

Porcupine Health Unit Fluoride Varnish Program: Outcome Evaluation



Health Unit • Bureau de santé
Dental Services dentaires

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Table of Contents

TABLE OF CONTENTS	1
OUTCOME EVALUATION: EXECUTIVE SUMMARY	2
ÉVALUATION DE RÉSULTATS : SOMMAIRE	3
THE PORCUPINE HEALTH UNIT'S FLUORIDE VARNISH PROGRAM	4
OBJECTIVE OF EVALUATION	5
OBJECTIVE #1: EFFECTIVENESS OF THE FLUORIDE VARNISH PROGRAM	5
INTERPRETATION	6
OBJECTIVE #2: THE OPTIMAL NUMBER OF FLUORIDE VARNISHES	7
INTERPRETATION	7
OBJECTIVE #3: EFFECT OF PROGRAM SETTING ON RETENTION AND OUTCOMES	9
EFFECT OF PROGRAM SETTING ON DENTAL HEALTH OUTCOMES	9
INTERPRETATION	9
CONCLUSIONS & RECOMMENDATIONS	10
1. EFFECT	10
2. THE OPTIMAL NUMBER OF VARNISHES APPLIED	10
3. RETENTION	10
4. DIFFERENCES AMONG SETTINGS (PHU, OEYC, DAY CARES)	11
APPENDICES	12
1. METHODS	12
DATA SOURCES & LINKING	12
STATISTICAL ANALYSIS	12
2. DENTAL OUTCOMES BY NUMBER OF VARNISH TREATMENTS	12
3. INCREMENTAL EFFECTS OF NUMBERS OF VARNISH TREATMENTS ON DENTAL OUTCOMES	14
4. COVERAGE OF FLUORIDE VARNISH PROGRAM 2007-2012 BY BIRTH YEAR OF CLIENTS	17
5. FIGURES FOR EACH ORDINAL NUMBER OF FLUORIDE VARNISHES RECEIVED	18
REFERENCES	21

Porcupine Health Unit

Fluoride Varnish Program:

Outcome Evaluation: Executive Summary

Improving oral health among children is an important public health objective. Fluoride varnish applied at regular intervals, can reduce dental caries among children. Evaluation of a fluoride varnish program delivered by the Porcupine Health Unit (PHU) in Northeastern Ontario demonstrates the effectiveness of fluoride varnish among children in this region.

Optimal benefit appears to require a minimum of 3 treatments between the ages of 0 and 4 inclusive when dental outcomes are assessed in junior and senior kindergarten. Dental outcomes in grade 2, two years after last program contact, do not show significant improvement among children who received fluoride varnish compared to those who never did.

The program is offered through three delivery channels: day cares, Ontario Early Years Centres, and via appointment at the PHU offices. Retention of children appears highest among children reached through day cares.

Additional dental health services, notably counselling of parents offered in some settings, are not leading to identifiably better outcomes when compared to varnish alone. Given that only 22% of clients receive the minimum 3 varnish treatments necessary to yield significant improvement in oral health, the results of this evaluation suggest prioritizing efforts to maximize the number of clients receiving three varnish treatments.

Given the absence of effect among grade 2 children, continuing varnish application beyond age 4 may merit consideration as a means to improving dental outcomes among older school-attending children.



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Bureau de santé Porcupine

Programme de vernis fluoré :

Évaluation de résultats : Sommaire

L'amélioration de la santé bucco-dentaire des enfants est un objectif important de la santé publique. L'application de vernis fluoré à des intervalles réguliers peut réduire la carie dentaire chez les enfants. Une évaluation du programme de vernis fluoré dispensé par le Bureau de santé Porcupine (BSP) dans le Nord-Est de l'Ontario démontre l'efficacité du vernis fluoré chez les enfants de cette région.

Pour profiter de manière optimale du vernis fluoré, il semble nécessaire d'en obtenir au moins trois applications entre les âges de 0 à 4 ans inclusivement, lorsque les résultats dentaires sont évalués chez les enfants en maternelle et au jardin d'enfants. Les résultats dentaires chez les élèves en 2^e année, deux ans après leur dernier contact dans le cadre du programme, semblent ne montrer aucune amélioration importante chez les enfants qui ont reçu du vernis fluoré comparativement à ceux qui n'en ont jamais reçu.

Le programme est offert par l'entremise de trois voies de prestation : les garderies, les Centres de la petite enfance de l'Ontario et sur rendez-vous aux succursales du BSP. Le taux de rétention des enfants au programme semble être plus élevé chez ceux atteints par l'entremise des garderies.

Les services de soins dentaires supplémentaires, notamment les conseils offerts aux parents dans certains milieux, n'amènent pas à une amélioration manifeste des résultats comparativement au vernis seul. Étant donné que seulement 22 % des clients ont reçu les trois traitements au vernis fluoré nécessaires pour engendrer une amélioration importante à la santé bucco-dentaire, les résultats de l'évaluation suggèrent d'appuyer en priorité les efforts cherchant à maximiser le nombre de clients qui reçoivent trois traitements au vernis fluoré.

En l'absence d'une efficacité manifeste chez les élèves de la 2^e année, l'application du vernis fluoré après l'âge de 4 ans pourrait être envisagée comme moyen d'améliorer les résultats dentaires chez les enfants d'âge scolaire plus âgés.



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The Porcupine Health Unit’s Fluoride Varnish Program

Poor dental health among children in the area served by Porcupine Health Unit (PHU) has been identified as a program priority. Fluoride varnish, applied regularly to young children’s teeth can both prevent dental caries and reduce the number of decayed teeth (**Marinho, Worthington, Walsh, & Clarkson, 2013**). The program goal is to deliver four treatments to each participating child.

PHU delivers its Fluoride Varnish Program in three different settings: in PHU clinics, in Ontario Early Years Centres (OEYCs), and in Day Cares. Table 1 summarizes how the program differs in these three settings.

Table 1: Fluoride Varnish Program by Setting. The frequency of operation, visit type, recall activities, and complementary services provided differ by setting.

