Screening, Referral, Behavioral Counseling, and Preventive Interventions for Oral Health in Children and Adolescents Aged 5 to 17 Years
A Systematic Review for the US Preventive Services Task Force

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IMPORTANCE Dental caries is common in children and adolescents aged 5 to 17 years and potentially amenable to primary care screening and prevention.

OBJECTIVE To systematically review the evidence on primary care screening and prevention of dental caries in children and adolescents aged 5 to 17 years to inform the US Preventive Services Task Force.

DATA SOURCES MEDLINE, Cochrane Central Register of Controlled Trials, and Cochrane Database of Systematic Reviews (to October 3, 2022); surveillance through July 21, 2023.

STUDY SELECTION Diagnostic accuracy of primary care screening instruments and oral examination; randomized and nonrandomized trials of screening and preventive interventions and systematic reviews of such studies; cohort studies on primary care oral health screening and preventive intervention harms.

DATA EXTRACTION AND SYNTHESIS One investigator abstracted data; a second checked accuracy. Two investigators independently rated study quality. Random-effects meta-analysis was performed for fluoride supplements and xylitol; for other preventive interventions, pooled estimates were used from good-quality systematic reviews.

MAIN OUTCOMES AND MEASURES Dental caries, morbidity, functional status, quality of life, harms; diagnostic test accuracy.

RESULTS Three systematic reviews (total 20,684 participants) and 19 randomized clinical trials, 3 nonrandomized trials, and 1 observational study (total 15,026 participants) were included. No study compared screening vs no screening. When administered by dental professionals or in school settings, fluoride supplements compared with placebo or no intervention were associated with decreased change from baseline in the number of decayed, missing, or filled permanent teeth (DMFT index) or decayed or filled permanent teeth (DFT index) (mean difference, −0.73 [95% CI, −1.30 to −0.19]) at 1.5 to 3 years (6 trials; n = 1395). Fluoride gels were associated with a DMFT- or DFT-prevented fraction of 0.18 (95% CI, 0.09-0.27) at outcomes closest to 3 years (4 trials; n = 1525), fluoride varnish was associated with a DMFT- or DFT-prevented fraction of 0.44 (95% CI, 0.11-0.76) at 1 to 4.5 years (5 trials; n = 3902), and resin-based sealants were associated with decreased risk of carious first molars (odds ratio, 0.21 [95% CI, 0.16-0.28]) at 48 to 54 months (4 trials; n = 440). No trial evaluated primary care counseling or dental referral. Evidence on screening accuracy, silver diamine fluoride, xylitol, and harms was very limited, although serious harms were not reported.

CONCLUSIONS AND RELEVANCE Administration of fluoride supplements, fluoride gels, varnish, and sealants in dental or school settings improved caries outcomes. Research is needed on the effectiveness of oral health preventive interventions in primary care settings and to determine the benefits and harms of screening.
O
ral health issues, most commonly due to dental caries, are common in children and adolescents and are often untreated.1 Dental caries can lead to pain, disability, and decreased well-being.2,5 Gaps exist in the provision of oral health services in school-aged children6 and include disparities related to race and ethnicity, socioeconomic status, and other factors.1,7 In school-aged children and adolescents, oral health screening and preventive interventions could potentially be provided in primary care settings and reduce associated negative health consequences and disparities. This evidence report was conducted to inform the US Preventive Services Task Force (USPSTF) for a new recommendation on primary care screening, dental referral, behavioral counseling, and preventive interventions for oral health in children and adolescents aged 5 to 17 years. This report does not address school- or community-based oral health interventions,8 which are outside the USPSTF’s scope. A complementary evidence report was conducted for the USPSTF on oral health screening and prevention in adults9; the USPSTF addressed oral cancer screening separately10 and previously addressed screening and prevention of dental caries in children younger than 5 years.11,12

