NCC Pediatrics Continuity Clinic Curriculum:
Dental Health I: Preventive Care
Faculty Guide

Goals & Objectives:

- Learn how to perform an oral health risk assessment and provide anticipatory guidance.
- Recognize the preventive role of fluoride in water, toothpaste, varnish.
- Review how to apply fluoride varnish and how to properly document this procedure.

Pre-Meeting Preparation:

- "Fluoride and Dental Caries Prevention in Children" *(PIR, 2014)*
- "Fluoride Use in Caries Prevention in the Primary Care Setting" *(AAP Clinical Report, 2020)*
  - Oral Health Risk Assessment Tool
- Mission Statement & Treatment Policy of WR-B Dental School
  - Includes Tricare/United Concordia Dental Link—*Try to find a pediatric provider in your area!*
- Smiles for Life National Oral Health Curriculum
  - Scroll down and select "Child Oral Health" option.
  - *You do NOT need to register in order to access the pre/post tests and curriculum*

Conference Agenda:

- Review Dental Health I Quiz
- Complete Dental Health I Cases
- Hands-on Demo: Fluoride varnish treatments. *Residents—practice on each other.*

Post-Conference: *Board Review Q&A*

Extra-Credit:

- AAP Oral Health "Protecting Tiny Teeth Toolkit" *—training program*
- CDC website: Oral Health—*links for providers and parents*
  - "Using Fluoride to Prevent and Control Dental Caries" *(MMWR 2001)*
- AAP Policy Statement: Maintaining and Improving the Oral Health of Young Children *(2023)*
- "Smiles for Life" Modules: www.smilesforlifeoralhealth.org
- "Disparities in the Quality of Pediatric Dental Care: New Research. . ." *(Society for Research in Child Development, 2018)*
- "Promoting Children's Health Equity with Medical-Dental Integration" *(AMA J. of Ethics, 2022)*

Fluoride and Dental Caries Prevention in Children

Charlotte W. Lewis, MD, MPH*

Author Disclosure
Dr Lewis has disclosed no financial relationships relevant to this article. This commentary does contain a discussion of an unapproved/investigative use of a commercial product/device.

Practice Gaps

1. Low-income children experience more dental caries and more complications of caries, such as dental abscesses. Beginning fluoride toothpaste and fluoride varnish during the first year of life can reduce low-income children's risk of getting dental caries.
2. Pediatricians and other primary care clinicians for children have an important role to play in implementing a dental caries primary prevention program for all children, which should include regular use of fluoride as the mainstay.
3. Fluoride toothpaste and community water fluoridation benefit both children and adults, decreasing the risk of dental caries throughout the life span.

Objectives

After completing this article, readers should be able to:

1. Understand the mechanism that leads to dental caries.
2. Understand how fluoride prevents dental decay.
3. Be knowledgeable of the various sources of fluoride.
4. Be aware of evidence to support safe use of fluoride and how to counter misinformation perpetuated by antifluoride groups.
5. Be able to recommend specific fluoride modalities, depending on the child's risk for dental caries.

Introduction

Fluoride is a valuable caries prevention modality that has a large body of evidence supporting its use. Because infants, young children, and their parents typically visit the pediatric office many times before ever seeing a dentist, parents may bring questions about fluoride to their pediatricians. Moreover, health supervision visits provide unique opportunities for pediatricians to address fluoride in the context of preventive oral health. However, until recently, pediatricians typically received little training in oral health and therefore may need additional education about fluoride to answer parents' questions, counter misinformation, and ensure appropriate use of fluoride among their patients. Given that approximately one-quarter of US children younger than 5 years have caries, it is particularly important that pediatricians are knowledgeable about fluoride and comfortable with delivering it to their patients.

Fluoride is highly effective in preventing dental caries (commonly known as dental decay), with both primary and secondary preventive properties. By definition, primary prevention precedes the onset of disease so that disease is avoided. An example of primary prevention is regular consumption of fluoridated water, which provides adequate topical exposure to fluoride to prevent dental caries. Secondary prevention involves early identification of caries so it can be arrested or reversed. An example is fluoride varnish (FV) application to white spot lesions, which are the white, chalky spots at the gingival margins that are the first visible evidence of caries. FV remineralizes these areas and reverses the decay process.

Abbreviations

CWF:	community water fluoridation
ECC:	early childhood caries
FDA:	Food and Drug Administration
FPL:	federal poverty level
FTP:	fluoride toothpaste
FS:	fluoride supplement
FV:	fluoride varnish
NHANES:	National Health and Nutrition Examination Survey

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Effect of Dental Caries in Childhood

Caries begins in childhood and eventually affects 90% of adults. Even so, dental decay's effect on low-income individuals is disproportionate, leading to earlier onset, more affected teeth, complications, and ultimately teeth lost during adulthood because of caries. Results of the National Health and Nutrition Examination Survey (NHANES) III during 1999–2004, indicated that 24% of 2- to 4-year-olds and 51% of 6- to 8-year-olds had caries in primary teeth. (1) Among 12- to 19-year-olds, 59% had caries in permanent teeth. Children living below 200% of the federal poverty level (FPL) had more caries relative to children at or above 200% of the FPL (Figure 1). (1) Caries prevalence has decreased over time in all age categories, but this trend recently reversed for 2- to 4-year-olds, with a 5% increase (from 19% to 24%) since 1988–1994 (NHANES II). (1) The reasons for this increase are unclear.

The proportion of US children with *untreated* caries has remained approximately the same since 1988–1994. In 1999–2004, 16% of 2- to 4-year-olds and 28% of 6- to 8-year-olds had untreated caries in primary teeth, whereas 20% of 12- to 19-years-olds had untreated caries in permanent teeth. (3) Children living below 100% of the FPL had 2 to 3 times as many untreated caries as children living above 200% of the FPL. (3) Insurance and income-based disparities in access to dental care are important contributors to these differences in untreated caries. (4)(5) Despite mandated dental care coverage for low-income children under the Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) program (6) and, more recently, the State Children's Health Insurance Program (7) and the Children's Health Insurance Program Reauthorization Act, (8) it remains difficult for publicly insured children to access professional dental care, in part because fewer dentists accept Medicaid. (9) In 2008, just 38% of Medicaid-enrolled children, ages 2 to 18 years, received dental care in the previous year. (9)

Untreated caries can lead to toothache and other more serious medical problems. In 2008, approximately 15,000 US children presented to emergency departments with toothache cited as the reason for their visit. (10) Some of these children required hospital admission and/or surgery. In a well-publicized case in 2007, a Maryland boy died of complications resulting from dental caries. (11) Analysis of the 2007 National Survey of Children's Health documented that 14% of elementary school children had experienced toothaches in the previous 6 months. (12) Being from a low-income family, of minority race, or having special health care needs independently increased risk of toothache. (12)

Dental Decay Pathophysiology

Dental decay is a transmissible infectious disease in which cariogenic bacteria are passed from mother (usually) to child. *Streptococcus mutans* and *Lactobacillus* species, among other bacteria, produce acids as end products of carbohydrate metabolism. These acids dissolve the calcium-phosphate mineral of a tooth's enamel during a process called demineralization. If not reversed through remineralization, the tooth structure erodes until the demineralized area collapses, resulting in a cavity. (13) A balance of caries-promoting and caries-inhibiting factors is constantly in play (Figure 2).

Caries may affect primary or permanent dentition. Caries in the primary teeth of children younger than 6 years is referred to as early childhood caries (ECC). A typical pattern of decay in ECC is that caries first develops on the smooth surfaces of the maxillary primary incisors; ECC may then progress quickly to the remaining primary dentition. This pattern differs from that in the permanent teeth of older children and adults, in whom the occlusal surfaces of molars are most often affected. Older adults may experience caries in crown or root

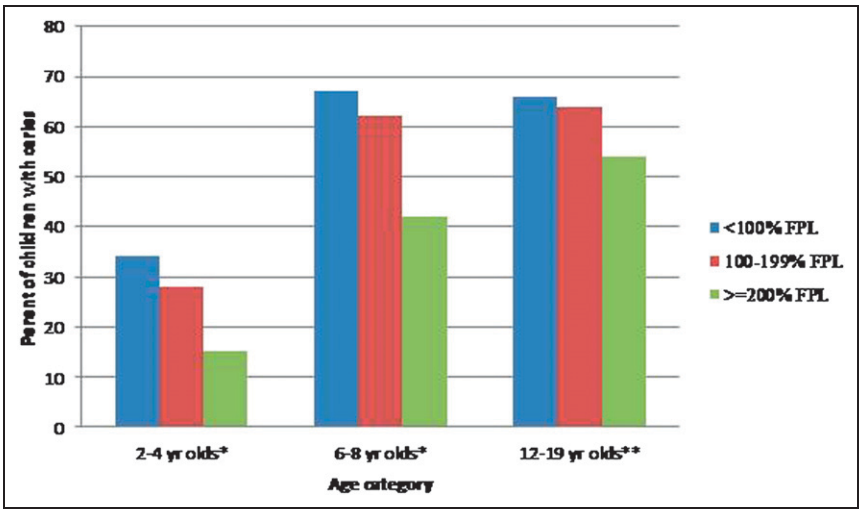

Figure 1. Percentage of US children with dental caries by federal poverty level (FPL) category (National Health and Nutrition Examination Survey III, 1999–2004). (1)(2)

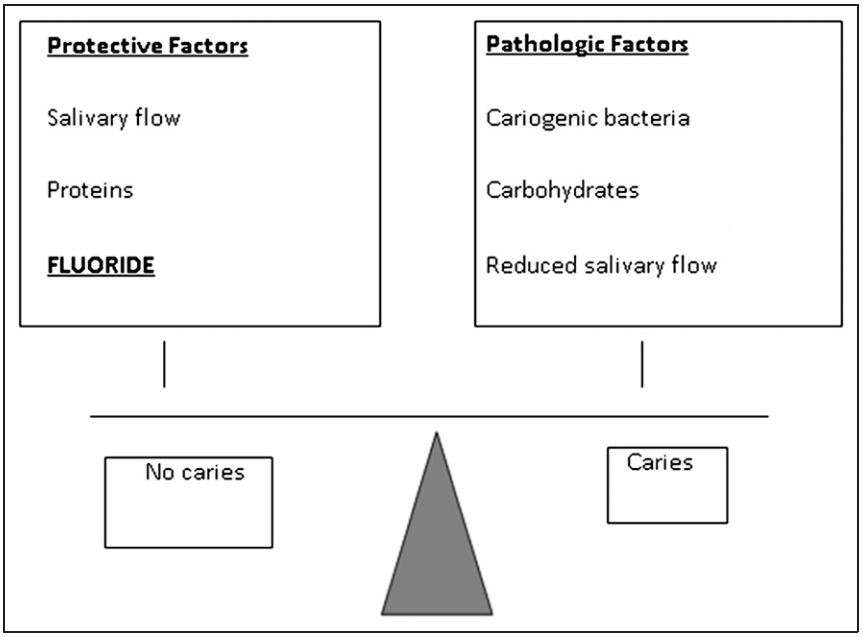

Figure 2. Ongoing balance between caries protective and pathologic factors. Fluoride can help to tip the balance in the direction of remineralization or "no caries" provided that pathologic factors are not overwhelming.

surfaces, which become vulnerable to decay as gum tissue recedes.

Caries Risk Factors

Caries disproportionately affects certain individuals and groups, predominantly defined by poverty. (1) Exactly how poverty interacts with other variables to produce higher levels of caries is incompletely understood. However, caries risk factors would be expected to cluster within families and communities because resources, habits, cultural and other beliefs, parental role modeling, and dietary and oral hygiene habits are more likely to be shared by family and community members.

Child-level characteristics associated with more caries include previous caries, (14) visible plaque, (15) consumption of sweetened liquids and candy, (15)(16)(17) suboptimal fluoride exposure, (18) and infrequent toothbrushing. (19)

Caregivers who harbor more cariogenic bacteria, because of untreated caries and/or poor oral hygiene, transmit more bacteria and infect children at younger ages. (16)(20)(21)(22) On the basis of some research evidence, interrupting vertical transmission of cariogenic bacteria is a potential strategy to prevent caries in young children. (23)(24) Other parental factors associated with more caries in their children include multiple decayed teeth, (25) maternal tooth loss from caries, (26) fewer years of maternal education, (23)(27) less than twice-daily toothbrushing, (28) and fatalistic oral health beliefs. (17)

Despite many variables associated with increased caries risk, predicting precisely which children are at higher risk for caries *before* onset of dental decay is a still-evolving science. Because children at high risk for caries develop ECC within the first few years of life, caries risk assessment should ideally take place *before* first tooth eruption and then be followed by implementation of an appropriate caries prevention program. However, the American Academy of Pediatric Dentistry's Caries-risk Assessment Tool (29) and other caries risk screening tools rely on a history or presence of caries or predisposing dietary and/or oral health habits. Yet, if caries or habits associated with caries are *already* present, then it is *too late* for optimal primary prevention. Low-income status (below 200% of the FPL) is the only caries risk factor that can reasonably be ascertained at first tooth eruption and thus is an appropriate criterion for initial assignment to an intensive caries prevention approach.

Fluoride's Mechanism For Caries Prevention and Fluorosis

Fluoride is a ubiquitous mineral. It is found in all soil, bodies of water, plants, and animals and, as such, is a normal constituent of all diets. (30) Early fluoride researchers believed that fluoride achieved its decay-inhibitory effects in a preeruptive fashion, that is, through incorporation into teeth before eruption via a systemic mechanism. Under this assumption, fluoride benefited only young children. On the basis of in vitro, clinical, and epidemiologic evidence, fluoride's effects are now known to be primarily posteruptive via a topical mechanism. (31)(32) When low levels of fluoride are sustained in saliva (after drinking fluoridated water or brushing with fluoride toothpaste [FTP]), the enamel demineralization and remineralization balance is pushed toward remineralization. Fluoride aids in incorporation of calcium and phosphate into enamel and is itself incorporated into enamel during mineralization. (33)

Fluoride-containing enamel, fluoroapatite, is harder and less acid soluble than the original enamel it replaces. Implications of fluoride's posteruptive mechanism are 2-fold: (1) topical fluoride is more effective than supplements that are swallowed, and (2) fluoride has beneficial effects throughout the lifespan.

