

Oral Health: School Fluoride Varnish Delivery Programs

Community Preventive Services Task Force
Finding and Rationale Statement
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CPSTF Finding and Rationale Statement

Context

Untreated tooth decay, one of the most prevalent diseases among children, diminishes the ability to eat, speak, learn, and play (U.S. Department of Health and Human Services 2000). Prevalence is significantly higher among children from families with lower incomes as well as racial and ethnic minority groups (Centers for Disease Control and Prevention 2019). Although there is strong evidence that topical fluoride treatments prevent decay in all teeth (Marinho et al. 2013; Weyant et al. 2013), less than 18% of children from families with lower incomes received a treatment during an annual dental visit in 2013-2014 (Wei et al. 2018). Significant disparities in fluoride treatment receipt also exist by race and ethnicity (Wei et al. 2018). Fluoride varnish is a commonly used topical fluoride treatment modality applied periodically to all teeth for children (Clark et al. 2020). The use of fluoride varnish for caries prevention is off-label (Clark et al. 2020). Fluoride varnish does not require specialized dental equipment and can be applied quickly by both dental and non-dental professionals in a variety of settings (Chou et al. 2021; Chou et al. 2023).

Delivering evidence-based preventive dental services in schools can increase receipt of services among children unlikely to receive them, otherwise. The Community Preventive Services Task Force (CPSTF), for example, recommends delivery of dental sealants in schools to reduce decay based on evidence that school programs increased receipt of sealants, reduced disparities by income in receipt of dental sealants, and reduced caries (Community Preventive Services Task Force 2013). Dental sealants are placed on the chewing surfaces of the back teeth (typically molars) in children. Sealant placement requires portable dental equipment and meticulous technique by dental health professionals (Community Preventive Services Task Force 2013).

Intervention Definition

School fluoride varnish delivery programs apply fluoride varnish¹ to the teeth of children attending preschools and schools (from tooth eruption at age 6 months through high school) either onsite or at offsite venues. Depending on state regulations, fluoride varnish applications may be administered by the following:

- Dental professionals (e.g., dentists, dental hygienists, dental therapists)
- Trained non-dental health professionals (e.g., physicians, nurses, medical assistants, community health workers)
- Trained lay workers (e.g., teachers, administrative staff, counselors, volunteers)

Programs also may provide one or more of the following additional services:

- Risk assessment for tooth decay
- Oral hygiene instruction and supplies
- Oral health education
- Dental sealants
- Referrals to dental care

Programs may prioritize schools in communities with a large number of students at elevated risk for tooth decay (e.g., with lower incomes).

CPSTF Finding (June 2024)

The Community Preventive Services Task Force (CPSTF) recommends school fluoride varnish delivery programs based on strong evidence of effectiveness in preventing dental caries (tooth decay) among school-aged children (preschool through high school). Evidence indicates that these programs, implemented primarily in communities with lower incomes and high rates of tooth decay among children, achieve meaningful rates of student participation, increase the number of treatments received, reduce dental caries, and reduce disparities in onset of tooth decay by income and other social determinants of health.

Rationale

Basis of Finding

The CPSTF recommendation is based on evidence from a systematic review of 31 studies (search period from database inception to December 2023). The systematic review included studies conducted in high (n=20) or upper-middle (n=11) income countries. Included studies evaluated intervention effects on dental caries initiation or progression, fluoride varnish (FV) receipt, and disparities in caries initiation by income or other social determinants of health including employment, housing, and access to care. Results are described below and summarized in Table 1.

Caries outcomes included incipient or cavitated lesions measured at the person, tooth, or surface level. Effectiveness was measured as the change in caries in the treatment relative to the control group, i.e., relative risk ratio (RR). Subtracting this value from one yields the preventive fraction (PF), the percentage change in caries associated with School Fluoride Varnish Delivery Programs (SFVDPs).

Nineteen studies with 25,826 participants found that SFVDPs reduced caries initiation in the permanent teeth (Table 1). Eleven of these studies were conducted in high-income countries with one U.S. study.