Methods

Scope of the Review
Detailed methods and evidence tables with additional study details are available in the full evidence report.13 Figure 1 and Figure 2 show the analytic frameworks and key questions (KQs) that guided the review. Separate analytic frameworks were used to distinguish treatment of children and adolescents with existing dental caries or periodontal disease (screening) from treatment of those without. Results from 2 fair-quality trials of xylitol15,16; results of 8 poor-quality trials are described in the full report.13 Detailed methods and evidence tables with additional study details are available in the full evidence report.13 Figure 1 and Figure 2 show the analytic frameworks and key questions (KQs) that guided the review. Separate analytic frameworks were used to distinguish treatment of children and adolescents with existing dental caries or periodontal disease (screening) from treatment of those without those conditions (preventive interventions). The full report includes findings for contextual questions (not systematically reviewed) on the association between dental caries and long-term health outcomes, oral health disparities, and primary care interventions to reduce disparities. In addition, this article focuses on results from 2 fair-quality trials of xylitol15,16; results of 8 poor-quality xylitol trials are described in the full report.13

Search Strategies
A research librarian searched MEDLINE, the Cochrane Central Register of Controlled Trials, and the Cochrane Database of Systematic Reviews from inception to October 3, 2022 (eMethods 1 in the Supplement). Searches were supplemented by reference list review of relevant articles. Since October 3, 2022, ongoing surveillance was conducted through article alerts and targeted searches of journals to identify major studies published in the interim that could affect the conclusions or understanding of the evidence and the related USPSTF recommendation. The last surveillance was conducted on July 21, 2023, and identified no eligible randomized trials.

Study Selection
Two investigators independently reviewed titles, abstracts, and full-text articles using predefined eligibility criteria (eMethods 2 in the Supplement). The population was asymptomatic children and adolescents aged 5 to 17 years who were not selected on the basis of having existing dental caries. Screening and diagnostic accuracy studies conducted in primary care settings of oral health examination or risk assessment instruments were eligible. Studies of risk instruments not administered in primary care settings were also eligible if they were relevant to primary care (ie, did not involve a dental professional examination or specialty tests). Eligible preventive interventions were primary care oral health behavioral counseling, referral to a dental professional, and preventive medications potentially feasible for primary care administration (not requiring extensive dental training): topical fluoride (varnish, foam, or gel), silver diamine fluoride (SDF) topical solution, dental sealants, and xylitol. Comparisons were against placebo or no intervention.

The most commonly reported outcome was dental caries (incidence or caries burden, often measured as the number of decayed, missing, or filled permanent teeth [DMFT index] or surfaces [DMFS index]; decayed or filled teeth [DFT] or surfaces [DFS] were also used in children because missing permanent teeth were less common and might not be due to caries). Other outcomes included periodontal disease presence and severity, morbidity, quality of life, functional status, and harms. Randomized or nonrandomized trials and diagnostic accuracy studies were eligible; cohort studies were also eligible for screening and preventive intervention harms.

Data Abstraction and Quality Rating
One investigator abstracted details about the study design, patient population, setting, interventions or screening instruments, analysis, follow-up, and results from each study. A second investigator reviewed abstracted data for accuracy. Two independent investigators assessed the quality of each study as good, fair, or poor using predefined criteria developed by the USPSTF (eMethods 3 in the Supplement). Discrepancies were resolved by consensus. In accordance with the USPSTF Procedure Manual,14 studies rated poor quality were included only if higher-quality evidence was unavailable.

Data Synthesis
For all KQs, the overall quality of evidence was rated as “good,” “fair,” or “poor” based on study limitations, consistency, precision, reporting bias, and applicability, using the approach described in the USPSTF Procedure Manual.14

Meta-analyses of oral health preventive interventions from high-quality systematic reviews were reported when available. Systematic reviews measured caries burden based on the prevented fraction (caries index in control group minus intervention group, divided by the control group caries index) or (for sealants) likelihood of first carious molars. For fluoride supplements, which lacked high-quality systematic reviews, profile likelihood model random-effects meta-analysis using Stata/SE version 16.1 (StataCorp) was performed to summarize effects on caries burden, based on the difference in DMFT or DFT increment (ie, difference in change from baseline to follow-up between treatment vs placebo or no treatment in the DMFT or DFT index; see eMethods 4 in the Supplement for detailed meta-analytic methods). Analyses were conducted stratifying on relevant factors, including placebo or no treatment control; school or home setting; follow-up less than 3 years or 3 years or more; Europe or Canada vs other geographic region; high or low baseline caries burden; age 10 years or older or younger than 10 years; and study quality. All significance testing was 2-tailed; P values of .05 or less were considered statistically significant. Assessment for
small study effects was not performed because the meta-analyses had fewer than 10 studies.17

Results

Across all KQs, 3 systematic reviews18-20 (total of 20,684 participants) of 54 unique trials (53 publications)21-73 and 23 additional studies (in 27 publications15,16,74-98; total of 15,026 participants) were included (Figure 3). One study assessed diagnostic accuracy of screening74; the systematic reviews18-20 and other 22 studies (19 randomized clinical trials15,16,75-91 and 3 nonrandomized trials92-94) addressed preventive interventions.

