

## Introduction

The prevention of dental caries is one of the most important goals of pediatric dentistry. Dental caries, despite being largely preventable, is the most prevalent chronic disease in both children and adults<sup>1</sup>. Dental caries is a multifactorial disease that requires a susceptible host, fermentable carbohydrates, and time to progress and eventually lead to tooth demineralization. In a survey conducted by the National Center for Health Statistics in 2015-2016, the prevalence of total dental caries (untreated and treated) in primary or permanent teeth among youth ages 2–19 years was 45.8%<sup>1</sup>.

Topical fluoride varnish is frequently applied as a treatment to prevent future dental caries. Fluoride varnish contains 5% sodium fluoride, which is equivalent to 22,600 ppm (2.26%) fluoride ion<sup>2</sup>. The American Dental Association recognizes 5% sodium fluoride (NaF) or 2.26% fluoride content varnish treatment for the benefit of caries prevention when given at least twice per year to children up to age 18<sup>3</sup>. The fluoride ion replaces the hydroxyl group in hydroxyapatite to produce fluorapatite in the enamel, which is more resistant to acid demineralization. Thus, the effects of fluoride application on enamel can largely reduce the risk of caries<sup>4</sup>.

The Decayed, Missing, and Filled Surfaces (DMFS) index is used to quantify dental caries. It is differentiated for primary teeth as dmfs and for permanent as DMFS<sup>5</sup>. This study will aim to evaluate the effect of fluoride varnish application on the prevention of dental carious lesions.

## Objectives

The goals of this study are:

### Primary:

- To determine the effectiveness of fluoride varnish as assessed by dmfs

### Secondary:

- To determine the effectiveness of fluoride varnish as assessed by DMFS, and to assess the effect of the frequency of varnish application on caries prevention.

## Methods

A retrospective chart review was conducted using the electronic dental records of patients who were seen at the Montefiore Medical Center Pediatric Dental Clinics between January 1, 2019 to January 1, 2022. The study population consisted of patients ages 6-8 years old, who presented to a Montefiore Pediatric Dental Clinic for a new patient examination (D0150) or recall examination (D0120) during 2019 and had 5% sodium fluoride varnish (D1206) applied at the initial visit. Additionally, the patients included in the study met the following inclusion criteria:

- cooperative behavior, Frankl's behavior rating scale score of 3 or 4
- do not use prescription strength fluoride products at home
- presented for a recall examination visit after the three year period

## Methods cont.

The patient's dmfs and DMFS scores at that initial visit and after the three year period were recorded. The total number of fluoride varnish applications (D1206) that the patient received during the three year period was also recorded.

A total of 6,720 pediatric dental patients, ages 6-8 years, presented for a new patient or recall dental examination in 2019. Out of the 6,756 patients, 1,055 patients met the inclusion criteria. From the qualified patients, a list of 100 random samples of patient charts was generated. From this random sampling list, data was recorded from 99 patients. One patient was excluded because the patient was treated under general anesthesia due to special health care needs.

The following data were collected from each randomly selected patient:

- age of patient in 2019
- dmfs at recall or initial exam visit in 2019
- DMFS at recall or initial visit in 2019
- total number of times fluoride varnish was applied during the 3 year study period
- dmfs after 3 years
- change in dmfs after 3 years
- DMFS after 3 years
- change in DMFS after 3 years

## Results

The following results were obtained:

Table 1. Overall distribution

Variable	N = 99 <sup>1</sup>
Age	7 (6, 7)
dmfs at initial visit	5 (0, 14)
dmfs after three years	7 (0, 16)
New dmfs after three years	0 (0, 0)
DMFS at initial visit	0 (0, 0)
DMFS after three years	0 (0, 2)
New DMFS after three years	0 (0, 2)
Number of times Fluoride was applied	2 (2, 3)

<sup>1</sup>Median (IQR)

- Fluoride resulted in a 75% reduction of dmfs (IRR=0.25, 95% CI 0.14 – 0.43). IRR = Incidence Rate Ratio
- Fluoride does not have a statistically significant effect on DMFS (IRR = 3.75, 95% CI 0.47 - 10.23).
- Frequency of application is not significantly associated with incidence of dmfs (IRR = 0.70, 95% CI 0.42-1.17, p-value = 0.2).