Twelve studies with 4,304 participants also found SFVDPs reduced decay initiation in the primary teeth (Table 1). Ten of these studies, including two U.S. studies, were conducted in high-income countries.

Seven studies with 1,556 students examined program effectiveness when applying FV to teeth with existing caries. Four of these studies were conducted in high-income countries, including one from the U.S. SFVDPs reduced progression of caries to more advanced stages and increased remineralization or arrestment of caries (Table 1). One U.S. study of a SFVDP serving 623 students, which did not include a concurrent control group, found that after the program, the mean number of early-stage caries per child had decreased.

SFVDP participation was estimated from 14 studies (12 conducted in high-income countries including three U.S. studies). The median participation rate of 68% (Table 1) was substantially higher than the annual percentage of U.S. children from families with lower incomes who received either FV or dental sealants in a clinical setting in 2013–2014 (<18%; Wei et al. 2018). Two studies found higher FV receipt in children participating compared to not participating in SFVDPs, with one study of 1,150 preschoolers in Scotland (McMahon et al. 2020) and one study of 24,811 adolescents in Sweden (Bergstrom et al. 2016) (Table 1).

Table 1. Summary of Intervention Effects on Oral Health Outcomes

Outcome Measure	Number of studies	Summary Effect Estimates or Narrative Results	Direction of Effect
Caries initiation in permanent teeth	19	Median RR = 0.68 (IQI: 0.63, 0.79) Median PF = 32% (IQI: 21%, 38%)	Favors the intervention
Caries initiation in primary teeth	12	Median RR = 0.75 (0.63, 0.96) Median PF = 25% (IQI: 4%, 27%)	Favors the intervention
Caries progression	6	Median (RR) = 0.90 (0.73, 0.94) Median PF = 10% (IQI: 6%, 27%)	Favors the intervention
Caries arrestment	4	Median RR =1.18 (1.10, 1.45) Median % increase =18% (IQI: 10%, 45%)	Favors the intervention
Caries arrestment	1	Mean number of early-stage caries lesions decreased by 0.4 lesions per child (1.7 lesions before program to 1.3 lesions after program; p<0.01)	Favors the intervention
Student participation rate	14	Median participation rate: 68% (IQI: 46%, 83%).	Favors the intervention
Receipt of fluoride varnish treatments	2	McMahon et al. 2020: Receipt of 3+ FV applications over 2 years 14 times higher among children randomly assigned to SFVDP (84%) compared to those not assigned (6%) Bergstrom et al. 2014: Mean number of annual FV applications was 3 times higher among children attending school with SFVDP (2 applications) compared to children not attending these schools (0.6 applications)	Favors the intervention

RR: Relative Ratio PF: Preventive Fraction IQI: Interquartile Interval

SFVDP: School Fluoride Varnish Delivery Program.

Eighteen of 23 studies with available data reported being conducted in communities with lower incomes or that were socially deprived (e.g., poor housing, lacking access to healthcare). Three of these studies conducted in the U.S. largely served historically disadvantaged racial and ethnic populations—one in the Navajo nation (Braun et al. 2016), one in a primarily Hispanic population in California (Dudovitz et al. 2018), and one in a predominantly Black population in Florida (Autio-Gold and Courts 2001). Two studies directly examined whether the reduction in caries initiation varied by income and other social determinants of health. Both the study of 371 adolescents in Sweden (Moberg Skold et al. 2005) and the study of 31,581 preschoolers in Scotland (Kidd et al. 2020) found that SFVDPs were more effective in socially deprived areas.

Applicability and Generalizability Considerations

Intervention Settings

School fluoride varnish delivery programs were effective in both high-income and upper-middle-income countries. Three of the studies were conducted in the United States. The included studies found SFVDPs to be effective in schools located in both rural and urban areas. SFVDPs were also effective in areas with and without optimally fluoridated drinking water.