	Frequency of Varnish Clinics	Visit Type	Recall Effort	Additional Services Provided
Porcupine Health Unit Clinics	Offered during regular dental clinics. Frequency varies by location (twice weekly to once every three months in district offices)	15–30 minute appointments accompanied by parent or guardian	Next visit in 3 months booked at end of appointment. Telephone reminder 1 day before next appointment	Comprehensive counseling on oral hygiene, benefits of fluoride varnish, and provision of a toothbrush.
OEYCs	3 months	Drop in visit accompanied by parent or guardian	Notices left at OEYC about 1 month prior to next varnish clinic	Abbreviated counseling on oral hygiene, benefits of fluoride varnish, and provision of a toothbrush
Day Cares	3 months	All children with signed consent in attendance on quarterly date receive varnish. No parent or guardian needs to be present.	Notices left at day care about 1 month prior to next varnish clinic	Provision of a toothbrush. Call to parent by dental hygienist if tooth decay seen.

Objective of Evaluation

1. Assess the effectiveness of the program in reducing the number of junior (JK) and senior kindergarten (SK) children developing caries among those who received the target 4 fluoride varnishes.
2. Identify the optimal number of fluoride varnishes beyond which diminishing effects on oral health outcomes occur.
3. Assess if the type of setting where fluoride varnishes were applied (i.e. at PHU clinics, OEYCs, or day cares) affects both retention and dental outcomes.

Objective #1: Effectiveness of the Fluoride Varnish Program

2884 participating children were identified from Fluoride Varnish Program records from 2007 through 2012. Dental outcomes were obtained from the Dental Indices Survey and its successor, the Oral Health Indices Survey. These are provincial school-based surveys of dental health wherein dental hygienists assess each child for decayed, extracted/missing and filled teeth (deft/DMFT¹). Within the PHU geography, dental outcomes were available for 10,218 children assessed between 2009 and 2013 (JK: 3423, SK: 3396, & Grade 2: 3399). Dental outcome among children in grade 2 were included to assess whether the dental health benefits from the varnish program persist after children no longer participate in the program.

The analyses of program effectiveness compare the outcomes for 1495 children (JK: 721, SK: 640, & Grade 2: 475) for whom dental outcome results were available and who received at least one fluoride varnish treatment with the outcomes for children who did not receive fluoride varnish.

The program goal is for children to be free of dental caries. The proportion (%) of children who reach this goal decreases with increasing age (JK to SK to Grade 2). This reflects the increasing amount of time (1) that has intervened since the varnish program intervention (ages 0 to 4) was completed, and (2) during which the teeth have been subject to cariogenic forces in the mouth *i.e.* the longer a child's tooth is in the mouth, the greater the chance of decay.

Table 2 reports odds ratios, a measure comparing the odds of being caries-free among children receiving varnish to the odds among those who did not. The confidence interval (95%CI) distinguishes between results due to chance and results likely to represent a true effect of the intervention. Where the confidence interval includes 1.0 (as with the Grade 2 results), any effect cannot be confidently attributed to the program intervention (*i.e.* there is a reasonable probability it could have been a chance effect). Results in Table 2 show that the program increases the chances of being free of caries for children assessed in JK or SK and that this effect is no longer present by Grade 2 when children are no longer covered by the Program.

¹ deft (decayed, extracted, and filled teeth) is the metric of dental decay used for primary teeth. Decayed, Missing, and Filled Teeth (DMFT) is the analogous metric used for permanent teeth.

Table 2: Prevalence of Caries-Free Clients who Received the Target of 4 Fluoride Varnish Treatments through the Program and the Odds Ratio of being caries-free.

	Junior Kindergarten	Senior Kindergarten	Grade 2
4 or More Treatments	79.9%	69.5%	45.7%
Fewer than 4 Treatments or No Treatments	68.6%	54.5%	37.8%
Odds Ratio of Being Caries-Free (95% Confidence Interval, Fisher’s Exact Test)	1.82 (1.27–2.66)	1.91 (1.29–2.88)	1.38 (0.66–2.85)

Oral health is also assessed by deft/DMFT counts (decayed, extracted/missing, filled teeth) as it incorporates severity of the disease, and is not just a measure of prevalence. For this measure, lower scores are better (i.e. fewer deft/DMFT is better) and children who received 4 or more varnish treatments had 0.74 fewer deft/DMFT than those receiving fewer than 4 or no treatments. This outcome improved to 0.81 fewer decayed, extracted/missing, or filled teeth among children assessed in SK. The JK results are statistically significant meaning that they are unlikely to be due to random chance. Both the SK results and, consistent with the proportion caries free outcome, the Grade 2 results, may be due to random chance.

Table 3: Average deft/DMFT Scores Amongst Clients who Received 4 Fluoride Varnish Treatments through the Program and Those Who Did Not, as well as the Statistical Significance of this Difference at each Grade Level.

	Junior Kindergarten	Senior Kindergarten	Grade 2
4 or More Treatments	0.63	1.37	2.34
Fewer than 4 Treatments or No Treatments	1.37	2.18	3.04
Difference in deft/DMFT Scores	0.74	0.81	0.70
Significance (Fisher’s Exact Test)	$p < 0.001$	$p = 0.68$	$p = 0.68$

Interpretation

These results indicate that the program is effective in improving oral health among children assessed in JK and SK. Less impressive outcomes among children assessed at Grade 2 may be the effect of fluoride varnish wearing off after 3 or more years since leaving the Fluoride Varnish program, the impact of unvarnished permanent teeth, or inadequate statistical power (i.e. the effect is real but we cannot be confident of this) due to the smaller number of Grade 2 children.

Objective #2: The Optimal Number of Fluoride Varnishes

Table 4 compares results for different numbers of varnish treatments. These results suggest that the overall improvement in oral health seen among JK and SK children requires a minimum of 3 varnish treatments before 5 years of age and that additional improvements are seen among children who receive four or more treatments. As noted above, by the time children reach grade 2, the effects of the program have diminished and this is not offset by increased numbers of treatments.

Small numbers of children received more than 4 treatments and the appendix includes figures for each dental outcome (% caries-free and deft/DMFT count) for JK, SK and Grade 2 children showing outcomes by numbers of treatments.