Screening

Key Question 1. How effective is screening for oral health performed by a primary care clinician in preventing negative oral health outcomes?

No study addressed this KQ.

Key Question 2a. How accurate is screening for oral health performed by a primary care clinician in identifying children and adolescents who

a. Have oral health issues?

b. Are at increased risk of future oral health issues?

Key Question 3. What are the harms of screening for oral health performed by a primary care clinician?

No study addressed this KQ.

Prevention

Key Question 1. How accurate is screening performed by a primary care clinician in identifying children and adolescents who are at increased risk of future oral health issues?

No study addressed this KQ.

Key Question 2. How effective is oral health behavioral counseling provided by a primary care clinician in preventing oral health issues?

No study addressed this KQ.

Key Question 3. How effective is referral by a primary care clinician to a dental health care provider in preventing oral health issues?

No study addressed this KQ.

Key Question 4. How effective are preventive interventions in preventing oral health issues?

Fluoride Supplements

Seven fair-quality trials (reported in 8 publications; n = 3382) evaluated fluoride supplements vs placebo or no supplement in children 5 years or older in settings with low socioeconomic status, non-fluoridated water, or high caries burden (eTables 3 and 4 in the Supplement).75-81,95 Trials were conducted in the US (3 studies),
Fluoride Gel

A good-quality systematic review\(^\text{18}\) (searches through November 2014) included 26 randomized or quasirandomized trials (in 25 publications)\(^{21-45}\) of fluoride gels vs placebo or no treatment in children 5 years or older (n = 8619) (eTables 6 and 7 in the Supplement). Baseline age and caries burden varied, and reporting of fluoride exposure, socioeconomic status, and provision of oral health education was suboptimal. Twelve trials were conducted in the US, 6 trials in Europe, 4 in Brazil, and 1 each in Canada, Israel, China, and Venezuela. Five trials were published from 1990 to 2005; the other trials were published between 1967 and 1988.

Fluoride gel was most commonly administered as acidulated phosphate fluoride (12 300 ppm F). Gels were applied in dental clinics or schools using a tray (19 trials), brush (6 trials), or floss (1 trial). In 15 trials, gels were applied by a dental professional (1-4 times per year) and in 11 trials, gels were self-applied (mostly 5 times per year) with dental hygiene or other adult supervision. Only 1 trial was assessed as low risk of bias.\(^{44}\) Methodological limitations in the other trials included use of a quasirandomized design (7 trials),\(^{21,22,29,31-33,38}\) unclear randomization or allocation concealment methods (19 trials), open-label design (10 trials), and high attrition (14 trials).

The systematic review found fluoride gels associated with reduced caries burden compared with no intervention or control based on a DMFT/DFT-prevented fraction of 0.32 (95% CI, 0.19-0.46) at outcomes closest to 3 years (10 trials; n = 3198). There was marked statistical heterogeneity (\(I^2 = 91\%\)), with estimates that varied by...
### Figure 3. Literature Search Flow Diagram: Screening and Interventions to Prevent Oral Health Issues in Children and Adolescents Aged 5 to 17 Years

<table>
<thead>
<tr>
<th>Abstracts of potentially relevant articles identified</th>
<th>Excluded</th>
</tr>
</thead>
<tbody>
<tr>
<td>8677 MEDLINE, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews</td>
<td>8146 Abstracts and background articles excluded</td>
</tr>
<tr>
<td>8530 Hand search of reference lists (58 as background)</td>
<td>531 Full-text articles reviewed for KQs</td>
</tr>
</tbody>
</table>

- **Excluded**:
  - 127 Ineligible intervention
  - 60 Ineligible study design
  - 56 Ineligible population
  - 54 Publication used as source document to identify studies
  - 40 Ineligible outcome
  - 42 Ineligible comparison
  - 31 Not a study
  - 10 Study not in English
  - 9 Ineligible setting
  - 7 Ineligible criteria for systematic reviews
  - 4 Poor quality
  - 3 Ineligible screener
  - 2 Abstract only
  - 2 Ineligible country
  - 1 Results not usable