Population Characteristics

Most of the effectiveness data were for students at elevated caries risk living in low socioeconomic areas, indicating applicability of findings to U.S. programs that prioritize these populations. SFVDPs were found to be effective for very young children attending preschools, children attending elementary schools, and adolescents attending middle and high schools. Study results were not stratified by gender, but the distribution of males and females was similar (50/50) in most studies.

Intervention Characteristics

Twenty-seven studies examined the effectiveness of SFVDPs in preventing caries initiation. There was strong evidence for the effectiveness of SFVDPs that applied FV at schools but limited evidence for school-linked programs. None of the included studies examined effectiveness in permanent teeth and two studies provided evidence for primary teeth. All studies applied FV at least twice annually and both two, and more than two, annual FV applications were effective in preventing caries initiation. The caries preventive benefits of at least twice annual application of FV in schools lasted from 9 to 48 months after the first application.

Fluoride varnish in school programs was applied by a variety of licensed dental professionals (e.g., dentists, dental hygienists) and non-dental providers. There was no evidence to suggest that FV effectiveness varied by type of provider. Fluoride varnish was effective in preventing caries in both the chewing and non-chewing surfaces of teeth suggesting that school programs could deliver FV as a stand-alone or adjunct service to dental sealants (typically only applied to chewing surfaces of molars).

Data Quality Issues

The body of evidence was largely comprised of studies with the greatest suitability of design (n=28) and of good quality of execution (n=21). Twenty-five studies were randomized controlled trials, and three were before-after studies with a concurrent control group. The two most frequent limitations in execution were inadequate description of the intervention or study population (n=9) and loss to follow-up exceeding 20% (n=8).

Potential Benefits

SFVDPs typically screen children for caries and refer children for needed care. CPSTF postulated that participation in these programs could indirectly confer benefits with increased identification of caries, potential reduction in unmet treatment needs, and establishment of an ongoing relationship with a dentist, or dental home. None of the studies identified in this review evaluated these outcomes. Although this review did not locate studies examining the direct impact of participation in SFVDPs on improved school performance, the broader literature indicates that reducing untreated caries improves the odds of higher academic performance and reduces the odds of absenteeism (Ruff et al. 2019; Rebelo et al. 2018).

Potential Harms

Seventeen studies reported whether students experienced adverse reactions—15 noted none; one (Turska-Szybka et al. 2021) noted a minor complaint over the color of teeth directly after applying FV; and one (Milsom et al. 2011) noted

other minor complaints (mostly nausea) affecting less than 1% of participants. The U.S. Preventive Services Task Force (USPSTF) review on the effectiveness of FV delivered to very young children similarly found only self-limiting adverse effects (Chou et al. 2021). This review did not locate studies examining systemic fluoride intake from participation in SFVDPs. Compared to other topical fluorides, however, systemic intake of fluoride after FV application is likely low (Chou et al. 2021; Marinho et al. 2013; Weyant et al. 2013). Dental fluorosis is a condition that affects the appearance of tooth enamel which may result from long term systemic exposure to fluoride while the teeth are developing (age 8 years and younger; Clark, et al. 2014). One study found that fluorosis prevalence in the permanent teeth of children aged 7 to 11 years did not statistically differ between those children who received biannual FV applications over 2 years when they were very young and their teeth were developing (27%) and those children who never received FV (35%) (Dos Santos et al. 2016).

Recommendations of Others

U.S. Preventive Services Task Force

- For children younger than 5 years, recommends that primary care clinicians apply fluoride varnish to primary teeth of all infants and children starting at the age of primary tooth eruption.²
- For children aged 5 to 17 years, found insufficient evidence to assess the balance of benefits and harms.³ The evidence review (Chou et al. 2023) for children aged 5 to 17 years noted that fluoride varnish was associated with improved caries outcomes when applied in school or dental settings, but evidence was lacking in primary care settings.

American Dental Association

- American Dental Association (ADA) recommends in-office application of fluoride varnish at least every three to six months for patients age 18 years and younger and at risk for caries, based on evidence favoring the FV application (Weyant et al. 2013). The ADA Current Policies manual (ADA 2024) recognizes that school-based oral health programs can play an important role in preventing and controlling dental caries in children and adolescents and can assist in the referral of those patients to establish a dental home.