Interpretation

Increasing numbers of fluoride varnish applications do seem to increase the numbers of children without dental caries and decrease the numbers of def/DMF teeth. Small numbers of children receiving more than 4 treatments limit the strength of this evidence beyond the statement that 3 to 4 treatments appear to be necessary to realize the improved oral health benefits and that evidence of benefit of more than four treatments is much weaker and inconsistent based on this evaluation. Resource considerations are also important for determining the optimal number of varnishes since this decision is ultimately about the marginal cost versus benefit. A minimum of 3 varnish applications appears to be necessary to realize measurable benefit. This result differs from previous studies concluding that at least two fluoride treatments are needed per year (Ismail & Tellez, pp. 34-6; Main & Azarpazhooh, 2007).

Table 4: Odds Ratios and difference in mean for deft/DMFT for various cut-offs of the number of fluoride varnishes.

	Junior Kindergarten		Senior Kindergarten		Grade 2	
	OR (95% CI) of Caries-Free Prevalence	difference in mean for deft/DMFT (<i>p</i> -value)	OR (95% CI) of Caries-Free Prevalence	difference in mean for deft/DMFT (<i>p</i> -value)	OR (95% CI) of Caries-Free Prevalence	difference in mean for deft/DMFT (<i>p</i> -value)
1 or more varnishes v. 0 varnishes	1.17 (0.96–1.43)	0.28 (<i>p</i> = 0.02)	1.11 (0.91–1.35)	-0.92 (<i>p</i> = 0.048)	1.19 (0.96–1.47)	-0.20 (<i>p</i> = 0.12)
2 or more varnishes v. 0–1 varnishes	1.42 (1.11–1.82)	0.41 (<i>p</i> = 0.02)	1.25 (0.99–1.59)	0.54 (<i>p</i> = 0.07)	1.33 (0.85–2.10)	0.34 (<i>p</i> = 0.003)
3 or more varnishes v. 0–2 varnishes	1.48 (1.12–1.98)	0.37 (<i>p</i> = 0.08)	1.36 (1.01–1.84)	0.47 (<i>p</i> = 0.33)	1.34 (0.85–2.10)	0.69 (<i>p</i> = 0.15)
4 or more varnishes v. 0–3 varnishes	1.82 (1.27–2.66)	0.74 (<i>p</i> = < 0.001)	1.91 (1.29–2.88)	0.81 (<i>p</i> = 0.68)	1.38 (0.66–2.85)	0.70 (<i>p</i> = 0.68)

Objective #3: Effect of Program Setting on Retention and Outcomes

The retention rate was calculated for each delivery channel. Across all sites, 67.4% of those receiving initial treatment returned for a second if still eligible; of those still eligible, 70.4% returned for a third treatment; and of those still eligible 64.6% returned for a fourth treatment (Table 5). Retention rates were higher at day cares than at OEYCs and PHU sites.

Table 5: Proportion returning for each additional fluoride varnish at each program setting.

Treatment Number	Proportion Returning for This Treatment			
	All Sites	PHU Clinics	OEYCs	Day Cares
2	67.4%	56.5%	54.1%	72.7%
3	70.4%	55.8%	65.1%	73.3%
4	64.6%	69.0%	58.9%	65.4%
5	66.8%	50.0%	48.5%	71.2%

Effect of Program Setting on Dental Health Outcomes

Comparing oral health outcomes among settings provides some indication of the effects of additional dental health counseling and prevention activities taking place in PHU clinics and OEYCs. Table 6 reports regression results comparing caries-free percentages among children reached through OEYCs and PHU clinics to the same outcome among children reached through day cares. In this table, the 95% CI include 1.0 indicating that outcomes among children reached through OEYC and PHU clinics are not significantly different from outcomes among children reached through day cares. Although the OEYC and PHU sites deliver additional preventive services and directly to parents (as a parent or adult must be with the child, unlike in the day cares), these results provide no evidence of benefit from these additional services on oral health outcomes assessed at JK, SK or Grade 2.

Table 6. Logistic Regression Analysis of Caries Free Status. Results Presented as Odds Ratios with 95% Confidence Intervals in Parentheses.

Odds Ratios (95% Confidence Interval)	Junior Kindergarten	Senior Kindergarten	Grade 2
Receiving Varnishes at an OEYC versus Day Care	1.27 (0.78–2.04)	1.18 (0.74–1.87)	1.33 (0.75–2.33)
Receiving Varnishes at a Porcupine Health Unit Clinic versus Day Care	1.01 (0.60–1.70)	0.84 (0.51–1.41)	1.11 (0.63–1.93)

Interpretation

When dental outcomes are compared for each of the three sites where varnish was provided (PHU clinics, OEYCs, day cares), no significant differences in dental outcomes

are identified. Program setting does, however, affect retention (assessed as return rates) with the highest return being among children reached through day cares. Although resource allocation was outside the scope of this evaluation, with day cares having higher return rates and no evidence of improved outcomes from the additional counseling at OEYCs and PHU sites, assessing the comparative costs per participating child across the different settings appears warranted, particularly if counseling & varnish is more costly per client than the day care-based delivery of varnish to children unaccompanied by parents.

Conclusions & Recommendations

1. Effect

Four fluoride varnishes significantly improves the percentage of JK & SK children without caries (16% and 28% respectively) and significantly reduces the number of caries by an average of about 0.7–0.8 caries per JK student. While improved oral health results are also noted among children in Grade 2, these effects are no longer significant and may be due to random chance. These results can be reframed in terms of numbers needed to treat—reaching an additional 4-6 children with varnish is needed to yield one more child who is free of dental caries at the JK-SK age.

The percentage caries-free analysis above does not account for the Program reducing how many caries some children develop, where it does not prevent all caries. deft/DMFT scores account for the number of caries (severity) and not just the percentage of children with or without caries. Using this outcome measure, four fluoride varnishes also significantly reduced the number of caries children had at JK by an average of 0.74 caries. Using a number needed to treat (NNT) approach, about 1½ children need to be treated to prevent 1 cavity in JK.

The effect of the Program seems to have largely waned by grade 2 when most children are age 7. This is likely because the last treatment was at age 5, and benefits do not persist. Consideration may be given to offering a fluoride varnish program to school-aged children, perhaps through schools, in order to extend the improvements in oral health to children beyond the SK level.