Excess fluoride intake can result in fluorosis. Dental fluorosis refers to localized changes to tooth enamel, presenting in its mild forms as white markings on the teeth (Figure 3A and B) with more distinct white marking seen in moderate fluorosis (Figure 3C). (34) It is caused by elevated fluoride ingestion during tooth development. (35) Aesthetic considerations for fluorosis are most important in permanent maxillary incisors (the most visible teeth), which are most susceptible to fluorosis before age 2 years. (36)(37)(38)(39) Once permanent teeth mineralization is complete, by 8 years old, there is no longer risk of additional dental fluorosis with further fluoride exposure. (40) It is recommended that fluoride intake in children not exceed 0.05 to 0.07 mg/kg daily. (41) Above this range, an unacceptable degree of fluorosis may result. Below 0.05 mg/kg, fewer children develop fluorosis, but more children develop caries. (42) Early fluoride studies, before community water fluoridation (CWF) or availability of fluoride-containing dental products, established that there is not a single definable level of fluoride intake that maximizes caries prevention without at least some dental fluorosis on a population level. (43) The goal is to limit the degree of fluorosis and number of individuals affected without tipping the balance toward higher caries prevalence. Almost all fluorosis in the United States is very mild or mild (Figure 4); (44) teeth with this degree of fluorosis are more resistant to caries than teeth without fluorosis. More severe dental fluorosis, which manifests as enamel pitting and predisposition to staining (Figure 3D), is unusual in the United States but occurs in other parts of the world where there are naturally high levels of fluoride in the water (eg, >2 ppm). Teeth with severe fluorosis are paradoxically more susceptible to caries.

As opposed to the localized effects of dental fluorosis, skeletal fluorosis is a systemic condition caused by long-term exposure to excessively high levels of fluoride—either ingested or inhaled. Chronic fluoride toxicity leads to poor quality bone and painful calcification and ossification of tendons and ligaments. (45) Skeletal fluorosis is extremely rare in the United States (41) but is endemic in parts of India, China, and Africa. (46) When described in the United States, it is typically in individuals who drink large quantities of black tea or very concentrated black tea (black tea naturally contains fluoride). For example, in a 2013 case report in the *New England Journal of Medicine*, a 47-year-old woman who presented with skeletal fluorosis "reported that for the past 17 years she has habitually consumed a pitcher of tea made from 100 to 150 tea bags daily." (47) There has not been a reported case of skeletal fluorosis resulting from drinking optimally fluoridated water.

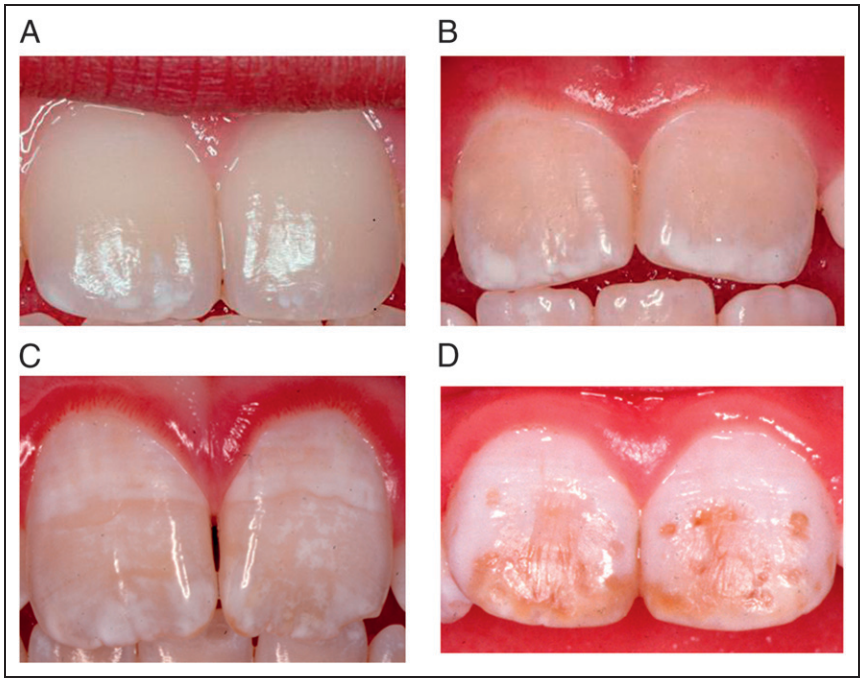

Figure 3. Fluorosis categorized as very mild (A), mild (B), moderate (C), and severe (D). (81)

Sources of Fluoride

Community Water Fluoridation

CWF is considered among the 10 greatest US public health achievements of the 20th century (48) and one of the few public health interventions with clear-cut, significant cost-effectiveness. (49) CWF refers to the addition of fluoride to that naturally present in water to attain an optimal fluoride level to prevent caries. According to a Centers for Disease Control and

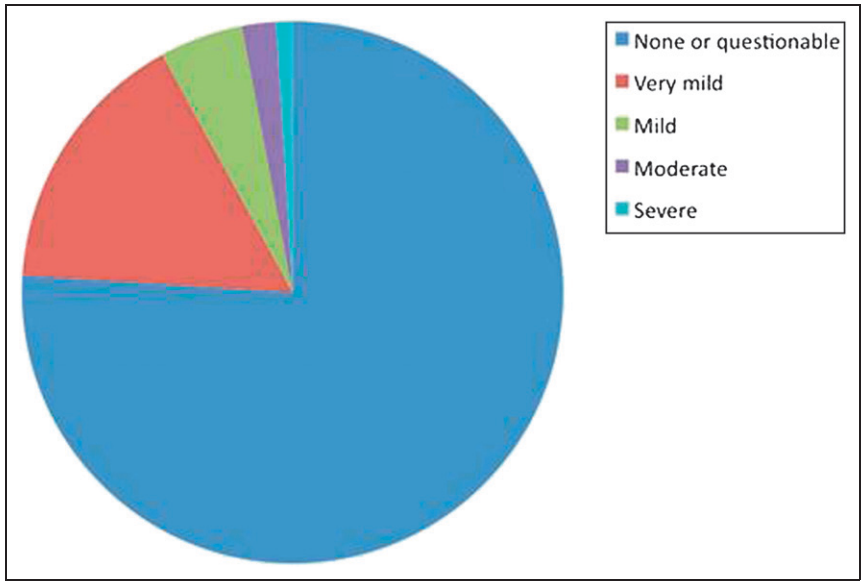

Figure 4. Proportion of 6- to 49-year-olds in the United States with dental fluorosis by severity (National Health and Nutrition Examination Survey III, 1999-2004). (97)

Prevention fluoridation census in 2010, 72% of Americans on public water systems receive CWF. (49) The concept of CWF began with observations in the early 20th century that individuals drinking naturally fluoridated water were more resistant to dental decay. (50) Landmark investigations in the 1940s of 21 cities with varying levels of naturally occurring fluoride in the water identified 1 ppm of fluoride in water as the level maximizing caries prevention while minimizing fluorosis risk. (51) (52) Prospective field trials of CWF in 4 pairs of treatment-control cities in the United States and Canada demonstrated that CWF resulted in a 50% to 75% reduction in caries. (53) In 1945, Grand Rapids, Michigan, was the first US city to fluoridate its public water. (54) CWF also decreases coronal and root caries among adults and has reduced the number of teeth lost to caries in adulthood. (35)(55) A 2007 meta-analyses estimated a caries preventive fraction for CWF in adults to be 27% (the preventive fraction refers to the reduction in carious lesions that can be attributed to drinking fluoridated water; in this case, there were 27% fewer carious lesions relative to adults who did not drink fluoridated water). (56)

Recently, the US Department of Health and Human Services recommended that the optimal fluoride level in US CWF be uniformly decreased to 0.7 ppm. (57) This recommendation was made in light of widening exposure to fluoride sources other than CWF and an increasing prevalence of dental fluorosis. Previously, the fluoride concentration in CWF ranged from 0.7 to 1.2 ppm based on the precept that water intake varied depending on the ambient air temperature (ie, CWF was 0.7 ppm in hotter areas and 1.2 ppm in colder areas). However, water intake no longer varies with ambient temperature as much as in the past, (58) and as such, there is now a consistent US recommendation of 0.7 ppm of fluoride in CWF.

A number of countries supply CWF to at least 40% of their population, including Australia, Brazil, Canada, Chile, Hong Kong, the Irish Republic, Israel, Malaysia, New Zealand, and Singapore, among others. (59) Water fluoridation is not technically or financially feasible in many parts of the world, including most of Central and South America and Europe, in large part because there are not modern, centralized water systems. (60) Instead, salt fluoridation (250 ppm), advocated by the World Health Organization, is commercially available (eg, in grocery stores) in more than 30 countries as a source of fluoride for population-based caries prevention. (61)

Because bottled beverages, such as juices, are often produced with fluoridated community water, these liquids contain fluoride. (41) In a study of more than 500 juices and juice-flavored drinks, 43% had a fluoride concentration above 0.6 ppm; grape juice, in particular, often exceeded 1.0 ppm. (62) As Americans consume more soda and juice in place of water and milk, these beverages "diffuse" from fluoridated into nonfluoridated areas and have become increasingly important sources of dietary fluoride. (41) This phenomenon has various implications. First, consumption in nonfluoridated areas of beverages manufactured with fluoridated water, (63) as well as widespread FTP use, mean that notable differences in caries rates between cities with and without CWF, observed in original studies in the 1950s, are no longer as pronounced. Relatively recent CWF effectiveness studies in the United States estimate 25% fewer caries in children who drink optimally fluoridated water compared with those who do not. (64) Second, this makes it more difficult to estimate an individual's fluoride intake for determining caries or fluorosis risk.

Decisions to fluoridate US community water supplies are usually made by state or local authorities, although there have been ballot initiatives for and against CWF.

Despite overwhelming evidence of CWF's cost-effectiveness and benefit in preventing caries, fluoride still evokes controversy, as evidenced by numerous websites and Internet entries that assert fluoride's toxic effects and advancing conspiracy theories about fluoride. There are 4 common categories of concern about fluoride: (1) fluoride is a toxin, (2) CWF represents mass medication, (3) CWF eliminates individual choice, and (4) CWF results in adverse health effects. Because pediatricians and other health professionals are called on to promote and defend fluoride, it is worthwhile to understand these claims and evidence against them (Table 1).

Fluoride-Containing Dental Products

FLUORIDE SUPPLEMENTS. With recognition of CWF's capacity to prevent caries, other fluoride sources were introduced. The first was fluoride supplements (FSs), as drops or tablets, which became available in the late 1940s as a means to deliver fluoride to children living in communities without CWF. The American Dental Association first published FS recommendations in 1958. (73) FSs are still recommended by the American Dental Association for children older than 6 months who are at high risk for caries and who reside in fluoride-deficient communities. (74) The American Academy of Pediatrics policy about FS dosing and prescribing by pediatricians expired in 2000.

There remains some mixed evidence of the effectiveness of FSs in preventing caries in young children, (75) yet the disadvantages are substantial, including need for prescription, the fact that liquid formulations are ingested so that the fluoride is delivered systemically rather than topically, and higher fluorosis risk in young children using FSs. (76)(77)(78)(79) The preponderance of strong research evidence supporting the relative advantages of FTP over FSs led Canada, (79) England, (80) Australia, (81) New Zealand, (82) and the European Union (83) to recommend against regular use of FSs in favor of promoting FTP use in young children instead.

FLUORIDE TOOTHPASTE. The 1960s brought direct consumer marketing of FTP. Toothbrushing with FTP is a valuable delivery system for topical fluoride. After brushing with FTP, fluoride levels peak in saliva and then remain at low concentrations for 2 to 6 hours, providing fluoride for enamel remineralization. (33) In the United States, over-the-counter FTP, including those marketed for children, are allowed by the Food and Drug Administration (FDA) to contain either 1,000 ppm of fluoride (1.0 mg of fluoride per gram of toothpaste, in the form of 0.76% sodium monofluorophosphate) or 1,100 ppm of fluoride (1.1 mg of fluoride per gram of toothpaste as 0.24% sodium fluoride or 0.0454% stannous fluoride). Lower-concentration FTP (eg, 250-550 ppm) is available in other countries. However, on systematic review, these toothpastes did not consistently reduce caries. (84) Lower-concentration FTP is not approved by the FDA for sale in the United States.

FTP has many advantages over FSs, including that FTP works topically, is widely available in grocery and drug stores, does not require a prescription, and is much less expensive (<1 cent per day for FTP compared with 52 cents per day for fluoride drops; Colgate 360 Anticavity Fluoride Toothpaste [Dora the Explorer], 4.6 oz (130 g), costs $2.99 on drugstore.com and would last more than 1 year at 50 mg per brushing or 100 mg of paste per day, and a 1-month supply of FSs [FLURA-DROPS], 0.25 mg per drop, at Costco costs $15.57 for a 30-day supply). Furthermore, FTP is widely used by older children and adults, therefore providing opportunities for modeling and instilling a lifelong habit early in life. There is a large body of strong research evidence about benefits of FTP in preventing caries. On systematic review, daily FTP use resulted in 24% fewer caries in permanent teeth and 13% fewer caries in primary teeth, on average, when compared with nonfluoride toothpaste. (85) Furthermore, strong research evidence indicates that FTP's beneficial effects are increased with (1) higher fluoride concentration toothpaste (trials indicate 6% fewer carious lesions, on average, with every 500-ppm increase in FTP fluoride concentration >1,000 ppm), (86) (2) twice-daily use (with a caries preventive fraction of 14% when brushing twice a day compared with once daily), (87)(88) and (3) parent-supervised brushing. (87)(89) Fewer data assessing the effect of earlier FTP initiation on caries are available. Research evidence from cross-sectional and population-based surveys in Europe found significantly lower prevalence of caries at 5 years and older when children began brushing with FTP before 1 year of age compared with those who started after 2 or 3 years of age. (89)(90) However, earlier FTP use is associated with increased fluorosis risk, (34)(76)(77)(78)(79) presumably because very young children will swallow some FTP until they learn to spit out the residue.