American Academy of Pediatrics

- In the primary care setting, fluoride varnish should be applied at least once every six months for all children and every three months for children at high risk for caries, starting when the first tooth erupts and until the establishment of a dental home (Clark et al. 2020). AAP also notes that pediatricians can promote child oral health through collaboration with schools and districts and with school nurses to advocate for evidence-based school oral health programs and recommends pediatricians support school-based health centers, some of which deliver FV (AAP 2022).

Considerations for Implementation

The following considerations for implementation are drawn from U.S. studies included in this review (Braun et al. 2016; Dudovitz et al. 2018), the broader literature on barriers and facilitators to implementing school sealant programs (Community Preventive Services Task Force 2013; Patel et al. 2022), and information from the American Academy of Pediatrics on state policies regarding Medicaid billing and delivery of FV (AAP 2024).

The CPSTF recognizes that schools can be an important venue to deliver preventive services to children unlikely to receive them and recommends school-based health centers (some provide dental services; CPSTF 2015) and school-based sealant programs (many also provide FV; CPSTF 2013; Bakhurji et al. 2019). School sealant programs not already providing FV could add this intervention, which requires no additional equipment and takes advantage of the program's current access to schools. School programs may be administered by the school (e.g., school health center) or by outside entities (e.g., Federally Qualified Health Centers, State Oral Health Programs, dental schools).

Many state Medicaid programs reimburse for FV and sealants delivered in schools, but low Medicaid reimbursement rates (Patel et al. 2022) and care that is not reimbursed (Dudovitz et al. 2018) can hinder program implementation and sustainability. Medicaid reimbursement policy regarding who can bill for preventive dental services (Dudovitz et al. 2018) and who can deliver them (Scherrer et al. 2007) may pose greater barriers for non-dental providers. In most states, Medicaid only allows medical providers who are physicians or nurses with advanced degrees, i.e., nurse practitioners, to bill for FV application (AAP 2024; Dudovitz et al. 2018) and typically does not reimburse for FV delivered to children older than age 6 years (AAP 2024). Although the majority of states allow medical providers to delegate delivery to other types of health professionals (e.g., medical assistants, registered nurses), in a few states, other types of non-dental providers are not allowed to apply FV, even without seeking reimbursement (AAP 2024).

The Indian Health Service (IHS) serves a child population with one of the highest rates of early childhood caries in the world (Indian Health Service 2010). The IHS allows different types of non-dental providers to apply FV in preschool programs including trained lay health workers (Braun et al. 2016) and Head Start staff including directors, health coordinators, and teachers (Indian Health Service 2010).

Other factors affecting school adoption and student participation, respectively, include:

1. schools' concerns about disruptions in instructional time (Dudovitz et al. 2018);
2. changing approaches to seeking consent; and
3. socio-demographic, cultural, and linguistic factors affecting demand and ability to participate.

One U.S. study noted the importance of involving a local champion, such as a school nurse, who understood the value of the program and was trusted by both parents and school personnel to increase school acceptance and student participation (Dudovitz et al. 2018). Minimizing student time out of class by ensuring efficient delivery of services could also increase school acceptance of SFVDPs (Dudovitz et al. 2018).

When implementing programs, it is important to note that the greatest caries reductions will likely result from implementing programs as soon as the first tooth erupts—preschool (e.g., Early Head Start) for primary teeth beginning eruption at age 6 months and kindergarten for permanent teeth beginning eruption at age 6 years; (Braun et al. 2016)—and applying FV at least twice annually.

Several publicly available resources provide guidance on the implementation of SFVDPs.

