medical setting at this tertiary care center are still low, despite the increase in the rates each calendar year from 2018 to 2021. The introduction of a QI project focusing on FV application in the Family Medicine clinics suggests one approach to increase the rates of FV application in the medical setting and to improve access to FV for many children in the United States. The results of this study showing that race and ethnicity, type of provider, and insurance type were associated with the receipt of FV application suggests factors that can be considered in determining steps to increase the use of FV application in medical settings. There is a need for more research on provider, child, caregiver, health institution, insurance, family, and community factors associated with FV application in several states or nationwide.

*To see this article online, please go to: <http://jabfm.org/content/37/5/826.full>.*

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