- **Studies included**:
  - 27 Articles (23 studies) plus 3 systematic reviews included

#### Screening

- 0 Studies included for KQ1 (screening effectiveness)
- 1 Study included for KQ2a (diagnostic accuracy, existing issues)
- 0 Studies included for KQ2b (diagnostic accuracy, at risk)
- 0 Studies included for KQ3 (harms of screening)

#### Preventive interventions

- 0 Studies included for KQ1 (diagnostic accuracy, at risk (same as screening KQ2b))
- 0 Studies included for KQ2 (behavioral counseling)
- 0 Studies included for KQ3 (referral)
- 22 Trials plus 3 systematic reviews included for KQ4 (preventive interventions)
  - Fluoride gel: 1 systematic review (26 trials) + 1 subsequent trial
  - Fluoride varnish: 1 systematic review (14 trials) + 1 subsequent trial
  - Sealants: 1 systematic review (16 trials) + 2 subsequent trials + 1 additional publication
  - SDF: 1 trial
  - Xylitol: 10 trials

- 13 Trials included for KQ5 (harms of preventive interventions)
  - 6 Fluoride varnish
  - 3 Sealants
  - 2 Fluoride gel
  - 1 SDF
  - 1 Supplementation
  - 1 Xylitol

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The sum of the number of studies per key question (KQ) exceeds the total number of studies because some studies were applicable to multiple KQs or systematic reviews. SDF indicates silver diamine fluoride.

- Fifty-four trials included in the systematic reviews (in 53 publications).
control type (placebo control–prevented fraction, 0.18 [95% CI, 0.09-0.27]; $I^2 = 6%$; 4 trials; $n = 1525$; no treatment control–prevented fraction, 0.43 [95% CI, 0.29-0.57]; $I^2 = 90%$; 6 trials; $n = 1673$). The systematic review found no statistically significant interactions between baseline caries level, exposure to fluoride, application method, application frequency, gel concentration, or follow-up duration and effects of gels. A supplemental analysis of data reported in the systematic review found similar estimates when children were stratified by baseline age younger than 10 years or 10 years or older (eFigure 3 in the Supplement). One subsequent good-quality trial$^{72}$ ($n = 986$) reported results consistent with the systematic review (eTables 8 and 9 in the Supplement).

Fluoride Varnish

A good-quality systematic review$^{39}$ (searches through May 2013) included 14 trials$^{46-59}$ of fluoride varnish vs placebo or no varnish in children 5 years or older ($n = 6965$) (eTables 10 and 11 in the Supplement). Baseline age, caries burden, and fluoride exposure varied. Eight trials were conducted in Europe, 2 trials each in Brazil and India, and 1 trial each in Canada and China. Four trials were published prior to 1990, 3 between 1990 and 1997, and 7 between 2005 and 2012. Fluoride varnish was most commonly administered as 5% sodium fluoride varnish (22 600 ppm) every 6 months. In all trials, varnish was applied by dental professionals in schools or local clinics. Ten trials were open-label or did not provide information on blinding, and 8 trials did not adequately randomize participants or had unclear randomization methods. Other methodological limitations included inadequate allocation concealment methods (79% of trials) and between-group baseline differences (21% of trials).

The systematic review found fluoride varnish associated with a DMFS/DFS-prevented fraction of 0.43 (95% CI, 0.30-0.57) at 1 to 4.5 years (14 trials; $n = 3419$), although statistical heterogeneity was present ($I^2 = 75%$). There were no statistically significant interactions between baseline caries severity, background fluoride exposure, varnish concentration, follow-up duration, application frequency, time since permanent teeth eruption, or control type and effects of varnish. Findings were similar when using the DMFT/DFT-prevented fraction (0.44 [95% CI, 0.31-0.76]; $I^2 = 86%$), which was reported in 5 trials ($n = 3902$). One subsequent fair-quality cluster randomized trial$^{83}$ of 6- and 7-year-old children in rural China ($n = 5397$) reported results consistent with the systematic review (eTables 12 and 13 in the Supplement).$^{83}$