Concern over young children swallowing toothpaste has led to ongoing questions about the right age to start use of FTP. Part of the confusion results from difficult-to-interpret recommendations. For example, the label on the FTP package (as required by the FDA) states that parents should ask their physician or dentist whether a child younger than 2 years should use FTP. In response, the Centers for Disease Control and Prevention advises

Table 1. Antifluoridation Assertions and the Facts

Antifluoridation Assertions	Facts
"Fluoride is 'a toxin' added to the public water system." "Fluoride is more toxic than lead." "Evidence for the toxic effects of FTP is found on the warning label on FTP labels–'Keep out of reach of children under 6 years of age. If more than used for brushing is accidentally swallowed, get medical help or contact Poison Control right away.'"	• Fluoride is naturally present at varying concentrations in all bodies of water; the concentration of fluoride in ocean water is 1.2 ppm. • An estimated 57.4 million people worldwide drink naturally fluoridated water in which fluoride is already present at approximately 1 ppm. (59) • Unlike fluoride and other micronutrients, there is no safe threshold for lead exposure. • There is an optimal range of fluoride intake at which the effects are beneficial (ie, fewer dental caries). (41) At lower than optimal intake, more caries are observed; at higher than optimal intake, fluorosis and other adverse effects occur. (41) • Nothing is unique about fluoride's potential for toxicity at excess levels of intake relative to other micronutrients. Analogously, taking one iron tablet prevents anemia but taking higher amounts exposes a child to excess iron, which is dangerous and should also prompt urgent medical attention.
"CWF represents 'mass medication.'"	• Medications are used to treat disease. CWF is not intended to treat disease but to prevent it on a population level. • Prescription FTP or FV dispensed by dentists can be used to treat caries but at 100- to 1,000-fold higher concentrations than what is present in optimally fluoridated water.
"CWF eliminates individual choice about fluoride." "People who want fluoride can take fluoride supplements."	• CWF helps to equalize risk of caries across socioeconomic groups in a way that fluoride taken on an individual basis does not. (65) • Unlike supplements, CWF is effective at preventing cavities in individuals of all ages. (35)(56)(64) • Supplements are associated with higher levels of dental fluorosis. (66) • Individual choice is still possible in that one can opt out of drinking tap water.
"Fluoride results in adverse health effects," such as increased risk for diminished IQ, hip fracture, arthritis, Alzheimer's disease, cancer, etc.	• There is no established evidence for an association between CWF and any disease or intellectual impairment. (67)(68)(69) Drinking fluoridated water is associated with dental fluorosis, most of which is mild or very mild in the United States. (44) • A particularly persistent claim is that drinking fluoridated water increases risk of osteosarcoma in boys. Initial concerns were based on a rat study in which rats were given extremely high levels of fluoride in their water. Subsequently, male rats experienced "marginally higher" osteosarcoma rates in irradiated limbs. (70) • The balance of evidence from well-designed case-control and population-based studies in humans indicates no credible evidence for a link between osteosarcoma and CWF. (67)(68)(69)(71)(72)

CWF=community water fluoridation; FTP=fluoride toothpaste; FV=fluoride varnish.

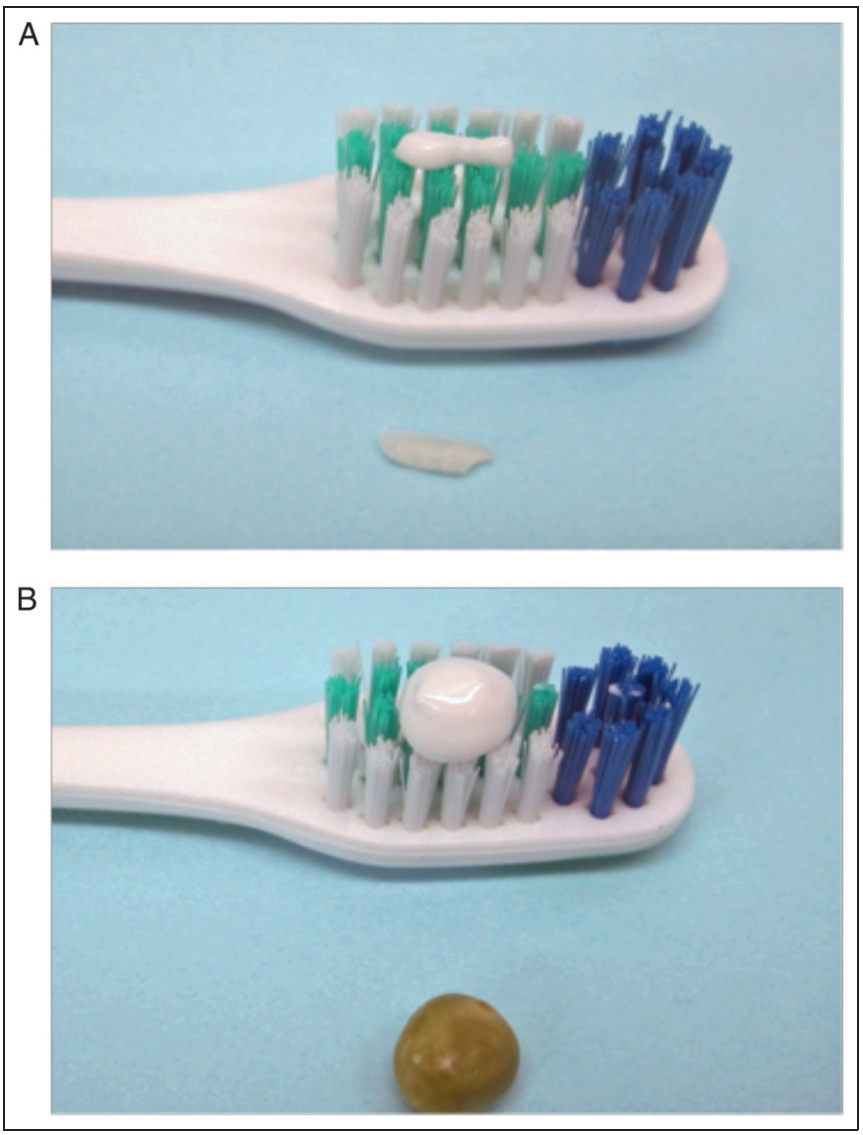

Figure 5. Using an analytic laboratory scale (Mettler Toledo, Columbus, OH), a rice-grain-size and pea-size amount of fluoride toothpaste (FTP) were weighed. A rice-grain-size amount of 1,100-ppm FTP weighed 50 mg and contained 0.055 mg of fluoride. A pea-size amount of 1,100-ppm FTP weighed 250 mg and contained 0.27 mg of fluoride (photographs courtesy of Katherine Lewis, PhD).

health professionals to "consider the fluoride level in the community drinking water, other sources of fluoride, and factors likely to affect susceptibility to dental caries when weighing the risk and benefits of using FTP (before age 2 years)." (34) Given the difficult task of accurately determining how much daily fluoride a child consumes or ascertaining a child's susceptibility to caries, it is a potentially formidable challenge for pediatricians to advise parents about when a child should begin using FTP. To make matters more confusing, commercial messaging about the safety of fluoride-free training toothpastes implies that FTP is unsafe for young children. Such messages may lead parents to inaccurately attribute greater hazard to swallowing toothpaste than actually exists (C. Lewis, unpublished data, 2011) and, as a consequence, may potentially limit parents' use of and the beneficial effects of FTP. The Maternal and Child Health Bureau convened an expert panel in 2007, which recommended, based on some research evidence and consensus, that children younger than 2 years at high risk for caries should use a "smear" of FTP twice daily; however data (90)(91) mentioned in the previous paragraph have also suggested that all children could potentially benefit from starting FTP use before age 1 year.

Empirically, using a small amount of FTP means less is swallowed and thus there is a lower fluorosis risk. Two-year-olds ingest an average of approximately two-thirds of the toothpaste used in brushing. (92) Given this, if a child uses a rice-grain-size amount (approximately 50 mg of paste) of FTP (Figure 5) during twice-daily brushing, he/she gains the beneficial effect of topical fluoride and ingests only approximately 0.08 mg of fluoride, which is much less than is swallowed when taking fluoride drops (0.25-1.0 mg per 1 mL) and is substantially below the threshold for increased fluorosis risk of 0.05 to 0.07 mg/kg daily (in the above scenario a 10-kg child would consume 0.008 mg/kg of fluoride). Rinsing after brushing is contraindicated based on strong research evidence. For young children who do not know how to spit, rinsing causes more FTP to be swallowed. (92) Among older children, rinsing and spitting out the residue reduce the beneficial effect of the fluoride and result in more caries. (93)(94)

How the balance of risks and benefits of early FTP is perceived has led countries to adopt different recommendations, based on some research evidence and consensus,

about what age to start use of FTP. One approach, currently used in the United States, Australia, and Canada, is based on risk stratification—with children at high risk of caries advised to begin use of FTP at first tooth eruption, (95) whereas children at low risk of caries should wait until 2 years of age (or 18 months in Australia (81) and 3 years in Canada (79)) before using FTP. The other approach, used in England, recommends that *all* children, beginning in infancy, have their teeth brushed twice daily with a "smear" of at least 1,000 ppm of FTP. Furthermore, in England, the recommended amount of FTP per brushing increases to pea-size (approximately 250 mg of paste), and the recommended fluoride concentration in the FTP increases to 1,350 to 1,500 ppm for children 3 years and older. (80)

There is need for high-quality studies focused on relative risks and benefits of early FTP use. In the meanwhile, there are reasons to consider adopting England's strategy of universal and early FTP initiation in the United States: (1) young children at low risk of caries also experience caries at not inconsequential levels (2); (2) caries prevalence among young children is unacceptably high and has increased (2); (3) even if a child does not spit after brushing with a rice-grain-size amount of FTP, fluoride intake from FTP use 2 times per day is well below the fluorosis-risk level; (4) it establishes a good habit early; and (5) it places appropriate emphasis on disease prevention.

OTHER FLUORIDE-CONTAINING DENTAL PRODUCTS. Dental professionals rely on a variety of fluoride-containing products, including foam, gel varnish, prescription-strength toothpaste, and mouthrinse, for caries prevention and treatment. The most thoroughly evaluated for pediatric use are fluoride gels and varnish. Applying these highly concentrated fluoride products to teeth, using a dual arch tray for gel or brush to paint on varnish, leaves a fluoride-calcium compound on tooth enamel that releases fluoride whenever biofilm (ie, plaque) pH decreases. (96) Both fluoride gel (97) and varnish (98) are effective in preventing caries, based on strong research evidence, but FV has a number of advantages over gels, including that FV can be used on infants and toddlers (gel is too easily swallowed), adheres better to the tooth's enamel surface, and allows for longer sustained levels of fluoride in the

Table 2. Useful Information for Pediatricians About Fluoride in Water and Other Beverages

1. The EPA oversees regulations for drinking water provided by public water systems. Naturally occurring fluoride levels in community water supply are not allowed to exceed 4 ppm, and water suppliers are required to notify consumers if the fluoride concentration of the water exceeds 2 ppm. (106)
2. The FDA has oversight of FTP and bottled water. It does not require the label of bottled water to list the presence of fluoride unless fluoride has been added. (107) Some bottled water companies sell optimally fluoridated water (http://www.bottledwater.org/fluoride).
3. Well water contains variable amounts of fluoride, ranging from 0 to 7.22 ppm in one study. (108) The only way to know the fluoride content of well water is to have it tested. Most state health departments have lists of local certified water testing labs. Some state universities will conduct fluoride testing on water samples for about $15–20. National Testing Labs offers residential water testing for fluoride for about $50 (www.watercheck.com).
4. Reverse osmosis and distillation remove virtually all fluoride from water. (109) UV light exposure and water softeners do not change the fluoride content of the water. (110)
5. Under-the-sink, faucet-mount, or pitcher-type activated charcoal filtration units do not affect the fluoride concentration of tap water. (30)
6. Minimal fluoride is present in breast milk or cow's milk. (111)
7. There is negligible fluoride in powdered infant formula. The fluoride content of infant formula made from powder reflects the fluoride in the water used to prepare it. Preparing infant formula with fluoridated water has been associated with higher risk of fluorosis. (112) The ADA states that formula can be prepared with optimally fluoridated water and that providers need to be "cognizant of the potential risks of enamel fluorosis development," (113) which is advice that may be difficult to implement on a practical level. There is a lower fluoride intake and theoretically less risk of fluorosis with CWF at 0.7 ppm. (114)
   - For example, a 10-kg infant who drank 28 oz of formula prepared with 0.7 ppm of fluoridated water would consume 0.54 mg of fluoride or 0.054 mg/kg of fluoride, which is approximately the recommended intake.
   - If the water contained 1 ppm, then the infant would consume 0.078 mg/kg of fluoride, in excess of the recommended intake.

ADA=American Dental Association; CWF=community water fluoridation; EPA=Environmental Protection Agency; FDA=Food and Drug Administration; FTP=fluoride toothpaste.

Table 3. Recommendations and Evidence Type for Fluoride-Based Caries Prevention[a]

FTP Use

On the basis of strong research evidence, it is recommended that children brush with at least 1,000 ppm of FTP (A) (76)(77) and do not rinse after brushing (A). (84) Other recommendations, based on some research evidence and consensus, include the following:

- Initiate twice daily brushing with a smear of FTP at first tooth eruption in all low-income children (<200% FPL) (B). (95)
- Consider initiation of FTP before age 1 year in all children (C). (78)(79)

Children at High Caries Risk

Low-income families and communities experience more caries. Infants living in low-income households should be considered at high risk for caries (A) (1)

- Low-income children and communities should be prioritized for intensive fluoride-based prevention. It is recommended, based on strong research evidence, that low-income children:
  - On an individual level, receive at least twice-yearly FV application beginning by age 1 year to prevent ECC (A). (92)
  - On a community-level, supervised and classroom-based toothbrushing with FTP (94) should be provided in preschool and elementary school (A) and fluoride mouthrinse programs (93) for older children (>6 years) (A). (92)(116)
- Other recommendations pertaining to low-income children, based on some research evidence and consensus, include the following:
  - Low-income children should receive early and regular professional dental care for caries screening and implementation of primary, secondary, and tertiary prevention (C). (114)
  - Caries risk status should be regularly reevaluated and children reassigned to intensive primary prevention if other caries risk factors are identified (D).

Caries Prevention Anticipatory Guidance

It is recommended that education about caries prevention include the following:

- Frequently consuming sugar-sweetened foods and drinks (including 100% juice) increases caries (A). (117)(118)(119)(120)(121)
  - Taking a bottle/sippy cup with any kind of juice or sugar-sweetened beverage to bed increases caries (C). (122)
- Regularly drinking optimally fluoridated water reduces caries (A). (33)(61)(123)
- Using FTP of at least 1,000 ppm twice daily reduces caries (A). (76)(77)

Research Needs

Longitudinal studies and RCTs are needed to monitor trends and refine fluoride-based preventive recommendations (D).