## Results cont.

Table 2. Distribution of incident dmfs and DMFS by period

Variable	At Baseline N = 99 <sup>1</sup>	At three Years N = 99	p-value
dmfs	5 (0, 14)	0 (0, 0)	<0.001 <sup>2</sup>
DMFS	0 (0, 0)	0 (0, 2)	0.229 <sup>3</sup>

<sup>1</sup>Median (IQR)

<sup>2</sup>Generalized Estimating Equation

<sup>3</sup>Resampling based on a Zero Inflated Model

Table 3. Overall distribution by Frequency of application

Variable	Frequency			
	Low (<= 2)		High (>2)	
	At Baseline, N = 69 <sup>1</sup>	At three Years, N = 69 <sup>1</sup>	At Baseline, N = 30 <sup>1</sup>	At three Years, N = 30 <sup>1</sup>
dmfs	6 (0, 18)	0 (0, 0)	2 (0, 12)	0 (0, 0)
DMFS	0 (0, 0)	0 (0, 2)	0 (0, 0)	0 (0, 2)

<sup>1</sup>Median (IQR)

## Discussion

- Fluoride resulted in a 75% reduction of incidence of dmfs (IRR=0.25, 95% CI 0.14 – 0.43,  $p < 0.001$ ). This finding follows clinical guidelines of applying fluoride varnish to primary teeth.
- Fluoride does not have a statistically significant effect on DMFS (IRR = 3.75, 95% CI 0.47 – 10.23,  $p = 0.229$ ) (Table 2). However, this result needs to be interpreted cautiously as the numbers of incident DMFS is small and largely contributed by few patients, i.e., 3 outliers. In addition, the study design might not be an appropriate one in assessing the effect of fluoride on incidence of DMFS and the plausibility that fluoride increasing the incidence of DMFS is questionable. In a Cochrane Library review, the effectiveness of fluoride varnish was determined using a parallel design model comparing dmfe and DMFE scores in high-risk patients. Evidence from this review revealed a substantial caries-inhibiting effect of fluoride varnish in both permanent and primary teeth<sup>6</sup>.
- Frequency of application of treatment is not significantly associated with incidence of dmfs (IRR = 0.70, 95% CI 0.42-1.17,  $p = 0.2$ ). Due to small number of events, a similar analysis with respect to DMFS could not be carried out. However, the study did indicate promising results that the increased number of applications is leading to a decreased dmfs score in patients. This coincides and supports more frequent applications of fluoride varnish for pediatric patients.

## Discussion cont.

- Patients ages 6-8 were evaluated. At this time, DMFS score can only be assessed based on limited number of teeth that are fairly new in the mouth.
- Given the study design, the association between fluoride and the incidence of DMFS might be misleading. In period two, three patients contributed a sizeable portion of DMFS and certainly have influenced the resulting model. We need to be very cautious in interpreting this result. Generally, excluding such patients without a compelling justification is not appropriate; therefore, was not carried out in the current analysis.

## Limitations

- There is interoperator variability. The patients were seen by different providers and that may affect the recorded dmfs and DMFS due to variations in clinical and radiographic judgment of dental carious lesions.
- The COVID-19 pandemic affected compliance for on-time recalls, thus many patients did not return for their periodic oral evaluations in a timely manner. This decreased the number of fluoride applications received during the study period.
- The study population consists of residents in optimally fluoridated New York City. The results may be different in non fluoridated communities.
- There is tremendous variation in oral hygiene and the use of over-the-counter toothpastes and mouthwashes.
- Some of the patients had dental sealants applied to the first permanent molars, and this affects caries risk for those surfaces.
- The permanent teeth have not been present for more than 3 years, for most children in the study.

## Conclusion

This study concludes that applications of fluoride varnish lead to a significant decrease in dmfs among children ages 6-8. Data suggested that increased applications are leading towards a lower dmfs.

## References

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