Sealants

One good-quality systematic review$^{20}$ (searches through August 2016) included 16 trials$^{54,58,60-73}$ of a sealant vs no sealant (eTables 14 and 15 in the Supplement). Fifteen trials ($n = 4195$) evaluated a resin-based sealant, and 3 trials ($n = 905$ participants) evaluated a glass ionomer sealant (2 trials evaluated both types$^{66,72}$). Children were aged 6 to 10 years at baseline in all trials but 1 (12-13 years).$^{72}$ Baseline caries burden varied, and reporting of socioeconomic status and water fluoridation levels was suboptimal. Four trials were conducted in the US or Canada, 3 trials in China, 4 trials in Europe, and 1 trial each in Brazil, Colombia, New Zealand, and Thailand. Five trials were published between 2011 and 2014, 1 trial in 2005, and 10 trials between 1976 and 1995. In all trials, sealants were applied to occlusal surfaces of permanent premolar or molar teeth by dental professionals, except for 1 trial$^{72}$ in which sealants were administered by dentists or schoolteachers with 3 days of training. The trials were unable to effectively mask outcome assessors because sealant materials are visible; other methodological limitations included unclear or inadequate randomization (33% of trials), unclear allocation concealment methods (37% of trials), and high or unclear attrition (at 48-54 months; 60% of trials).

The systematic review found resin-based sealants associated with decreased risk of caries in the primary dentition. Among children aged 5 to 10 years (7 trials; $n = 1322$; odds ratio [OR], 0.12 [95% CI, 0.08-0.19]; $I^2 = 72%$). Although statistical heterogeneity was present, estimates favored sealants in all trials (ORs ranged from 0.06 to 0.32). Based on the pooled estimate, the absolute risk difference ranged from 11% to 51%. Findings were similar at 36 months (7 trials; $n = 1410$; OR, 0.17 [95% CI, 0.11-0.27]; $I^2 = 90%$) and at 48 to 54 months (4 trials; $n = 440$; OR, 0.21 [95% CI, 0.16-0.28]; $I^2 = 45%$); 1 trial ($n = 120$) reported decreased risk at longer-term follow-up (OR at 9 years, 0.35 [95% CI, 0.22-0.55]).$^{61}$ One trial ($n = 671$) found resin-based sealants compared with no treatment associated with slightly decreased change from baseline in DMFS index among older (12-13 years) children (mean difference, −0.24 [95% CI, −0.36 to −0.12]).$^{72}$ Too few trials reported community water fluoridation levels to determine interaction with sealant effectiveness.

The systematic review found limited evidence on the effectiveness of glass ionomer sealants vs placebo, based on 2 trials with inconsistent findings (1 trial reported no benefit.$^{66,72}$) In 1 of the trials, outcomes were very similar when sealants were administered by a dentist or a schoolteacher. Two subsequent, fair-quality trials$^{54,85}$ ($n = 187$ and $n = 50$) also reported inconsistent findings for glass ionomer sealants vs no sealants (eTables 16 and 17 in the Supplement).

Silver Diamine Fluoride

One fair-quality trial ($n = 452$) evaluated SDF solution applied to primary canines and molars and occlusal surfaces of first permanent molars every 6 months vs no SDF for prevention of caries in 6-year-old schoolchildren in a setting with low community fluoridation (0.09 ppm F) and with high caries burden (mean DMFS, 3.6) in Cuba (eTables 18 and 19 in the Supplement).$^{86}$ The trial report did not describe how persons who administer SDF were trained. At 36 months, SDF use was associated with fewer new active (decayed or filled) deciduous caries surfaces (mean, 0.3 vs 1.4; $P < .001$), fewer active first permanent molar surfaces (mean, 0.4 vs 1.1; $P < .001$), and decreased likelihood of experiencing at least 1 new decayed or filled tooth (26.1% vs 49.7%; relative risk, 0.52 [95% CI, 0.40-0.70]).

Xylitol

Two fair-quality cluster-randomized trials$^{15,16}$ ($n = 432$ and $n = 496$) evaluated xylitol vs no xylitol in children 5 years or older (eTables 20 and 21 in the Supplement). Xylitol was administered in supervised school settings; in 1 trial, parents also administered xylitol when children were at home.$^{16}$ One trial was open-label$^{15}$; neither trial adjusted for clustering, and both trials had unclear randomization methods.