ECC=early childhood caries; FPL=federal poverty level; FTP=fluoride toothpaste; FV=fluoride varnish; RCT=randomized controlled trial.
[a]A: Recommendation based on well-designed RCT, diagnostic studies on relevant population, high-quality meta-analysis, or systematic review. B: Recommendation based on RCT with minor limitations or overwhelmingly consistent evidence from observational studies. C: Recommendation based on observational studies (case-control and cohort). D: Recommendation based on expert opinion, case reports, reasoning from first principles.

enamel crystal matrix. Furthermore, FV does not require special preparation of teeth, requires only brief training to become adept at its application, is generally acceptable to patients, is portable, and requires little storage space—all of which make it easy to use in nondental settings (eg, in schools, public health clinics, and medical offices). In most states, pediatricians can bill for FV application to low-income children insured by Medicaid.

FV is effective in preventing caries in both primary and permanent teeth. The FDA approves FV as a cavity liner and desensitizing agent. FV is used "off-label" for preventing dental caries. Systematic reviews indicate that FV prevents 46% of permanent tooth caries and 33% of primary tooth caries. (99) (100) FV's effect differs, depending on a population's caries prevalence. The number needed to treat to prevent one carious surface in primary dentition ranged from 3.7 children in low-caries communities to 1.6 children in high-caries communities. Children at high risk of caries should be prioritized for at least twice-yearly FV beginning in infancy to optimize ECC prevention. A well-designed randomized controlled trial in San Francisco, California, demonstrated a preventive fraction of 58% in decayed lesions in children who were enrolled in the study at approximately age 20 months and followed up for 2 years, providing a strong research basis for recommending twice-yearly FV in US children at high risk for caries. (101) In England, guidelines specify that all children receive FV 2 times per year, based on some research evidence and consensus, and children at high risk for caries receive FV 3 to 4 times per year. (80)

Community-Level Fluoride Interventions

Among fluoride-based, community-level strategies, there is strong research evidence of the caries preventive

effectiveness of school fluoride mouthrinse programs, particularly in high-caries populations. (102) However, fluoride mouthrinse should not be used until a child is at least 7 years old because younger children may swallow large amounts. Although supervised toothbrushing with FTP takes place at US Head Start programs, no information could be found about classroom-based toothbrushing programs in US grade schools despite strong research evidence from Europe that such programs are effective. On systematic review, supervised FTP toothbrushing programs in school resulted in a caries preventive fraction of 23%. (103)

Other community-level strategies for caries prevention in young children, also more common in Europe, include free or reduced cost FTP distribution. An English randomized controlled trial that evaluated a free FTP mail distribution program, which was targeted at infants and children living in low-income communities, resulted in significantly fewer carious teeth at ages 5 to 6 years. (105) In the United States, free FTP distribution could be added to the purview of the Supplemental Nutrition Program for Women, Infants, and Children (WIC), which targets low-income families and already provides oral health preventive education at a number of sites. (105)

Conclusions

This article provides an evidence-based overview of fluoride modalities and their preventive properties that will allow pediatricians to effectively promote the appropriate use of fluoride for prevention of dental caries in their patients and communities. Table 2 provides additional information about fluoride in water and other beverages to help answer questions that commonly arise in pediatricians' offices.

Widespread availability of fluoride has decreased the prevalence of caries in the United States. Nevertheless, almost all US adults have caries, and like other chronic diseases, dental decay has its substantive origins in childhood behaviors and environment. Table 3 presents specific recommendations for fluoride-based prevention of caries.

On the basis of strong research evidence, CWF and FTP remain the most effective tools to promote optimal oral health for US children and adults. These 2 modalities should form the cornerstones of caries prevention. Ongoing expansion of CWF will require well-funded media campaigns and other organized efforts to counter misinformation perpetuated by antifluoridation groups.

Although additional studies are needed to clarify how to best deliver FTP to very young children, consideration should be given to initiating FTP use at first tooth eruption as standard caries primary prevention for all US children. On the basis of strong research evidence about the relative advantages of FTP, a number of countries (but not the United States) no longer recommend FSs. Because low-income children experience more caries, they should receive an additional intensive caries primary prevention program composed of, in addition to twice-daily FTP use, at least twice-yearly FV, prioritization for early and regular professional dental care, and targeted community- and school-based caries interventions. A dual-track (standard vs intensive) primary prevention approach emphasizes the importance of caries prevention for all children while also addressing the substantial oral health disparities that adversely affect the health and well-being of millions of US children. (8)

Summary

- On the basis of strong research evidence, fluoride reduces demineralization, enhances remineralization, and strengthens tooth enamel, thus decreasing susceptibility of the tooth to decay from acidic by products of bacterial carbohydrate metabolism.
- On the basis of strong research evidence, community water fluoridation has markedly decreased rates of dental decay in the United States and around the world since it was first implemented in the mid-20th century.
- On the basis of strong research evidence, fluoride's effects on preventing caries are primarily topical. However, drinking fluoridated water exposes the teeth to topical fluoride as does twice daily brushing with fluoride toothpaste and periodic application of fluoride varnish.
- On the basis of strong research evidence, twice daily use of at least 1,000 ppm of fluoride toothpaste reduces dental caries.
- On the basis of strong research evidence, fluoride varnish has important caries prevention properties and should be applied to the teeth of low-income children twice yearly, beginning in the first year of life.
- On the basis of some research evidence, fluoride drops are associated with more dental fluorosis, and because they are swallowed their routine use is inconsistent with the primarily topical mechanism of fluoride's action in preventing caries. A number of countries have reexamined the evidence surrounding fluoride drops and no longer recommend them, in favor of early initiation of fluoride toothpaste instead.
- On the basis of strong evidence, fluoride, like all other micronutrients, has a recommended level of intake at which caries prevention is optimized. At lower levels of intake, more dental caries occur. At high levels of intake, fluorosis and other adverse effects occur.

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(NOTE: Selected references appear below. Numbers correspond to the references in the article. The complete list of references is available online at http://pedsinreview.aappublications.org/content/35/1/3/suppl/DCSupplementary_Data.

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CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

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Fluoride Use in Caries Prevention in the Primary Care Setting

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Dental caries remains the most common chronic disease of childhood in the United States. Caries is a largely preventable condition, and fluoride has proven effectiveness in caries prevention. This clinical report aims to clarify the use of available fluoride modalities for caries prevention in the primary care setting and to assist pediatricians in using fluoride to achieve maximum protection against dental caries, while minimizing the likelihood of enamel fluorosis. Fluoride varnish application is now considered the standard of care in pediatric primary care. This report highlights administration, billing, and payment information regarding the fluoride varnish procedure.

Dental caries (ie, tooth decay) is an infectious disease caused by bacteria on the tooth surface metabolizing carbohydrates and producing acid, which dissolves tooth enamel. If unchecked, this process continues through the tooth and into the pulp, resulting in pain and tooth loss. This can further progress to local infections (ie, dental alveolar abscess or facial cellulitis), systemic infection, and, in rare cases, death. Dental caries in the United States is responsible for many of the 51 million school hours lost per year as a result of dental-related illness, which translates into lost work hours for the adult caregiver.[1] Early childhood caries is the single greatest risk factor for caries in the permanent dentition. Good oral health is a necessary part of overall health, and studies have demonstrated adverse effects of poor oral health on multiple chronic conditions, including diabetes control.[2] Therefore, failure to prevent caries has health, educational, and financial consequences at both the individual and societal levels.

Dental caries is the most common chronic disease of childhood,[1] with 59% of 12- to 19-year-olds having at least 1 documented cavity.[3] Caries is a "silent epidemic" that disproportionately affects poor, young, minority populations and children living below 100% of the poverty level.[1] In the United States, 25% of 2- to 5-year-old children from low socioeconomic and minority groups experience 80% of dental disease.[4] Among 3- to 5-year-olds, untreated dental decay was significantly greater for non-

abstract

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Drs Clark, Keels, and Slayton participated in the concept and design of the manuscript, analysis and interpretation of data, and drafting and revising of the manuscript; and all authors approved the final manuscript as submitted.This document is copyrighted and is property of the American Academy of Pediatrics and its Board of Directors. All authors have filed conflict of interest statements with the American Academy of Pediatrics. Any conflicts have been resolved through a process approved by the Board of Directors. The American Academy of Pediatrics has neither solicited nor accepted any commercial involvement in the development of the content of this publication.

DOI: https://doi.org/10.1542/peds.2020-034637

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

To cite: Clark MB, Slayton RL, AAP SECTION ON ORAL HEALTH. Fluoride Use in Caries Prevention in the Primary Care Setting. *Pediatrics.* 2020;146(6):e2020034637

Hispanic Black and Hispanic children (19.3% and 19.8%, respectively) than for non-Hispanic white children (11.3%).[4] This disparity persisted among children 6 to 9 years and 13 to 15 years of age.[4] Dental caries is a global problem, with early childhood caries prevalence among socioeconomically disadvantaged groups reported to be as high as 70%.[5] It has been suggested that health beliefs, self-efficacy, access to care, and parents' attitudes and practices related to dietary and oral hygiene behaviors may contribute to this disparity.[6]

Children with special health care needs, including those with developmental delay, complex neurodevelopmental disabilities, or congenital heart disease are also affected disproportionately.[7,8] In a study of Head Start children, those with developmental delays had a caries prevalence ratio that was 1.26 times higher than classmates without developmental delays.[8] This difference may be attributable to challenges with home care routines such as toothbrushing and use of medications with high sugar content, among other factors.[8] Children with special health care needs are frequently considered as a group when determining caries risk. However, some diagnoses place children at greater risk for caries, whereas other children are at decreased or similar risk as children without special health care needs. In a retrospective longitudinal study of children with autism spectrum disorder, Down syndrome, congenital heart disease, and cerebral palsy, Frank et al[7] determined that the caries risk among the group of children with special health care needs was higher than among the control subjects but the risk differed significantly by diagnosis. The caries burden was greatest in children with congenital heart disease, followed by those with autism spectrum disorders.[7] For children with Down syndrome, the risk was close to that of controls and considerably lower than the other 3 groups of children with special health care needs.[7]

Unfortunately, dental caries prevalence in young children increased between the previous 2 national surveys, despite improvements among older children.[9] Many children do not receive dental care at young ages, and because the risk of dental caries is heavily influenced by parenting practices, pediatricians have a unique opportunity to participate in the primary prevention of dental caries. The 2007–2016 Medical Expenditure Panel Survey demonstrated that 88.8% of infants and 1-year-olds have office-based physician visits annually, compared with only 3.6% of infants and 1-year-olds having general dental visits (American Academy of Pediatrics [AAP], unpublished analysis of 2007–2016 Medical Expenditure Panel Survey, August 2019). Studies show that health care dollars are saved with simple home and primary care setting prevention measures.[10]

The development of dental caries requires 4 components: teeth, bacteria, carbohydrate exposure, and time. Once teeth emerge, they become colonized with cariogenic bacteria. The bacteria metabolize carbohydrates and create acid as a byproduct. The acid dissolves the mineral content of enamel (demineralization) and, over time, with repeated acid attacks, the enamel surface disintegrates and results in a cavity in the tooth. Protective factors that help to remineralize enamel include exposing the teeth to fluoride, limiting the frequency of carbohydrate consumption (to 3 meals and 2 healthy snacks per day), choosing less cariogenic foods (selecting cheese or raw carrots over candy or crackers; selecting fresh fruit over dried fruit or processed fruit snacks), practicing good oral hygiene (brushing twice a day for 2 minutes and flossing between all teeth that touch), and receiving regular dental assessments and care. If carious lesions are identified early, the process can be halted or reversed by modifying the patient's individual risk and protective factors. The AAP's publications "Maintaining and Improving the Oral Health of Young Children"[11] and *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*[12] discuss these concepts in greater depth and provide targeted anticipatory guidance. For primary prevention to be effective, it is imperative that pediatricians be knowledgeable about the process of dental caries, social determinants of oral health, prevention of the disease, and available interventions, including fluoride.

Fluoride is available from many sources, divided into 3 major categories: tap water (and foods and beverages processed with fluoridated water), home administered, and professionally applied. The widespread decline in dental caries in many developed countries, including the United States, has been largely attributable to the use of fluoride. Fluoride has 3 main mechanisms of action[13]:

1. Fluoride promotes enamel remineralization.
2. Fluoride reduces enamel demineralization.
3. Fluoride inhibits bacterial metabolism and acid production.

The mechanisms of fluoride are both topical and systemic, but the topical effect is the most important, especially over the life span.[14]

There has been substantial public and professional debate about fluoride, and a great deal of information is available, often with confusing or conflicting messages. Excess fluoride ingestion during tooth development can result in subsurface

hypomineralization and porosity between the developing enamel rods, termed enamel fluorosis.[15] Fluorosis of permanent teeth occurs when excessive fluoride is ingested during the time that tooth enamel is being mineralized; therefore, the risk is influenced by both dose and frequency of ingestion. Recent evidence also suggests a genetic susceptibility or resistance to the development of fluorosis.[16] Fluorosis develops in children younger than 8 years, with the most susceptible period for permanent maxillary incisor fluorosis (central teeth) between 15 and 30 months of age.[17–19] The vast majority of enamel fluorosis is mild or very mild and characterized by small white striations or opaque areas not readily noticeable to the casual observer and is of minimal clinical consequence.

Moderate and severe forms of enamel fluorosis are uncommon in the United States but have both an aesthetic concern and, potentially, a structural concern with pitting, brittle incisal edges and weakened groove anatomy in the permanent 6-year molars.[20] After 8 years of age, there is no further risk of fluorosis except for the third molars because all other permanent tooth enamel is fully mineralized.

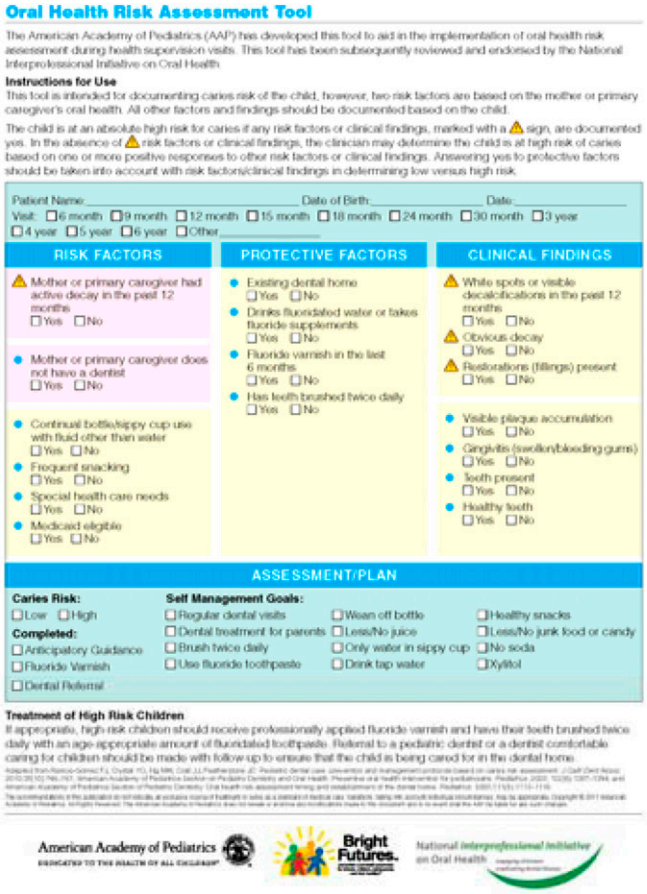
Dental and governmental organizations (the American Dental Association [ADA], American Academy of Pediatric Dentistry [AAPD], and Centers for Disease Control and Prevention [CDC]) have all published guidelines on the use of fluoride. In 2001, the AAP endorsed the CDC publication "Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States."[21]

The 2 intents of this clinical report are as follows:

1. to assist pediatricians in using fluoride to achieve maximum protection against dental caries, while minimizing the likelihood of enamel fluorosis; and
2. to clarify what advice should be given by pediatricians regarding fluoride in the primary care setting.