2. The Optimal Number of Varnishes Applied

While the data do not permit the exact specification of an optimal number of varnishes, the evidence from this evaluation suggests that the optimal number is 3–4 varnish applications. Significant benefit requires a minimum of 3 treatments and additional benefit of more than 4 treatments was not evident from the available data. Current evidence-based best practice recommends 2 fluoride varnish applications per year. This evaluation shows that having at least 3 applications in the entire preschool period confers some benefits even if two per year is not reached.

3. Retention

Ensuring children receive the targeted number of treatments is arguably the biggest challenge facing this program. The majority of clients do not receive the target number of treatments with an estimated 12.5% reaching the target of 4 treatments. Quality improvement efforts focused on increasing retention, particularly for the minimum of 3

treatments that appear to be necessary to demonstrate benefit, are strongly supported by the evaluation findings. Increasing retention to ensure more than 3 treatments—including the literature-recommended two applications per year—could yield even greater benefits for children in the region.

4. Differences among Settings (PHU, OEYC, day cares)

Most children are reached through day cares. Day cares also have the highest retention rates. The dental outcomes do not differ significantly among the settings. In particular, even without parental participation, varnish-only service (no counseling) delivered via the day cares with oral health resources sent home is effective. If the education and counseling services delivered through the PHU and OEYC settings are to be effective in producing additional dental health improvements beyond varnish alone, consideration to cost and redesign would seem prudent given the absence of benefit identified from the available data. Plan-Do-Study-Act (PDSA) or other quality improvement approaches may be useful to inform this redesign effort.

If there are unmet needs among children attending day cares, higher retention rates at day cares, coupled with the absence of evidence of benefit of the more intensive program offering at PHU clinics and OEYCs, suggest that moving resources from PHU clinics and OEYCs to expand day care availability would yield further improvements in oral health.

Appendices

1. Methods

Data Sources & Linking

The 2007-2012 database of Fluoride Varnish Program clients included records of 2,884 clients participating at least once in the program. Information included demographics, birth dates, setting where fluoride varnish was received (i.e. Porcupine Health Unit clinic, OEYC, Day Care), the number of varnish applications received, and the date of the last varnish application.

The Dental Indices Survey and its successor the Oral Health Indices Survey includes the dental health screening results of 10,218 children (3,423 from Junior Kindergarten; 3,396 from Senior Kindergarten; 3,399 from Grade 2) screened in 2009–2013. These survey data include demographic information, date of screening, the school the child was attending, caries prevalence, and their deft/DMFT (decayed, extracted/missing, filled teeth) score.

Program participants were probabilistically linked to outcome data based on demographic factors (name, date of birth, sex, and geographic location of school and fluoride varnish application setting). 1,836 of the oral health screening results (721 from Junior Kindergarten, 640 from Senior Kindergarten, and 475 from Grade 2) were linked to 1,495 clients treated through the fluoride varnish program.

Statistical Analysis

For the primary objective of the evaluation, the hypothesis that clients receiving four fluoride varnish treatments would have a higher probability of never having had caries and of having a lower deft/DMFT score was tested using a Fisher's Exact Test and Wilcoxon Rank Sum test. Using an alpha of 0.05 means that statistically significant results could have occurred by chance 5% of the time or less.

The second objective regarding the incremental benefit of each additional varnish treatment was examined by plotting the dental caries-free prevalence and mean deft/DMFT scores against the number of fluoride varnish applications clients received.

The third objective of the evaluation—whether retention and outcomes differ among the different settings where the Fluoride Varnish Program is offered—was examined by calculating retention rates at each setting, logistic regression of the caries-free prevalence adjusting for setting of last visit, and tables of mean deft/DMFT scores by setting. Because only the setting of the last visit for any client was available, it was assumed that the setting in which a client was last seen was the setting at which they were seen for all of contact with the program.

Statistical analysis was performed using R 3.0.3 (R Core Team, 2014) (Vienna, Austria) and the “rms” package (Harrell Jr., 2014).

2. Dental Outcomes by Number of Varnish Treatments

For each number of treatments, the proportion (%) caries-free and the mean deft/DMFT scores were computed for the clients who received that number of treatments. These results show generally an increasing proportion of clients being caries-free with

increasing numbers of varnishes, and lower (better) deft/DMFT scores for increasing numbers of varnishes. This trend is seen in JK, SK, and grade 2. Dental health therefore improves with each additional fluoride varnish received.

Appendix Table 1. Dental Health Outcomes by Number of Varnish Treatments Received

Number of Fluoride Varnishes Received	Junior Kindergarten		Senior Kindergarten		Grade 2	
	Proportion Caries-Free (Standard Error)	Mean deft/DMFT (Standard Error)	Proportion Caries-Free (Standard Error)	Mean deft/DMFT (Standard Error)	Proportion Caries-Free (Standard Error)	Mean deft/DMFT (Standard Error)
0	0.58 (0.01)	1.40 (0.08)	0.48 (0.01)	1.09 (0.06)	0.33 (-)	2.70 (0.06)
1	0.54 (0.04)	1.40 (0.17)	0.44 (0.04)	2.40 (0.21)	0.39 (0.03)	3.16 (0.23)
2	0.64 (0.05)	1.14 (0.22)	0.51 (0.04)	1.92 (0.24)	0.33 (0.05)	3.08 (0.31)
3	0.61 (0.05)	1.53 (0.27)	0.42 (0.06)	2.23 (0.31)	0.41 (0.07)	2.50 (0.42)
4	0.78 (0.05)	0.59 (0.19)	0.68 (0.06)	1.23 (0.35)	0.45 (0.09)	2.41 (0.63)
5	0.67 (0.07)	0.57 (0.22)	0.56 (0.08)	1.24 (0.33)	0.40 (0.22)	2.40 (1.12)
6	0.70 (0.08)	0.59 (0.23)	0.80 (0.11)	0.64 (0.55)	1.00 (0.00)	0 (-)
7	0.67 (0.10)	0.71 (0.33)	0.54 (0.14)	2.69 (0.96)		
8	0.75 (0.13)	0.50 (0.23)	0.33 (0.27)	1.33 (0.88)		
9	0.60 (0.16)	0.78 (0.44)	0.33 (0.27)	3.33 (2.40)		
10	0.80 (0.18)	1.80 (1.80)				
11	1.00 (0.00)	0.00 (0.00)				

3. Incremental Effects of Numbers of Varnish Treatments on Dental Outcomes

For each incremental increase in the cut-off of the number of varnishes used for comparison, the odds ratio and the mean deft/DMFT was computed. Statistical assurance of a true effect emerges after 3 fluoride varnishes.