- [Preventing Tooth Decay | State Strategies | Policy, Performance, and Evaluation | CDC](https://www.cdc.gov/policy/statestrategies/oralhealth/index.html)
[https://www.cdc.gov/policy/statestrategies/oralhealth/index.html]
- [Advancing Prevention and Reducing Childhood Caries in Medicaid and CHIP Learning Collaborative | Medicaid](https://www.medicaid.gov/medicaid/quality-of-care/improvement-initiatives/advancing-prevention-and-reducing-childhood-caries-medicaid-and-chip-learning-collaborative/index.html)
[https://www.medicaid.gov/medicaid/quality-of-care/improvement-initiatives/advancing-prevention-and-reducing-childhood-caries-medicaid-and-chip-learning-collaborative/index.html]
- [Fluoride Varnish](https://www.astdd.org/docs/fluoride-varnish.pdf) (astdd.org) [https://www.astdd.org/docs/fluoride-varnish.pdf]
- [Fluoride Varnish | California Oral Health Technical Assistance Center \(ucsf.edu\)](https://oralhealthsupport.ucsf.edu/topic/fluoride-varnish)
[https://oralhealthsupport.ucsf.edu/topic/fluoride-varnish]
- [Dental Portal | Indian Health Service \(ihs.gov\)](https://www.ihs.gov/doh/index.cfm?fuseaction=ecc.varnish) [https://www.ihs.gov/doh/index.cfm?fuseaction=ecc.varnish]
- [Local Oral Health Program \(LOHP\) Resource Guide \(ucsf.edu\)](https://oralhealthsupport.ucsf.edu/sites/g/files/tkssra861/f/wysiwyg/Local%20Oral%20Health%20Program%20%28LOHP%29%20Resource%20Guide%20.pdf)
[https://oralhealthsupport.ucsf.edu/sites/g/files/tkssra861/f/wysiwyg/Local%20Oral%20Health%20Program%20%28LOHP%29%20Resource%20Guide%20.pdf]
- [School-Based Fluoride Varnish & Sealant Program | Health and Human Services North Dakota](https://www.hhs.nd.gov/health/oral-health-program/SEALND)
[https://www.hhs.nd.gov/health/oral-health-program/SEALND]
- [Washington State School-based Sealant and Fluoride Varnish Program Guidelines](https://doh.wa.gov/sites/default/files/legacy/Documents/8380/160-172-OHsealguid-en-L.pdf)
[https://doh.wa.gov/sites/default/files/legacy/Documents/8380/160-172-OHsealguid-en-L.pdf]

Evidence Gaps

CPSTF identified several areas that have limited information. Additional research and evaluation could help answer the following questions and fill remaining gaps in the evidence base.

CPSTF identified the following questions as priorities for research and evaluation:

- How effective are school programs in reducing disparities in the United States for historically disadvantaged racial and ethnic groups and for rural areas?
- How can programs maximize school engagement and student participation?
- What can programs do to minimize delivery time and costs?

Remaining questions for research and evaluation identified in this review include the following:

- How effective are school programs when delivered by non-dental providers in the United States?
- How effective are school programs which deliver a single fluoride varnish application per year?
- How effective are school programs for students of low and moderate caries risk?
- How effective are school programs serving children in communities with higher social economic status?
- How effective are school programs in preventing caries in chewing surfaces of teeth in adolescents?
- Do school programs improve quality of life, school performance, and other health outcomes including harms?

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¹American Dental Association recommends fluoride varnish containing 5% sodium fluoride, which is 2.26% fluoride ion (Weyant et al. 2013).

²Recommendation: [Prevention of Dental Caries in Children Younger Than 5 Years: Screening and Interventions | United States Preventive Services Task Force](https://uspreventiveservicestaskforce.org/uspstf/recommendation/prevention-of-dental-caries-in-children-younger-than-age-5-years-screening-and-interventions1) [https://uspreventiveservicestaskforce.org/uspstf/recommendation/prevention-of-dental-caries-in-children-younger-than-age-5-years-screening-and-interventions1]

³Recommendation: [Oral Health in Children and Adolescents Aged 5 to 17 Years: Screening and Preventive Interventions | United States Preventive Services Task Force](https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/oral-health-children-adolescents-screening-preventive-interventions) [https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/oral-health-children-adolescents-screening-preventive-interventions]

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