CURRENT INFORMATION REGARDING FLUORIDE USE IN CARIES PREVENTION

Sources of ingested fluoride include drinking water, infant formula, fluoride toothpaste, prescription fluoride supplements, fluoride mouth rinses, professionally applied topical


Oral Health Risk Assessment Tool

The American Academy of Pediatrics (AAP) has developed this tool to aid in the implementation of oral health risk assessment during health supervision visits. This tool has been subsequently reviewed and endorsed by the National Interprofessional Initiative on Oral Health.

Instructions for Use

This tool is intended for documenting caries risk of the child, however, two risk factors are based on the mother or primary caregiver's oral health. All other factors and findings should be documented based on the child.

The child is at an absolute high risk for caries if any risk factors or clinical findings, marked with a ⚠ sign, are documented yes. In the absence of ⚠ risk factors or clinical findings, the clinician may determine the child is at high risk of caries based on one or more positive responses to other risk factors or clinical findings. Answering yes to protective factors should be taken into account with risk factors/clinical findings in determining low versus high risk.

Patient Name:_____ Date of Birth:_____ Date:_____

Visit: ☐6 month ☐9 month ☐12 month ☐15 month ☐18 month ☐24 month ☐30 month ☐3 year ☐4 year ☐5 year ☐6 year ☐Other_____

RISK FACTORS	PROTECTIVE FACTORS	CLINICAL FINDINGS
⚠ Mother or primary caregiver had active decay in the past 12 months ☐Yes ☐No	• Existing dental home ☐Yes ☐No	⚠ White spots or visible decalcifications in the past 12 months ☐Yes ☐No
• Mother or primary caregiver does not have a dentist ☐Yes ☐No	• Drinks fluoridated water or takes fluoride supplements ☐Yes ☐No	⚠ Obvious decay ☐Yes ☐No
• Continual bottle/sippy cup use with fluid other than water ☐Yes ☐No	• Fluoride varnish in the last 6 months ☐Yes ☐No	⚠ Restorations (fillings) present ☐Yes ☐No
• Frequent snacking ☐Yes ☐No	• Has teeth brushed twice daily ☐Yes ☐No	• Visible plaque accumulation ☐Yes ☐No
• Special health care needs ☐Yes ☐No		• Gingivitis (swollen/bleeding gums) ☐Yes ☐No
• Medicaid eligible ☐Yes ☐No		• Tooth present ☐Yes ☐No
		• Healthy teeth ☐Yes ☐No

ASSESSMENT/PLAN

Caries Risk: ☐Low ☐High

Completed: ☐Anticipatory Guidance ☐Fluoride Varnish ☐Dental Referral

Self Management Goals: ☐Regular dental visits ☐Dental treatment for parents ☐Brush twice daily ☐Use fluoride toothpaste ☐Wean off bottle ☐Less/No juice ☐Only water in sippy cup ☐Drink tap water ☐Healthy snacks ☐Less/No junk food or candy ☐No soda ☐Xylitol

Treatment of High Risk Children

If appropriate, high-risk children should receive professionally applied fluoride varnish and have their teeth brushed twice daily with an age-appropriate amount of fluoridated toothpaste. Referral to a pediatric dentist or a dentist comfortable caring for children should be made with follow-up to ensure that the child is being cared for in the dental home.

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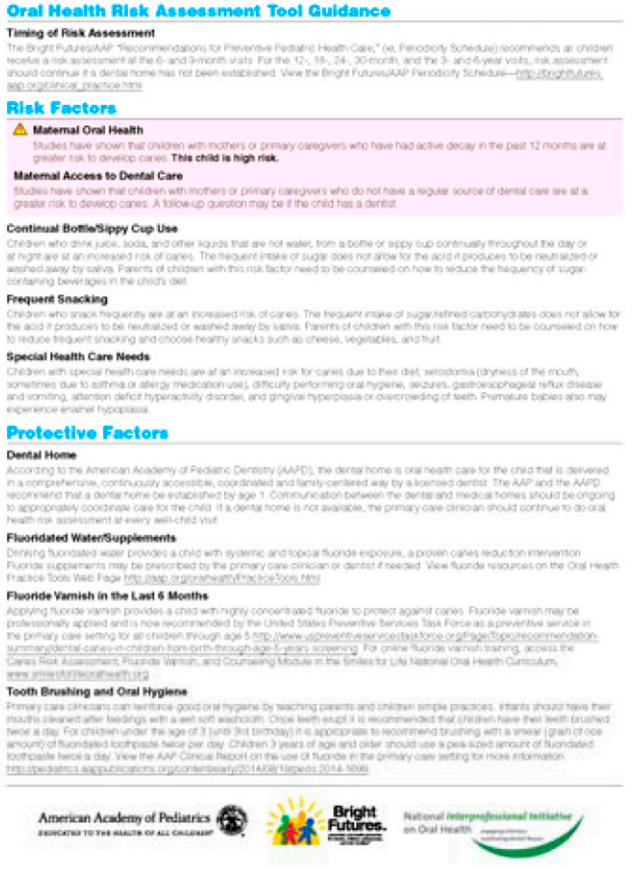
Oral Health Risk Assessment Tool Guidance

Timing of Risk Assessment

The Bright Futures/AAP "Recommendations for Preventive Pediatric Health Care," (ie, Periodicity Schedule) recommends all children receive a risk assessment at the 6- and 9-month visits. For the 12-, 18-, 24-, 30-month, and the 3- and 4-year visits, risk assessment should continue if a dental home has not been established. View the Bright Futures/AAP Periodicity Schedule—http://brightfutures.aap.org/clinical_practice.html

Risk Factors

⚠ Maternal Oral Health

Studies have shown that children with mothers or primary caregivers who have had active decay in the past 12 months are at greater risk to develop caries. **This child is high risk.**

Maternal Access to Dental Care

Studies have shown that children with mothers or primary caregivers who do not have a regular source of dental care are at a greater risk to develop caries. A follow-up question may be if the child has a dentist.

Continual Bottle/Sippy Cup Use

Children who drink juice, soda, and other liquids that are not water, from a bottle or sippy cup continually throughout the day or at night are at an increased risk of caries. The frequent intake of sugar does not allow for the acid it produces to be neutralized or washed away by saliva. Parents of children with this risk factor need to be counseled on how to reduce the frequency of sugar-containing beverages in the child's diet.

Frequent Snacking

Children who snack frequently are at an increased risk of caries. The frequent intake of sugar/refined carbohydrates does not allow for the acid it produces to be neutralized or washed away by saliva. Parents of children with this risk factor need to be counseled on how to reduce frequent snacking and choose healthy snacks such as cheese, vegetables, and fruit.

Special Health Care Needs

Children with special health care needs are at an increased risk for caries due to their diet, xerostomia (dryness of the mouth, sometimes due to asthma or allergy medication use), difficulty performing oral hygiene, seizures, gastroesophageal reflux disease and vomiting, attention deficit hyperactivity disorder, and gingival hyperplasia or overcrowding of teeth. Premature babies also may experience enamel hypoplasia.

Protective Factors

Dental Home

According to the American Academy of Pediatric Dentistry (AAPD), the dental home is oral health care for the child that is delivered in a comprehensive, continuously accessible, coordinated and family-centered way by a licensed dentist. The AAP and the AAPD recommend that a dental home be established by age 1. Communication between the dental and medical homes should be ongoing to appropriately coordinate care for the child. If a dental home is not available, the primary care clinician should continue to do oral health risk assessment at every well-child visit.

Fluoridated Water/Supplements

Drinking fluoridated water provides a child with systemic and topical fluoride exposure, a proven caries reduction intervention. Fluoride supplements may be prescribed by the primary care clinician or dentist if needed. View fluoride resources on the Oral Health Practice Tools Web Page http://aap.org/oralhealth/Practice Tools.htm/

Fluoride Varnish in the Last 6 Months

Applying fluoride varnish provides a child with highly concentrated fluoride to protect against caries. Fluoride varnish may be professionally applied and is now recommended by the United States Preventive Services Task Force as a preventive service in the primary care setting for all children through age 5 http://www.uspreventiveservicestaskforce.org/Page/Topic/recommendation-summary/dental-caries-in-children-from-birth-through-age-5-years-screening. For online fluoride varnish training, access the Caries Risk Assessment, Fluoride Varnish, and Counseling Module in the Smiles for Life National Oral Health Curriculum, www.smilesforlifeoralhealth.org

Tooth Brushing and Oral Hygiene

Primary care clinicians can reinforce good oral hygiene by teaching parents and children simple practices. Infants should have their mouths cleaned after feedings with a wet soft washcloth. Once teeth erupt it is recommended that children have their teeth brushed twice a day. For children under the age of 3 (until 3rd birthday) it is appropriate to recommend brushing with a smear (grain of rice amount) of fluoridated toothpaste twice per day. Children 3 years of age and older should use a pea-sized amount of fluoridated toothpaste twice a day. View the AAP Clinical Report on the use of fluoride in the primary care setting for more information. http://pediatrics.aappublications.org/content/early/2014/08/19/peds.2014-1856

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FIGURE 1
AAP Oral Health Risk Assessment Tool.

fluoride, and some foods and beverages.[22] Preventive strategies for caries can be tailored by focusing on key risk factors for dental caries associated with diet, bacteria, saliva, and status of the teeth (both current and previous caries experience).[11] The AAP Oral Health Risk Assessment Tool (Fig 1) is recommended in *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents* and endorsed by the National Interprofessional Initiative on Oral Health. This tool can be found at www.aap.org/en-us/Documents/oralhealth_RiskAssessmentTool.pdf.

Table 1 provides condensed recommendations for use of fluoride modalities in patients at low and high risk of caries as described in the following sections.

Fluoride Toothpaste

Fluoride toothpaste has consistently been proven to provide a caries-preventive effect for individuals of all ages.[21,23] In the United States, the fluoride concentration of over-the-counter (OTC) toothpaste ranges from 1000 to 1100 ppm. This translates into 1 mg of fluoride in a 1-inch (1 g) strip of paste. A pea-sized amount of toothpaste is approximately one-quarter of an inch. Therefore, a pea-sized amount of toothpaste containing 1000 to 1100 ppm fluoride would have approximately 0.25 mg of fluoride. Most fluoride toothpastes in the United States contain sodium fluoride, sodium monofluorophosphate, or stannous fluoride as the active ingredient.

Children younger than 6 years are more likely to ingest toothpaste and increase the risk of fluorosis. Fluorosis risk can be minimized by using the recommended amounts of toothpaste and storing toothpaste where young children cannot access it without parental help. Parents should supervise children younger than 8 years to ensure the proper amount of toothpaste and effective brushing technique.

Recommendations and Dosing

The use of fluoride toothpaste should begin with the eruption of the first tooth. For children younger than 3 years, the recommended amount is a smear or grain of rice size (approximately 0.1 mg of fluoride). Once the child has turned 3 years of age and is more able to consistently expectorate, a pea-sized amount of toothpaste (approximately 0.25 mg of fluoride) should be used.[24,25] It is preferable to spit, but not rinse, after brushing. Expectorating without rinsing reduces the amount of fluoride swallowed and leaves some fluoride available in the saliva for uptake by the dental plaque. Parents should be strongly advised to supervise their child's use of fluoride toothpaste to avoid overuse or ingestion, especially with children who have complex neurodevelopmental disabilities and cannot consistently expectorate.

High-concentration toothpaste (5000 ppm) is available by prescription only, and this decision is usually made by a dental health professional. The active ingredient in this toothpaste is sodium fluoride. This agent can be recommended for children 6 years and older and adolescents who are at high risk of caries and who are able to expectorate after brushing. Examples of children for whom high-concentration fluoride toothpaste might be indicated are those with history of dental caries and new lesions, children with xerostomia, and those with gastroesophageal reflux causing dental erosion. Dental health professionals may also prescribe this agent for adolescents who are undergoing orthodontic treatment because they are at increased risk of caries during this time.[26]

Fluoride Varnish

Fluoride varnish is a concentrated topical fluoride applied to the teeth that sets on contact with saliva. Advantages of this modality are that it is well tolerated by infants and young children, has a prolonged therapeutic effect, and can be applied by both dental and nondental health professionals in a variety of settings.[27] The concentration of fluoride varnish is 22 600 ppm (2.26% fluoride ion), and the active ingredient is sodium fluoride. The unit dose packaging from most manufacturers provides a specific measured amount (0.25 mL, providing 5 mg of fluoride ion). The application of fluoride varnish during an oral screening is of benefit to children, especially those with limited access to dental care. The current AAPD recommendation for children at high risk of caries is that fluoride varnish be applied to the teeth every 3 to 6 months.[28] The 2013 ADA

TABLE 1 Summary of Fluoride Modalities for Low- and High-Risk Patients

Fluoride Modality	Low Caries Risk	High Caries Risk
Toothpaste	Starting at tooth emergence (smear of paste until age 3, then pea-sized)	Starting at tooth emergence (smear of paste until age 3, then pea-sized)
Fluoride varnish	Every 3–6 mo starting at tooth emergence	Every 3 mo starting at tooth emergence
Mouth rinse OTC	Do not use	Starting at age 6 y if the child can reliably swish and spit
Community water fluoridation	Yes	Yes
Dietary fluoride supplements	Yes, if drinking water supply is not fluoridated	Yes, if drinking water supply is not fluoridated

guideline recommends application of fluoride varnish at least every 6 months to both primary and permanent teeth of those at elevated caries risk.[29] Medicaid pays both physicians and dentists for the application of fluoride varnish in all 50 states.