Appendix Table 2. Odds Ratios of Being Caries-Free and Difference in deft/DMFT Scores for Each Incremental Increase in the Cut-off for the Number of Fluoride Varnish Treatments Received

	Junior Kindergarten		Senior Kindergarten		Grade 2	
	OR (95% CI) of Caries-Free Prevalence	mean difference in deft/DMFT (p-value)	OR (95% CI) of Caries-Free Prevalence	mean difference in deft/DMFT (p-value)	OR (95% CI) of Caries-Free Prevalence	mean difference in deft/DMFT (p-value)
1 or more varnishes v. 0 varnishes	1.82 (1.27–2.66)	0.28 ($p = 0.02$)	1.91 (1.29–2.88)	-0.92 ($p = 0.048$)	1.38 (0.66–2.85)	-0.20 ($p = 0.12$)
2 or more varnishes v. 0–1 varnishes	1.48 (1.12–1.98)	0.41 ($p = 0.02$)	1.36 (1.01–1.84)	0.54 ($p = 0.07$)	1.34 (0.85–2.10)	0.34 ($p = 0.003$)
3 or more varnishes v. 0–2 varnishes	1.42 (1.11–1.82)	0.37 ($p = 0.08$)	1.25 (0.99–1.59)	0.47 ($p = 0.33$)	1.33 (0.85–2.10)	0.69 ($p = 0.15$)
4 or more varnishes v. 0–3 varnishes	1.17 (0.96–1.43)	0.74 ($p < 0.001$)	1.11 (0.91–1.35)	0.81 ($p = 0.68$)	1.19 (0.96–1.47)	0.70 ($p = 0.68$)

Appendix Table 3. The prevalence of caries-free status and statistical significance of the difference for a cut-off of 4 fluoride varnish treatments.

Caries-Free Prevalence	Junior Kindergarten	Senior Kindergarten	Grade 2
4 or More Treatments	79.9%	69.5%	45.7%
Fewer than 4 Treatments or No Treatments	68.6%	54.5%	37.8%
Odds Ratio (95% Confidence Interval, Fisher's Exact Test)	1.82 (1.27–2.66)	1.91 (1.29–2.88)	1.38 (0.66–2.85)
Statistical Significance (Fisher's Exact Test)	$p < 0.001$	$p < 0.001$	$p = 0.38$

Appendix Table 4. The prevalence of caries-free status and statistical significance of the difference for a cut-off of 3 fluoride varnish treatments.

Caries-Free Prevalence	Junior Kindergarten	Senior Kindergarten	Grade 2
3 or More Treatments	76.3%	62.0%	44.8%
Fewer than 3 Treatments or No Treatments	68.5%	54.6%	37.7%
Odds Ratio (95% Confidence Interval, Fisher's Exact Test)	1.48 (1.12–1.98)	1.36 (1.01–1.84)	1.34 (0.85–2.10)
Statistical Significance (Fisher's Exact Test)	p = 0.005	p = 0.04	p = 0.18

Appendix Table 5. The prevalence of caries-free status and statistical significance of the difference for a cut-off of 2 fluoride varnish treatments.

Caries-Free Prevalence	Junior Kindergarten	Senior Kindergarten	Grade 2
2 or More Treatments	75.4%	59.9%	40.2%
1 or No Treatments	68.4%	54.5%	37.8%
Odds Ratio (95% Confidence Interval, Fisher's Exact Test)	1.42 (1.11–1.82)	1.25 (0.99–1.59)	1.11 (0.81–1.50)
Statistical Significance (Fisher's Exact Test)	p = 0.003	p = 0.06	p = 0.54

Appendix Table 6. The prevalence of caries-free status and statistical significance of the difference for a cut-off of 1 fluoride varnish treatment.

Caries-Free Prevalence	Junior Kindergarten	Senior Kindergarten	Grade 2
1 or More Treatments	71.9%	57.2%	41.4%
No Treatments	68.7%	54.6%	37.4%
Odds Ratio (95% Confidence Interval, Fisher's Exact Test)	1.17 (0.96–1.43)	1.11 (0.91–1.35)	1.19 (0.96–1.47)
Statistical Significance (Fisher's Exact Test)	p = 0.12	p = 0.29	p = 0.11

Appendix Table 7. The mean deft/DMFT scores and statistical significance of the difference for a cut-off of 4 fluoride varnish treatments.

Mean deft/DMFT Scores	Junior Kindergarten	Senior Kindergarten	Grade 2
4 or More Treatments	0.63	1.37	2.34
Fewer than 4 or No Treatments	1.37	2.18	3.04
Difference (Reduction in Caries)	0.74	0.81	0.70
Significance (Wilcoxon Rank Sum Test)	p < 0.001	p = 0.68	p = 0.68

Appendix Table 8. The mean deft/DMFT scores and statistical significance of the difference for a cut-off of 3 fluoride varnish treatments.

Mean deft/DMFT Scores	Junior Kindergarten	Senior Kindergarten	Grade 2
3 or More Treatments	0.94	1.70	2.43
Fewer than 3 or No Treatments	1.31	2.17	3.12
Difference (Reduction in Caries)	0.37	0.47	0.69
Significance (Wilcoxon Rank Sum Test)	p = 0.08	p = 0.33	p = 0.15

Appendix Table 9. The mean deft/DMFT scores and statistical significance of the difference for a cut-off of 2 fluoride varnish treatments.

Mean deft/DMFT Scores	Junior Kindergarten	Senior Kindergarten	Grade 2
2 or More Treatments	0.99	1.78	2.79
1 or No Treatments	1.40	2.32	3.13
Difference (Reduction in Caries)	0.41	0.54	0.34
Significance (Wilcoxon Rank Sum Test)	p = 0.02	p = 0.07	p = 0.003

Appendix Table 10. The mean deft/DMFT scores and statistical significance of the difference for a cut-off of 1 fluoride varnish treatments.