Under the Patient Protection and Affordable Care Act,[30] payers are required to cover, without cost-sharing, preventive services recommended by the US Preventive Services Task Force (USPSTF) and *Bright Futures* guidelines. The USPSTF recommended in 2014 that primary care clinicians apply fluoride varnish to the primary teeth of all infants and children starting at the age of primary tooth eruption (B recommendation).[31] All children 5 years and younger deserve to have application of fluoride varnish fully covered, as per USPSTF recommendations, as part of health maintenance and preventive care and for fluoride varnish application to be a covered benefit and separately paid service (ie, not considered incidental to the office visit). All practices should be paid separately and appropriately according to the definition of the *Current Procedural Terminology* (CPT) code, which defines fluoride application as a separately identifiable procedure. Fluoride varnish payment should not be bundled with routine preventive evaluation and management services because definitions of preventive care under those specific CPT codes do not include fluoride varnish application. Information regarding coding, billing, and payment for fluoride varnish application can be found on the AAP Web site (www.aap.org/oralhealth) and the Pew Center on the States Web site (www.pewstates.org/research/analysis/reimbursing-physicians-for-fluoride-varnish-85899377335). Many AAP Chapters have chapter oral health advocates who promote and advocate for pediatric oral health within their community. Contact information for these chapter oral health advocates can be found at www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Oral-Health/Pages/Chapter-Oral-Health-Advocates.aspx.

Indications for Use

In the primary care setting, fluoride varnish should be applied at least once every 6 months for all children and every 3 months for children at high risk for caries, starting when the first tooth erupts and until the establishment of a dental home. Medical and dental professionals are encouraged to work in collaboration to ensure that fluoride varnish is being applied.

Instructions for Use

Fluoride varnish must be applied by a dentist, dental auxiliary professional, physician, nurse, or other health care professional on the basis of individual state practice acts. It should not be dispensed to families to apply at home. Application of fluoride varnish is most commonly performed in the context of a well-child visit. Teeth are dried with a 2-inch gauze square, and then the varnish is painted onto all surfaces of the teeth with a brush. The dose recommended for young children is 0.25 mL, which is available in single-dose applicator kits. Children can eat and drink immediately after application and are instructed to eat soft foods and not to brush their teeth on the evening after the varnish application to maximize the contact time of varnish on the teeth. Children should resume brushing twice daily with fluoridated toothpaste the following morning.

OTC Fluoride Rinse

OTC fluoride rinse provides a lower concentration of sodium fluoride than toothpaste or varnish. The concentration is most commonly 230 ppm (0.05% sodium fluoride). Expert panels on this topic have concluded that OTC fluoride rinses should not be recommended for children younger than 6 years because of their limited ability to rinse and spit and increased risk of swallowing higher than recommended amounts of fluoride.[32] A teaspoon (5 mL) of OTC fluoride rinse contains approximately 1 mg of fluoride. For children older than 6 years, OTC rinses provide additional topical fluoride that may assist in the prevention of enamel demineralization. However, the evidence for an anticaries effect is limited, and decisions to recommend OTC fluoride rinses should be made in consultation with the child's dental health care provider.[33,34]

Dietary Fluoride Supplements

The USPSTF recommended in 2014 that primary care clinicians prescribe dietary fluoride supplements for children living in communities with nonfluoridated water or who drink well water that does not contain fluoride.[31] Because there are many sources of fluoride in water supplies and processed food and drinks, it is essential that all potential sources of fluoride be assessed before prescribing a dietary supplement, including consideration of differing environmental exposures (dual homes and child care). As a general guideline, if the source of drinking water in the primary home is fluoridated tap or well water, children will not require fluoride supplementation, even if they primarily drink bottled water because the teeth are exposed to fluoride through food preparation and brushing. The risk of fluorosis is high if fluoride supplements are given to a child consuming fluoridated water.[35] Information about the fluoridation levels in many community water systems can be found on the CDC Web site "My Water's Fluoride" (https://nccd.cdc.gov/doh_mwf/default/default.aspx). Not all communities report this information to the CDC, so it may be necessary to contact the local water department to determine the level of

fluoride in the community water. Well water must be tested for fluoride content before prescribing supplements, and this testing is available in most areas through the state or county public health laboratory. Challenges with dietary fluoride supplementation include determining the child's fluoride exposures and proper administration of the medication.

It is important to note that the USPSTF recommendations vary from the ADA and AAPD guidelines, which both recommend fluoride supplementation only be considered for children who drink fluoride-deficient water and are also at high risk for dental caries.[36,37] No caries risk assessment tool has been validated for pediatricians to use, but the AAP Oral Health Risk Assessment Tool was piloted through the Quality Improvement Innovation Network, and more than 80% of practices found the tool easy to implement because clinicians did not need to significantly alter current practice to incorporate risk assessment. Identification of high-risk patients for oral health referral increased from 11% to more than 87% with the use of this tool (Brightening Oral Health Workgroup and Quality Improvement Innovation Networks, AAP, Brightening Oral Health: Teaching and Implementing Oral Health Risk Assessments in Pediatric Care project, unpublished data, 2009).

Guidelines for Use

The CDC-recommended fluoride supplementation dosage schedule is provided in Table 2. Supplements can be prescribed in liquid, tablet, or lozenge form. Tablets are preferable for children who can chew because they gain an additional topical benefit to the teeth during the chewing process. Liquid supplements are recommended for younger children and should ideally be added to water or put directly into the child's mouth. Addition of the fluoride supplement to milk or formula is not recommended because absorption of fluoride is reduced in the presence of calcium.[38] The risk of fluorosis can be minimized by health care providers verifying that there are no other sources of fluoride exposure before prescribing systemic fluoride supplements.

TABLE 2 Fluoride Supplementation Schedule for Children

Age	Fluoride Ion Level in Drinking Water, ppm[a]		
	<0.3	0.3–0.6	>0.6
Birth to 6 mo	None	None	None
6 mo to 3 y	0.25 mg/d[b]	None	None
3–6 y	0.50 mg/d	0.25 mg/d	None
6–16 y	1.0 mg/d	0.50 mg/d	None

Source: Centers for Disease Control and Prevention.[21]
[a] 1.0 ppm = 1 mg/L.
[b] 2.2 mg of sodium fluoride contains 1 mg of fluoride ion.

Other Sources of Fluoride

Fluoride is present in processed foods and beverages and may be naturally occurring in some areas of the country. The presence of fluoride in juices and carbonated beverages does not counteract the cariogenic nature of these beverages.

Breastfeeding and Reconstitution of Infant Formula

The AAP recommends exclusive breastfeeding for the first 6 months of life, and there is no need during this period of time to supplement with fluoride or water that is fluoridated. A study of infant feeding practices revealed that 70% to 75% of mothers who fed their infants formula used tap water to reconstitute the powdered formula.[39] According to 2014 CDC data,[40] approximately 74% of US households using a community public water supply received optimally fluoridated water.[41] Before the emergence of the primary teeth, tap water can be used to reconstitute formula. There is a small risk of fluorosis in the permanent dentition if a fluoridated water source is used to reconstitute formula.[22] If families elect to purchase water, it is appropriate to buy water with no added fluoride before tooth emergence. After tooth emergence, formula should be mixed with optimally fluoridated tap water or nursery water with fluoride, or fluoride supplements should be prescribed. It should be noted that most bottled water has suboptimal concentrations of fluoride and that fluoride content is not listed unless fluoride is added by the manufacturer. Fluoride is often added to "nursery" water, and this must be declared on the packaging. Dietary fluoride supplements should not be prescribed for children drinking infant formula reconstituted with fluoridated water.

Community Water Fluoridation

Community water fluoridation is the practice of adding a small amount of fluoride to the water supply to achieve a fluoride concentration of 0.7 ppm. Community water fluoridation was heralded by the CDC as 1 of the top 10 public health achievements of the 20th century.[42] Community water fluoridation is a safe, efficient, and cost-effective way to prevent tooth decay and has been shown to reduce tooth decay by 25%.[43] It prevents tooth decay by providing both topical and systemic exposure of low levels of fluoride to the teeth over time. Although more than 210 million Americans live in communities with optimally fluoridated water, more than 70 million others do not have access to fluoridated water in their public water system.[41] The fluoridation status of a community water supply can be determined by contacting the local water department or accessing the CDC Web site "My Water's Fluoride" (https://nccd.cdc.gov/doh_mwf/default/default.aspx).

Recommended Concentration

Community water fluoridation was initiated in the United States in the 1940s. In 2015, the US Department of Health and Human Services finalized

a recommendation to lower the optimal fluoride concentration in drinking water to 0.7 mg/L.[44] This fluoride concentration replaced the previous recommendation, which was based on climate and ranged from 0.7 mg/L in warmest climates to 1.2 mg/L in coldest climates.[44] The change was recommended because recent studies revealed no variation in water consumption by young children on the basis of climate and to adjust for an overall increase in fluoride intake through foods and beverages processed with fluoridated water, fluoridated mouth rinses, and fluoride toothpastes.

Evidence Supporting Community Water Fluoridation

Despite overwhelming evidence supporting the safety and preventive benefits of fluoridated water, community water fluoridation continues to be a controversial and highly emotional issue. Opponents express a number of concerns that have been addressed or disproven by validated research. The only scientifically documented adverse effect of excess (nontoxic) exposure to fluoride is fluorosis. An increase in the incidence of mild enamel fluorosis among teenagers has been cited as a reason to discontinue fluoridation, although this is a cosmetic condition with no detrimental health outcomes. Recent opposition has sometimes centered on the question of who decides whether to fluoridate: elected and/or public officials or the voters. Some opponents believe fluoridation to be mass medication and call into question the ethics of community water fluoridation, but courts have consistently upheld that it is legal and appropriate for a community to adopt a fluoridation program.[45] Opponents express concern about the quality and source of fluoride, claiming that the additives (fluorosilicic acid, sodium fluoride, or sodium fluorosilicate), in their concentrated form, are highly toxic byproducts of the production of phosphate fertilizer and may include other contaminants, such as arsenic. The quality and safety of fluoride additives are ensured by Standard 60 of the National Sanitation Foundation/American National Standards Institute, a program commissioned by the US Environmental Protection Agency (EPA), and testing is conducted to confirm that the concentrations of arsenic or other substances are below those allowed by the EPA.[46] Finally, there have been many unsubstantiated or disproven claims that fluoride leads to kidney disease, bone cancer, and compromised IQ. More than 3000 studies or research articles have been published on the subject of fluoride or fluoridation.[47] Few topics have been as thoroughly researched as community water fluoridation, and the overwhelming weight of the evidence (along with over 75 years of experience) supports the safety and effectiveness of this public health practice.

Naturally Occurring Fluoride in Drinking Water

The optimal fluoride concentration in drinking water is 0.7 ppm, an amount proven beneficial in reducing tooth decay.[44] Naturally occurring fluoride may be below or above these levels in some areas. Under the Safe Drinking Water Act,[48] the EPA requires notification by the water supplier if the fluoride concentration exceeds 2 ppm. In areas where naturally occurring fluoride concentrations in drinking water exceed 2 ppm, people should consider an alternative water source or home water treatments to reduce the risk of fluorosis in young children.[49] Well water should be tested for the concentration of fluoride, and this testing is most commonly performed through the local health department.

Fluoride Toxicity

Toxic levels of fluoride are possible, particularly in children, resulting from ingesting large quantities of fluoride supplements, fluoridated toothpaste, or fluoride mouth rinse. The toxic dose of elemental fluoride is 5 to 10 mg of fluoride/kg of body weight.[50] Lethal doses in children have been calculated to be between 8 and 16 mg/kg. When prescribing sodium fluoride supplements, it is recommended to limit the quantity prescribed at one time to no more than a 4-month supply. Parents should be advised to keep fluoride products out of the reach of young children and to supervise their use.

Fluoride-Removal Systems

A number of water treatment systems are effective in removing fluoride from water,[51] including reverse osmosis and distillation. Parents should be counseled on the use of these and activated alumina filters in the home and, should they choose to use one that removes fluoride, the potential adverse effects on the family's oral health. Commonly used home carbon filters (eg, Brita or PUR) do not remove fluoride.[51] Families concerned about heavy metals or other impurities in their home water supply can use an activated carbon filter and still retain the benefits of fluoridated water.

Silver Diamine Fluoride

Silver diamine fluoride (SDF) is a minimally invasive, low-cost liquid solution that is painted on cavitated lesions. In young children, SDF provides a nonsurgical technique to manage carious lesions until the child can cope with traditional restorative dental care and, potentially, avoid sedation or a general anesthetic.[52] SDF has been used in Japan for more than 40 years and was cleared by the US Food and Drug Administration in 2014 to treat tooth sensitivity in adults.[53,54] Similar to fluoride varnish, SDF (38% solution) has been used off-label in children and adults to stabilize dental caries and reduce dental sensitivity. At present, the use

of SDF in the United States is largely limited to the dental profession because there are no formal professional guidelines for use outside of dentistry. SDF is indicated for the arrest of cavitated carious lesions in primary teeth as part of a comprehensive caries management program.[52] Information about SDF is included in this report in expectation of questions to pediatricians about this increasingly publicized intervention and increasing numbers of SDF-treated teeth seen in pediatric practices. The mechanism of SDF action is poorly understood, but silver ions are known to be antimicrobial, and the fluoride prevents further enamel demineralization. After SDF application, the lesions must be followed to assess their hardness state. Additional treatments can be applied to obtain sufficient hardness. The only known contraindication to SDF is silver allergy, but SDF is not indicated for carious lesions involving the pulp. The only significant adverse effect of SDF is that the carious lesion turns black (Figs 2 and 3), which can be esthetically problematic for some. SDF can also temporarily stain the skin black if it accidentally comes into contact with the epithelium, and SDF can cause mucosal irritation for approximately 48 hours after mucosal contact. Care must be taken when applying SDF to a cavitated lesion to avoid contact with the child's mucosa or skin. Details of SDF application technique for dental health professionals are delineated in the AAPD Chairside Guide.[54]

FIGURE 2
Permanent staining of carious lesions after SDF application. Photograph courtesy of Martha Ann Keels, DDS, PhD.

FIGURE 3
Three-year stabilization of a carious lesion on 1 primary molar after SDF application. Photograph courtesy of Martha Ann Keels, DDS, PhD.