Mean deft/DMFT Scores	Junior Kindergarten	Senior Kindergarten	Grade 2
1 or More Treatments	0.12	2.01	2.99
No Treatments	0.40	1.09	2.70
Difference (Reduction in Caries)	0.28	-0.92	-0.20
Significance (Wilcoxon Rank Sum Test)	p = 0.02	p = 0.048	p = 0.12

4. Coverage of Fluoride Varnish Program 2007–2012 by Birth Year of Clients

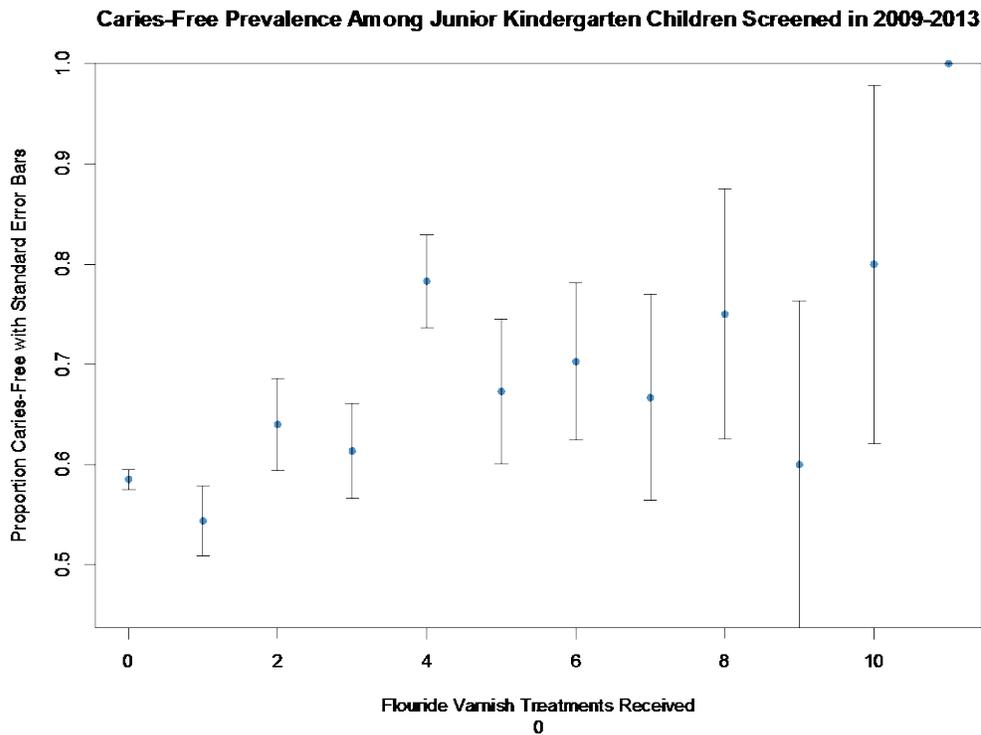
The percentage of children screened for oral health outcomes in each birth cohort were assessed for how many fluoride varnishes they had received. Among the 2001–2008 birth cohorts, the proportion receiving each successive fluoride varnish decreased (decreasing retention). Participation (defined as percentage of eligible clients reached) increased in each successive birth cohort from 1.1% in 2001 to 38.8% in 2008. However, two factors complicate a clear interpretation of this: first, only the 2007 and 2008 birth cohorts were in the eligible ages of 0–4 years during the years in which the program was in operation so these years would have the greatest opportunity to receive fluoride varnishes with previous years having had successively less opportunity; second, in 2008 a large expansion of the program took place with OEYCs, PHU offices, and more day cares being added to the Fluoride Varnish Program with additional sites added in subsequent years. These two factors may account for the increase in the percentage of clients receiving fluoride varnishes in each subsequent birth year cohort.

Appendix Table 11. Clients Screened and Proportion Receiving Each of 1 Through 4 Fluoride Varnish Treatments

Birth Year	Clients Screened 2009–2012	Proportion Receiving 1 Fluoride Varnish	Proportion Receiving 2 Fluoride Varnish	Proportion Receiving 3 Fluoride Varnish	Proportion Receiving 4 Fluoride Varnish
1998	2	50%	50%	50%	0%
1999	1	100%	100%	100%	0%
2000	4	25%	25%	25%	0%
2001	96	1.1%	1.1%	1.1%	0%
2002	815	0.8%	0.3%	0.1%	0%
2003	900	9.6%	1.1%	0.2%	0%
2004	1645	11.8%	6.2%	2.4%	0.7%
2005	2527	13.0%	7.1%	3.8%	1.7%
2006	1706	17.3%	10.3%	6.5%	3.7%
2007	1650	34.9%	22.6%	15.4%	9.8%
2008	821	38.8%	28.5%	21.7%	14.7%
2009	9	33.3%	11.1%	11.1%	0%
2010	2	50%	50%	50%	0%
2011	1	100%	100%	100%	0%
2012	1	100%	100%	100%	0%

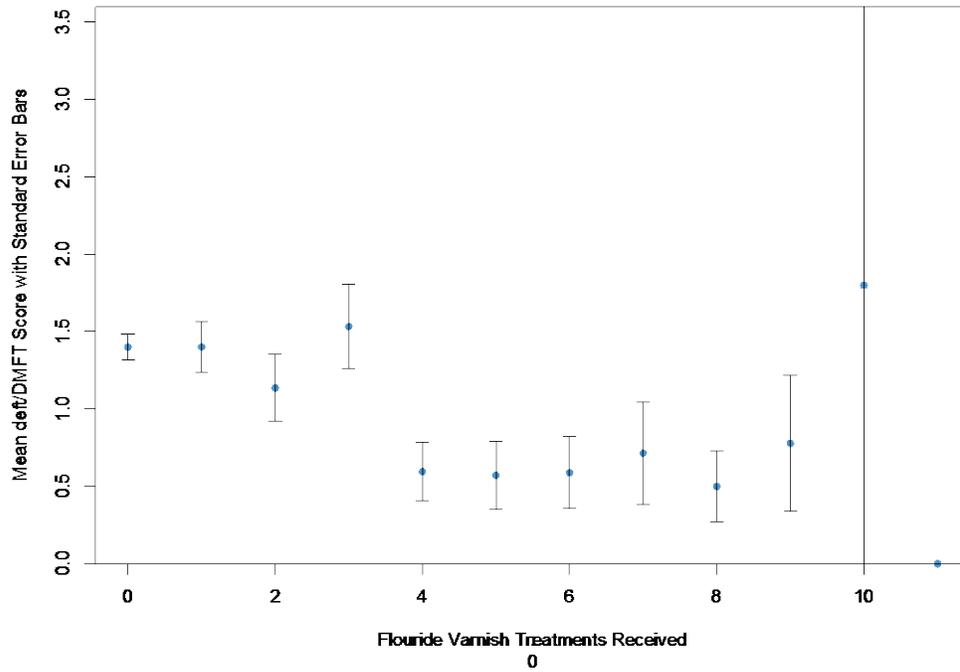
5. Figures for Each Ordinal Number of Fluoride Varnishes Received

Appendix Figures 1-6 provide graphical presentation of results (Appendix Figures 1, 3, 5: caries-free prevalence & Appendix Figures 2, 4, 6: deft/DMFT) for each outcome assessment (Appendix Figures 1, 2: JK; 3, 4: SK; 5, 6: Grade 2). The recommendation for an optimal target of 3-4 treatments is based on the absence of additional benefit (i.e. the overlapping error bars) with increasing numbers of treatments. With the exception of the deft/DMFT outcome among SK children receiving 7 treatments, there are no outcomes for any number of treatments greater than 4 that are significantly different than the outcomes for 4 treatments. In the case of seven treatments, these children actually had worse outcomes (higher average deft/DMFT scores).



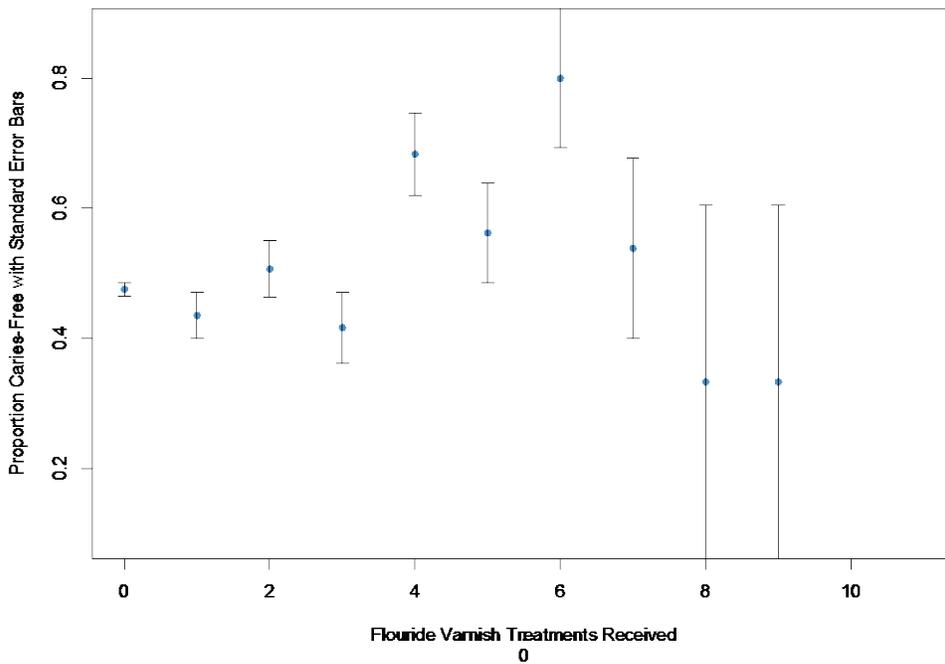
Appendix Figure 1. Caries Free Prevalence Among Junior Kindergarten Children Screened in 2009–2013 for Different Numbers of Fluoride Varnishes Received through the Fluoride Varnish Program 2007–2012.

Mean deft/DMFT Scores Among Junior Kindergarten Children Screened in 2009-2013



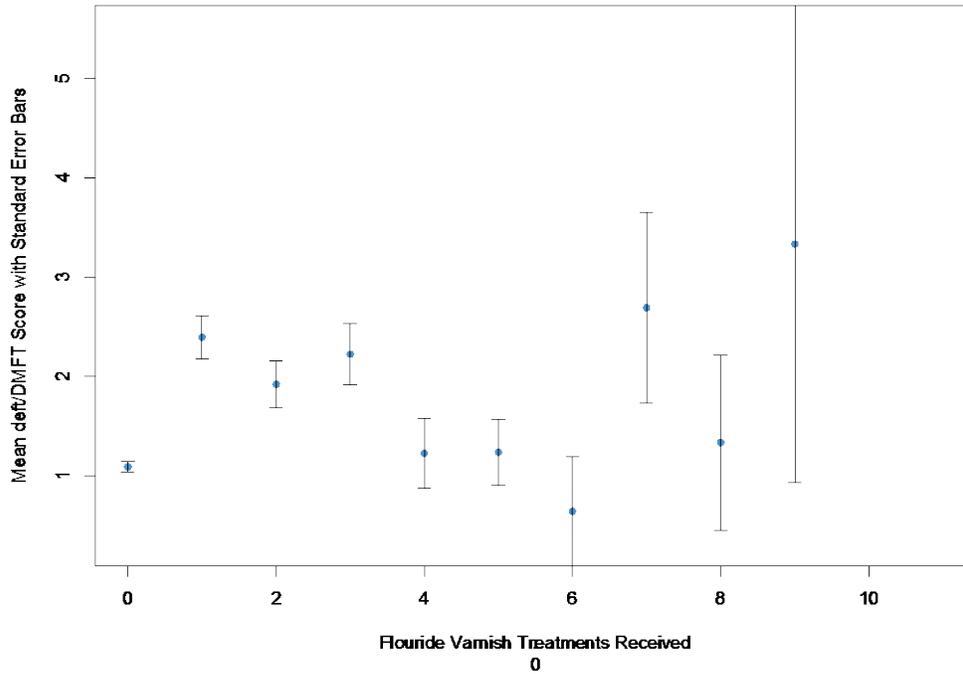
Appendix Figure 2. deft/DMFT Scores Among Junior Kindergarten Children Screened in 2009–2013 for Different Numbers of Fluoride Varnishes Received through the Fluoride Varnish Program 2007–2012.