SUGGESTIONS FOR PEDIATRICIANS

1. Know how to assess caries risk. As recommended by the AAP in "Maintaining and Improving the Oral Health of Young Children" and the fourth edition of Bright Futures, pediatricians should perform oral health risk assessments on all children at every routine well-child visit beginning at 6 months of age. The Oral Health Risk Assessment Tool has been developed by the AAP and Bright Futures and endorsed by the National Interprofessional Initiative on Oral Health. This tool can be accessed at www.aap.org/en-us/Documents/oralhealth_RiskAssessmentTool.pdf. The tool is a guide to help clinicians counsel patients about oral health and counsel in reducing risk.
2. Recommend use of fluoridated toothpaste starting at the eruption of the first tooth. A smear or grain of rice sized amount is recommended for children younger than 3 years, and a pea-sized amount of toothpaste is appropriate for most children starting at 3 years of age (see Fig 4).

FIGURE 4
Diagram of smear versus pea-sized amount of fluoride toothpaste.

3. Apply fluoride varnish according to the periodicity schedule and bill using the CPT code 99188. Fluoride varnish is a proven tool in early childhood caries prevention. Additional training on oral screenings, fluoride varnish indications and application, and office implementation can be found in the Smiles for Life Curriculum Course: Caries Risk Assessment, Fluoride Varnish and Counseling[55] at www.smilesforlifeoralhealth.org. Additionally, the AAP Children's oral health Web site is a resource for oral health practice tools at https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Oral-Health/Pages/Oral-Health-Practice-Tools.aspx.
4. Know how to determine the concentration of fluoride in a child's primary drinking water and determine the need for systemic supplements.[21]
5. Advocate for water fluoridation in your local community. Public water fluoridation is an effective and safe method of protecting the most vulnerable members of our population from dental caries. Pediatricians are encouraged to advocate on behalf of public water fluoridation in their communities and states. For additional information and water fluoridation facts and detailed questions and answers, see the following:
   - o http://www.ilikemyteeth.org;
   - o www.ada.org/en/public-programs/advocating-for-the-public/fluoride-and-fluoridation/fluoridation-facts; and

- o http://www.cdc.gov/fluoridation/.

6. Understand indications for SDF and be able to recognize the clinical appearance of SDF-treated teeth.

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ABBREVIATIONS

AAP: American Academy of Pediatrics
AAPD: American Academy of Pediatric Dentistry
ADA: American Dental Association
CDC: Centers for Disease Control and Prevention
CPT: *Current Procedural Terminology*
EPA: US Environmental Protection Agency
OTC: over-the-counter
SDF: silver diamine fluoride
USPSTF: US Preventive Services Task Force

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

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Oral Health Risk Assessment Tool

The American Academy of Pediatrics (AAP) has developed this tool to aid in the implementation of oral health risk assessment during health supervision visits.

Instructions for Use

This tool is intended for documenting caries risk of the child, however, two risk factors are based on the mother or primary caregiver's oral health. All other factors and findings should be documented based on the child.

The child is at an absolute high risk for caries if any risk factors or clinical findings, marked with a ⚠ sign, are documented yes. In the absence of ⚠ risk factors or clinical findings, the clinician may determine the child is at high risk of caries based on one or more positive responses to other risk factors or clinical findings. Answering yes to protective factors should be taken into account with risk factors/clinical findings in determining low versus high risk.

Visit: ☐ 6 month, ☐ 9 month, ☐ 12 month, ☐ 15 month, ☐ 18 month, ☐ 24 month, ☐ 30 month, ☐ 3 years, ☐ 4 years, ☐ 5 years, ☐ 6 years, ☐ other_____

RISK FACTORS	PROTECTIVE FACTORS	CLINICAL FINDINGS
⚠ Mother or primary caregiver had active decay in the past 12 months Yes ☐ No ☐	• Existing dental home Yes ☐ No ☐	⚠ White spots or visible decalcifications in the past 12 months Yes ☐ No ☐
• Mother or primary caregiver does not have a dentist Yes ☐ No ☐	• Drinks fluoridated water or takes fluoride supplements Yes ☐ No ☐	⚠ Obvious decay Yes ☐ No ☐
• Continual bottle/sippy cup use with fluid other than water Yes ☐ No ☐	• Fluoride varnish in the last 6 months Yes ☐ No ☐	⚠ Restorations (fillings) present Yes ☐ No ☐
• Frequent snacking Yes ☐ No ☐	• Has teeth brushed daily Yes ☐ No ☐	• Visible plaque accumulation Yes ☐ No ☐
• Special health care needs Yes ☐ No ☐		• Gingivitis (swollen/bleeding gums) Yes ☐ No ☐
• Medicaid eligible Yes ☐ No ☐		• Teeth present Yes ☐ No ☐
		• Healthy teeth Yes ☐ No ☐

Caries Risk: ☐ Low ☐ High

Completed: ☐ Anticipatory Guidance ☐ Fluoride Varnish ☐ Dental Referral

Treatment of High Risk Children

If appropriate, high-risk children should receive professionally applied fluoride varnish and have their teeth brushed daily with an age-appropriate amount of fluoridated toothpaste. Referral to a pediatric dentist or a dentist comfortable caring for children should be made with follow-up to ensure that the child is being cared for in the dental home.

Supported in part by Live, Learn and Thrive
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Adapted from Ramos-Gomez FJ, Crystal YO, Ng MW, Crall JJ, Featherstone JD. Pediatric dental care: prevention and management protocols based on caries risk assessment. *J Calif Dent Assoc.* 2010;38(10):746–761; American Academy of Pediatrics Section on Pediatric Dentistry and Oral Health. Preventive oral health intervention for pediatricians. *Pediatrics.* 2003; 122(6):1387–1394; and American Academy of Pediatrics Section of Pediatric Dentistry. Oral health risk assessment timing and establishment of the dental home. *Pediatrics.* 2003;111(5):1113–1116.

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Bright Futures™
prevention and health promotion for infants, children, adolescents, and their families™

Children's Oral Health
An initiative of the American Academy of Pediatrics

WR-B Pediatric Dentistry: Mission Statement & Treatment Policy

Mission Statement

Support the General Practice Residency and OMFS department both clinically and academically. To provide coordinated care and management of medically compromised patients within WR. To promote optimal oral health through family-centered education and consultation.

Guidelines and policies

Children and adolescents, especially medically compromised pediatric patients, may receive a dental screening appointment. The GPR and OMFS accreditation standards require specific pediatric dentistry encounters. Our screening process is guided by these requirements. Thus, based upon clinical findings, the child may be selected as a teaching case for residents. However, if space is available the child may also be seen by staff. If access to care is over 4 weeks, the patient will be directed to seek dental care for their child with a civilian pediatric dentist, as mandated by the TRICARE Dental Program.

Upon completion of the child's treatment plan, the patient may continue routine dental care for up to one year. Following this, the patient must establish a dental home for all further care (periodic exams, cleanings, treatment, and emergencies) with a civilian dentist.

Parents are encouraged to initiate their child's first dental visit no later than their first birthday. Proper oral hygiene, identification of risk factors, nutritional counseling, and anticipatory guidance can be discussed.

Patient referrals (for hospital providers)

The Staff Pediatric Dentist in the Department of Hospital Dentistry provides consultative and treatment services to various departments within the hospital. Patients referred to our department will receive treatment at this facility if certain screening requirements are met. Preference is given to the following patients:

1.) Children with multidisciplinary, special healthcare needs
2.) Otherwise healthy children with acute and extensive dental needs
3.) Children between 6mo and 3 years old
4.) Littlest Warriors
5.) Dependents of foreign military members

Referrals can be made through CHCS, code: CAAA (Hospital Dentistry) select PEDS DEN.
Ensure you have provided accurate contact information of the referring patient and provider.
***** If this is an urgent matter, the referring provider can contact the front desk directly at **301-400-2060** to arrange an appointment for the child. Inpatient hospital consultations can be made by calling the front desk during normal working hours between 0730-1600. After hours consultations are made through the on-call dental pager **866-295-4913, pin# 1209395**.

Tricare Dental Program

Healthy, developmentally normal children ≥3 years are encouraged to seek a dental home with a civilian provider of their choosing. Children 6mo-3 years may be seen by a provider at WR-B, as above. Tricare contracts with United Concordia for dental care for active-duty dependents. Direct parents to **http://www.tricare.mil/dental**. Click on links for "Tricare Dental Program" and "Participating Network Dentists" to get to the MetLife website. Here, parents can search for a pediatric provider in their zip-code. (www.tricare.mil/CoveredServices/Dental/FindDentist.aspx)

Dental Health I Quiz

1. The AAP, ADA, and AAPD recommend that infants be scheduled for an initial dental visit within **6** months of the eruption of the first primary tooth OR no later than **12** months of age.

2. Federal Fluoridation guidelines established in 1962 state that community drinking water should contain **0.7** to **1.2** ppm fluoride.

3. Please complete the following chart for fluoride supplementation:
Hint: Review MMWR Link (Table 1) or Harriet Lane

Fluoride Concentration in Community Drinking Water

Age	**<0.3 ppm***	**0.3-0.6 ppm**	**>0.6 ppm**
0-6 months	NONE	NONE	NONE
6 months-3 years	0.25 mg/day	NONE	NONE
3-6 years	0.5 mg/day	0.25mg/day	NONE
6-16 years	1 mg/day	0.5 mg/day	NONE

*1 parts per million (ppm) = 1mg/L

4. With whom does Tricare contract for insurance care? Were you able to find a provider on their website? United Concordia—*Encourage residents to try the website themselves!*

5. Risk factors for a child developing even mild fluorosis include which of the following?

a. The child gets frequent fluoride varnish applications from both their dentist and at well child visits from their pediatrician.
b. The child uses large amounts of fluorinated toothpaste when brushing teeth.
c. The child was prescribed an oral fluoride supplement from their pediatrician because they only drink a "little" fluorinated water.
d. **Both b and c**

6. Fluorosis is uncommon in the US, but still occurs. Children less than 8 yo are the most at risk. There is almost no risk of fluorosis from fluoride varnish, because it is a topical treatment. Swallowing large amounts of fluorinated toothpaste *does* put children at risk. When considering a systemic fluoride supplement it is very important to consider ALL sources of fluoride the child is getting (such as the water at school or daycare, etc).

6. Topical Fluoride helps prevent dental caries by inhibiting tooth demineralization and enhancing tooth remineralization. It also inhibits bacterial metabolism.

Dental Health I Cases

Case 1

You are seeing siblings in clinic for well checks. Mom is concerned because her 12 month old doesn't have any teeth. She asks you, "How many teeth should she have?" Since she doesn't have any teeth, mom asks if she still needs to be doing any kind of dental hygiene.

Mom doesn't have any specific concerns about her healthy 2.5 year old. However, you notice that she has a pacifier in her mouth. Mom tried to schedule an initial visit with her own dentist, but was told that their clinic didn't see kids "less than age 3 years." When asked about teeth brushing, mom laughs and states "Ha! She won't let me brush her teeth. She has to do it herself and just chews on the brush."

What other historical questions would you ask regarding the girls' dental health?
See AAP Risk Assessment Tool

For the 12 month old:

- Prematurity? Any other significant medical issues? Infants born prematurely may have tooth eruption at a delayed chronologic age compared to term infants (however, eruption occurs at the same post-conceptual age).
- Feeding habits? (Bottle or breast, feeding throughout the night? Sippy cup introduction?)
- Diet?
- Any oral care?
- Fluoride exposure?

For the 2.5 year old:

- Feeding/Diet habits? (Sippy/straw cup or regular? What is she drinking? Sugary food intake?)
- Oral care? Is mom using toothpaste?
- Fluoride exposure?

Mom's oral health status?

- *Streptococcus mutans* is strongly associated with dental caries→adheres to enamel by creating plaque and produces an acidic environment in which it can thrive. Plaque concentrates dietary sugar which *S. mutans* can ferment, creating lactic acid. This decreases local pH and causes demineralization of enamel.
- Maternal oral flora is very closely associated with infant oral flora. **Primary prevention** (optimizing maternal oral health; avoiding sharing utensils, cleaning pacifiers in mom's mouth, etc) can decrease or delay infant colonization with aciduric oral flora.

Mom mentions that the family lives in the District, and that she would "never let [her] children drink the tap water." She tells you that the family "only drinks Evian."

What guidance would you provide for the 2.5 year-old child? For the 12 month-old?

- Start routine oral care on the 12 month old, and schedule initial dental visits for both kids.
- No bottles in bed. If still frequently nursing, attempt to clean gums after each feed. Limit sugary food/juice intake.

- Discuss **fluoride supplementation** recommendations:
  - Switch to tap water, or if mom insists on bottled water, fluoridated nursery water.
  - Would you start fluoride liquid/tabs on these girls if mom still insists on Evian? (This is controversial in <6yo population. Some advocate only if high-risk).
  - Would you recommend fluoride toothpaste for both kids? (This is controversial: Some advocate not until kids can spit it out; some start with a smear right away).
  - Risk vs. benefit: Balance caries prevention with **fluorosis** (hypomineralization that results in a range of visually detectable enamel opacities). Risk is limited to kids <8yrs, as enamel is not susceptible after pre-eruptive maturation is complete.

Mom understands your guidance but wonders where she can find a pediatric dentist.
What do you tell her?
Children between 6mo-3yrs can be seen by WR-B Dentistry. Providers should place a referral for Peds Dentistry in CHCS. Keep in mind that, however, that space is limited in the dental clinic and preference is for "teaching cases" for the Dental Residents. Children > 3 years, as well as toddlers, may be referred to the Tricare Dental Program, operated through United Concordia. The Tricare Dental Program is a *voluntary, low-cost premium-based insurance plan*: monthly premium rates are based on the sponsor's military status and type of enrollment (i.e. single- vs. family-enrollment). Parents can go to the United Concordia website and find a provider in their zip code.

Mom notes during the interview that the 2.5 year old "really likes juice". Although she reassures you that it's "100% juice", she is unsure about how much juice is healthy for her daughter.
What would you recommend? No more than 4-6 oz per day. Review the role of sugary foods in the pathogenesis of dental caries

Case 2
Note: Dental Health II Module will discuss Special Needs Dental Care in greater detail

You are seeing one of your complex continuity clinic patients today for a routine health physical. He is a 5 year old male with a history of Cerebral Palsy, ADHD and congenital heart disease. His diet consists mainly of Pediasure via a sippy cup. His medications include Ritalin for his ADHD, Robinal for drooling, and Botox injections every 8 weeks for contractures. As part of your exam you note that he has white lines on his front incisors near the gingival margin.

When asking about dental visits, mother has not been able to find a dental provider "out in town" willing to see him for routine visits because of his medical history. She does try to brush his teeth with "baby toothpaste" at least once a day. His mother is so happy with the excellent care you have provided during the visit, she gives you a big smile on the way out, and you note she multiple dental fillings.

How would you catagorize this patient's risk of early childhood caries? Why?
High Risk- already has evidence of early childhood caries (the white lines on the incisors). This is one of the clinical factors carrying an "absolute high risk": 

What in this patient's history puts him at risk for caries?

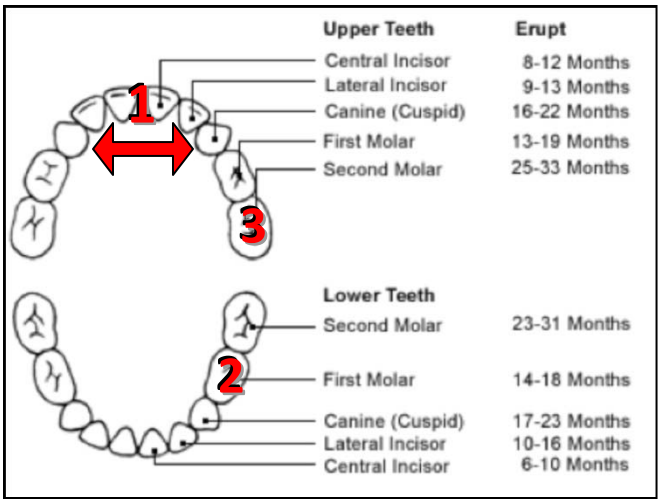
- Pediasure multiple times a day via a sippy cup
- No previous dental care
- Caregiver with caries
- Medications such as stimulants and Robinal that may decrease saliva in the mouth
- Not using fluorinated toothpaste

What are physical exam findings of early childhood caries (ECC)?

White lines near the gingival margin, white spots, brown cavitations.

Typically, ECC affect what teeth and in what order? (Notate on diagram)

Upper incisors (maxillary anterior teeth)→
First molars (mandibular primary molar)→
Second molars (maxillary primary molars)



What can you do for your patient today to help improve his dental health *(which, in turn, will improve his overall health and quality of life)*?

- Provide his mother with anticipatory guidance on the importance of brushing at least twice a day with a small amount of fluorinated tooth; to rinse out mouth with water after giving Pediasure; importance of fluorinated water; weaning from sippy cup (if able).
- Place referral for Peds Dentistry in CHCS.
- Apply fluoride varnish on his teeth in clinic TODAY.

Dental Health I Board Review

1. A 20-month old boy is seen for routine well child care. Physical exam reveals caries involving the maxillary incisors. **Which one of the following is most likely to have contributed to this condition?**

(A) The use of both fluoride drops and fluoride toothpaste simultaneously, which caused fluorosis.
(B) Falling asleep with a water-filled bottle in the mouth
(C) Falling asleep while breastfeeding
(D) Oral colonization with Staphylococcus aureus
(E) Living in an area in which tap water contains <0.2 ppm fluoride

Because of the patient's age and involvement of the maxillary incisors, this patient likely has nursing or bottle caries. Nursing/bottle caries are found in 3-6% of kids and are associated with falling asleep with a bottle or nipple in the mouth. Any liquid other than water can serve as a substrate for infection including breast milk. Streptococcus mutans is the most common bacterial agent. Those who live in areas of low fluoride (<0.3ppm) are at higher risk for caries. Excess fluoride may cause cosmetic abnormalities to enamel, but risk of caries is not increased.

2. A 7-month-old boy who is formula-fed presents to your clinic. The parents ask you how much fluoride should be in the water he drinks. **Which of the following would be your reply?**

(A) None
(B) At least 0.3 ppm
(C) At least 0.6 ppm
(D) At least 1 ppm
(E) At least 2 ppm

Fluoride plays a major role in the prevention of dental caries. The combination of the fluoride ion with tooth enamel increases resistance of the tooth to Streptococcus mutans. Fluoride supplementation is indicated in this age group if the water supply contains less than 0.3 ppm of fluoride. Some household water purification systems filter out fluoride; therefore, a history regarding these systems should be elicited. Fluoride is best administered at bedtime because taking the supplementation with food decreases its absorption.

3. You are seeing a 2-year-old boy for a health supervision visit and note that the child has caries involving the central incisors. The boy still takes a bottle of chocolate milk to bed and will not fall asleep without it. He also drinks 2-3 cups of juice daily. His primary water source is a municipal water system that is not fluoridated and has a measured fluoride concentration that is less than 0.3 ppm. You counsel the mother about healthy diet and bottle use.

Of the following, you are also MOST likely to recommend

(A) Daily oral fluoride supplements of 0.25mg
(B) Daily oral fluoride supplements of 0.5mg
(C) Monthly professional topical fluoride treatments
(D) Regular dental checkup beginning at 3 years of age

The child described in the vignette has early childhood caries (ECC), the most common chronic disease of childhood. More than 40% of children develop caries before they reach kindergarten. Along with consuming a noncariogenic diet and eliminating prolonged carbohydrate exposure (e.g. with use of baby bottles), fluoride supplementation is an effective preventive approach to ECC. Fluoride is administered both topically and systemically. Over the last 2 decades, the number of sources of fluoride exposure for children has increased. This increase in fluoride availability has also increased the prevalence of fluorosis, a primarily cosmetic consideration. Mild degrees of fluorosis may in fact promote oral health. However, consideration of the total fluoride exposure should be undertaken when considering fluoride supplementation.

Systemic fluoride exposure occurs primarily through fluoride supplementation of the public water supply and by administration of oral fluoride in the form of drops or tablets. From a public health perspective, water supply supplementation is the most effective method because it reaches a large population, including those who may not have access to oral health care. It also requires no specific individual action, thereby enhancing compliance. The USPHS recommends public drinking water supplementation to achieve fluoride concentrations of **0.7 to 1.2 ppm**. Between 15-20% of households in the US obtain water from private wells. These wells are not regulated on a federal level and are often minimally regulated at the state level, so the fluoride content of these water sources is frequently unknown. Supplementation of private wells is not recommended. However, water from such wells may cause fluorosis, so periodic fluoride testing is recommended.

For children considered at high risk for caries, such as the child in the vignette, daily oral supplementation is recommended if th the child resides in an area with inadequate public drinking water fluoride concentration. Children considered to be at high risk for dental caries include those whose mothers have significant caries histories and children who have high carbohydrate intake, poor dental hygiene practices, underutilization of dental services, special health care needs, low SES, late birth order, and demonstrated ECC on physical exam.

In addition to systemic supplementation, topical fluoride is an effective preventive strategy (evidence suggests that the primary effects of *all* fluoride supplementation is via direct exposure to the teeth). Professionally applied topical treatments can be provided in either the dental or the medical home and can be applied by ancillary personnel. Treatments (e.g. gels, foams, varnishes) should be applied at least every 6 months; in children who are at high risk of caries, applications should occur every 3 months. In the home, fluoridated toothpaste may be used twice daily. For children younger than 2 years, a "smear" is used, while a pea-sized amount is appropriate for children 2-5 years old. Rinsing after brushing should be kept to a minimum so that the fluoride has longer contact with tooth surfaces. Sodium fluoride mouth rinse (0.05%) may be used daily or weekly by children >6 years.

Dental care should be established within 6 months of tooth eruption or by 12 months of age. The American Academy of Pediatric Dentistry recommends that daily fluoride supplementation be given to children between the ages of 6 months and 16 years if the fluoride concentration in the public water is equal to or less than 0.6 ppm. The appropriate supplementation for the boy in the vignette is 0.25 mg/day.

4. A young mother in your practice presents for the 6-month health supervision visit for her third child whom she is breastfeeding. The older children are 2 and 4 years of age. The 4-year-old child recently required extensive dental extractions and capping of the deciduous teeth. You note that the 2- year-old is carrying a baby bottle of juice in the examination room. The infant you examine has 2 lower incisors.

Of the following, the MOST appropriate advice to give this mother about her children's dental health is to

(A) await eruption of the upper incisors before arranging a dental appointment for the infant
(B) begin brushing the baby's teeth with toothpaste
(C) continue breastfeeding the infant because it may prevent caries
(D) offer juice only from a cup to the 2-year-old child
(E) reassure her that dental caries are not hereditary

Families have become increasingly reliant on their primary care physicians for advice on oral health because of the shortage of pediatric dentists in many communities and an increasing awareness of the impact of dental health on the overall health of both children and adults. Dental disease has been implicated recently in the health of pregnant women and the cardiovascular health of older adults. It has been known for a long time that dental caries in children may affect a healthy diet, self-esteem, and oral comfort. Further, dental caries in early childhood represents a large financial burden due to the cost of tooth extractions, dental examinations, and surgeries under anesthesia. Suppurative complications may include dental abscess, buccal cellulitis, preseptal and orbital cellulitis, and hematogenous seeding resulting in osteomyelitis.

Historically, caries in young children have been attributed largely to feeding practices such as sleeping with or propping a bottle and delayed weaning. However, there is also evidence that other factors, including a family history of dental caries, transmission of *Streptococcus mutans* from mother to infant, and parenting practices, may increase the risk for caries. Socioeconomic barriers to dental care and ethnic and genetic factors also may increase the risk.

For the family in the vignette, the most appropriate advice is to counsel the mother about the risk of giving her children sugary drinks such as juice in a bottle. Breastfeeding has not been shown to be either causative or protective in development of childhood caries. It is not appropriate to advise the mother to brush her infant's teeth with toothpaste, although she should be advised on dental hygiene and proper nutrition. For infants, simply wiping the teeth with a cloth after feeding is satisfactory. Many parents are surprised to learn that dental care begins with the eruption of the first teeth and that pediatric dentists are interested in providing the first dental visit as soon as the first tooth erupts. Some parents equate dental visits with painful procedures and x-rays rather than simple oral evaluation, attention to hygiene, and professional cleaning, which are routine parts of pediatric dental visits.

The pediatrician should make early dental referral a part of anticipatory guidance at infant health supervision visits and should take a family dental history. The American Academy of Pediatrics recommends the first dental visit by age 1 year. Practical guidance for weaning, introduction of the cup at age 6 months, avoidance of sugary beverages and snacks, and cleaning of teeth nonintrusively from an early age is crucial to parent education. In some areas and settings, application of dental fluoride varnish by the pediatrician is available and reimbursed by insurers.

5. A 4-month-old infant comes to your office for a health supervision visit. When you pass through the waiting room, you observe his young mother prop the infant's bottle while he is in his stroller.

Of the following, the MOST appropriate action is to

(A) advise the mother to prop only bottles containing water
(B) discuss the advantages of holding her baby during feedings
(C) explain that the child is too young to have the bottle propped
(D) recommend that the mother obtain a bottle sling
(E) tell the mother that a bottle should not be propped when the infant is falling asleep

Infants should be fed when hungry, warm, and dry, not just when they are fussy in an attempt to quiet them. In addition, the bottle should be held, not propped, regardless of the infant's age. Even the use of a "safe" bottle holder such as a bottle sling should be avoided. Parents should be counseled that holding their baby when feeding enhances physical closeness and a feeling of security for the baby.

Propping a bottle increases the risk of choking and the development of otitis media. Parents also should be advised that their infant should not be put to bed with a bottle of formula or juice, a practice that could lead to dental decay. A parent should not force a baby to eat. If the child stops feeding, the parent should try to burp the baby. If the infant still does not want to feed after burping, he or she has had enough. If the baby prefers the formula to be warmed, the parent should not use the microwave, which might create hot spots that can burn a baby's mouth.

6. During a health supervision visit, you note that an 18-month-old boy has erosions of the medial portions of his maxillary central incisors and brown discoloration of several teeth. He was born at term following an uncomplicated pregnancy and has been well, except for two episodes of otitis media that were successfully treated with amoxicillin. His physical examination findings are otherwise normal.

Of the following, the MOST likely factor contributing to this boy's findings is

(A) amoxicillin exposure
(B) enamel hypoplasia
(C) excessive fluoride exposure
(D) exclusive breastfeeding
(E) maternal oral colonization with Streptococcus mutans

Dental caries has been called the most common chronic disease and the most common infectious disease of childhood. The term early childhood caries (ECC) has replaced older terms such as nursing bottle caries, baby bottle tooth decay, and milk bottle caries. Although its definition varies among authors, ECC generally refers to caries affecting the primary dentition, especially in the first 3 years after birth. It ranges from decay involving a single tooth to widespread caries involving the entire mouth.

Interaction of the tooth, ingested carbohydrates, and oral bacteria comprise the pathophysiology of caries. *Streptococcus mutans* is the predominant organism in the oral flora of children who develop caries and colonizes in the infant's mouth at an early age. Maternal oral flora is generally the source of the infant's oral flora, and dental care for the maternal-infant dyad has been suggested as a component of primary prevention for ECC. These cariogenic bacteria use dietary sugars to form dental plaque, which allows the bacteria to adhere to the teeth. The microbes also ferment ingested carbohydrates to form an acidic environment that causes enamel demineralization and shifts the oral flora further toward acid-tolerant cariogenic bacteria.

The initial appearance of caries is an opaque white area on the tooth. As demineralization progresses, teeth lose structure, progressing to the end stage of the process, development of cavities. Classically, baby bottle caries involved cavities of the central incisors, but all teeth are susceptible to this process.
The incidence of ECC has increased by 15% over the past 2 decades. Between 1999 and 2002, more than 40% of United States children developed caries in their primary teeth. Because the condition develops so early, the first visit to a dental clinician should occur within 6 months of the eruption of the first tooth and not later than 1 year of age. Risk factors for ECC have been recognized, although the best predictor of primary tooth caries is previous caries. Caries are more common in children from low-income households, including those enrolled in the Women, Infants and Children program, Head Start®, and Medicaid. Excessive consumption of sugars, especially sucrose, also increases cavity development.

Although some report that human milk may produce more caries than cow milk formula, exclusive breastfeeding is not a risk factor for early childhood caries. Excessive fluoride exposure during the period of enamel formation leads to discoloration of the teeth, ranging from chalky white enamel (mild) to a pitted, brown appearance (severe), but it does not result in tooth erosion. Grey-brown to yellow discoloration of teeth occurs in children exposed to multiple courses of tetracycline, but such findings have not been associated with amoxicillin use. Enamel hypoplasia is typically found in preterm infants; children experiencing nutritional deficiencies (eg, rickets); or those who have genetic, metabolic, or endocrine disorders. In a well child, enamel hypoplasia would not be expected to contribute to the formation of dental caries.