Caries-Free Prevalence Among Senior Kindergarten Children Screened in 2009-2013



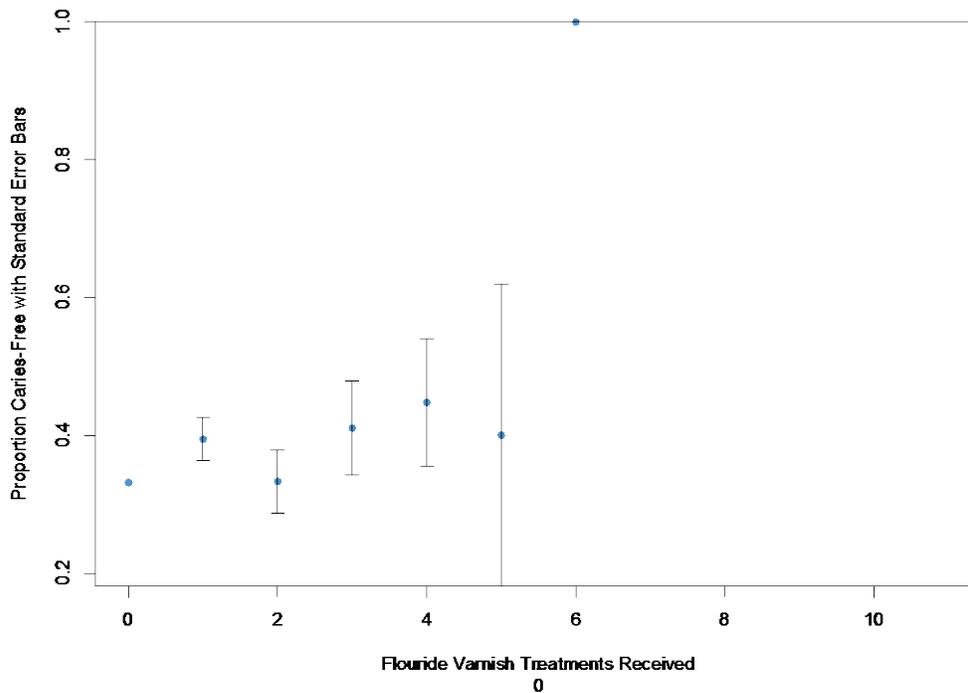
Appendix Figure 3. Caries Free Prevalence Among Senior Kindergarten Children Screened in 2009–2013 for Different Numbers of Fluoride Varnishes Received through the Fluoride Varnish Program 2007–2012.

Mean deft/DMFT Scores Among Senior Kindergarten Children Screened in 2009-2013

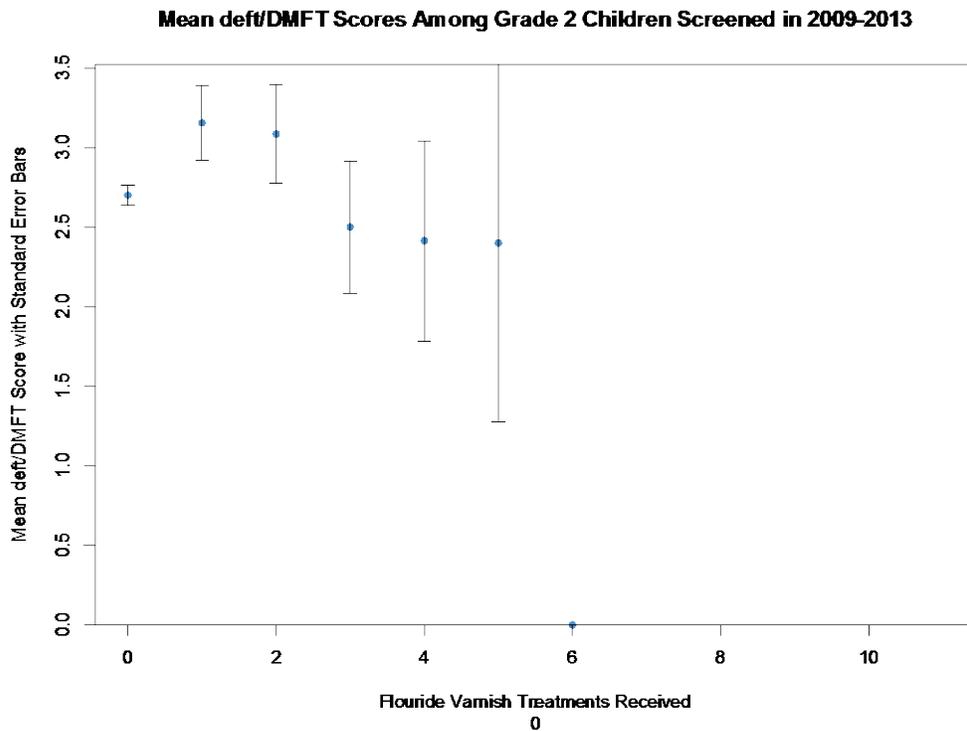


Appendix Figure 4. deft/DMFT Scores Among Senior Kindergarten Children Screened in 2009–2013 for Different Numbers of Fluoride Varnishes Received through the Fluoride Varnish Program 2007–2012.

Caries-Free Prevalence Among Grade 2 Children Screened in 2009-2013



Appendix Figure 5. Caries Free Prevalence Among Grade 2 Children Screened in 2009–2013 for Different Numbers of Fluoride Varnishes Received through the Fluoride Varnish Program 2007–2012.



Appendix Figure 6. deft/DMFT Scores Among Grade 2 Children Screened in 2009–2013 for Different Numbers of Fluoride Varnishes Received through the Fluoride Varnish Program 2007–2012.

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