One trial$^{15}$ enrolled 10-year-old children ($n = 496$) in Finland in an area with natural water fluoridation and low baseline caries burden. It found xylitol lozenges for 1 or 2 years associated with similar
effects on caries burden at 4 years vs no xylitol based on the DMFS
(DMFS with caries lesions extending into the dentin) increment
(mean, 3.02 for xylitol for 2 years vs 2.74 for no xylitol; \( P > 0.05 \)) or
likelihood of DMFS greater than 0 (vs placebo; adjusted OR, 1.01
[95% CI, 0.40–2.56]), although estimates were imprecise. Another
cluster-randomized trial \((n = 432)^{16} \) evaluated children (mean age, 11.6
years) with high baseline caries burden (mean DMFS, 13.2-15.3) in
a nonfluoridated setting in Lithuania. The trial found no difference
between 5-times-daily use of xylitol gum vs placebo (nonxyli-
tol gum in DMFS increment [all stages] at 3 years; mean, 8.1 vs 8.3;
\( P > 0.5 \)). However, xylitol gum was associated with decreased DMFS
increment vs no gum (mean, 8.1 vs 12.4; \( P < .05 \)). Xylitol and pla-
cebo gum were also associated with similar likelihood of experienc-
ing a DMFS increment of 14 or greater.

Key Question 5. What are the harms of specific interventions (be-
behavioral counseling, referral, and preventive interventions) to pre-
vent oral health issues?

Evidence on harms of oral health preventive interventions was very
limited. One trial of fluoride supplements \((n = 349)\) reported
no adverse events.\(^79\) None of 26 trials of fluoride gels included in a
good-quality systematic review\(^86\) reported on tooth surface stain-
ing. Two trials in the systematic review reported on acute toxicity
(nausea, gagging, or vomiting), with 1 trial reporting no events and
and a pooled analysis finding no difference between gel vs placebo or
(n = 1704) reported no adverse events, and 1 trial\(^55\) (n = 2967) re-
ported results that varied depending on the control type (large
benefit vs no gum but no benefit vs placebo gum\(^66\)).

Evidence on the effectiveness of interventions administered in
the home or primary care setting was lacking because few trials of
limited quality were available. There were no eligible trials of pri-
care counseling or referral to a dental professional. Trials of pre-
ventive interventions did not evaluate health outcomes (eg, qual-
ity of life or function), and factors that could potentially affect the
effectiveness of oral health preventive interventions—such as wa-
ter fluoridation levels, provision of oral health education, and oral
health behaviors—were not consistently reported.

The harms of preventive interventions were sparsely reported,
although serious harms were not described. As reported in trials of
SDF for arresting caries,\(^86\) the single trial\(^56\) of SDF for prevention
reported increased risk of black staining of inactive caries lesions.
No study evaluated the association between exposure to fluoride
via oral health preventive interventions in children older than
5 years and adolescents and risk of fluorosis. Studies of fluorosis
risk have focused on younger children, who are at increased risk
due to being at earlier stages of enamel and neurocognitive
development.\(^11,12\)

Limitations
This review had several limitations. First, non–English-language ar-
ticles were excluded. However, non–English-language articles likely
to affect conclusions were not identified. Second, the review did not
search for studies published only as abstracts and did not formally
assess for publication bias with graphical or statistical methods for
small sample effects when conducting meta-analysis, due to small
numbers of studies with serious methodological limitations.\(^17\) Third,
previously published systematic reviews were used, rather than re-
lying exclusively on primary studies. However, the systematic re-
views were assessed as good-quality, and review findings were
supplemented with subsequently published primary studies.\(^100\)
Fourth, the review did not evaluate the effectiveness of tooth brush-
ing or flossing, as these are routinely recommended and per-
formed outside the primary care setting. Rather, the review ad-
dressed the effectiveness of oral health counseling, which includes
counseling on tooth brushing, flossing, and diet. Fifth, meta-
analyses had substantial statistical heterogeneity. To address sta-
tistical heterogeneity, random-effects models were used and strati-
fied analyses on study-level factors were examined for potential
sources. Sixth, poor-quality trials of xylitol were included, due to few
higher-quality studies. However, xylitol conclusions were based on
fair-quality trials. Seventh, few trials of preventive interventions have
Table. Summary of Evidence: Oral Health Screening and Preventive Interventions in Children and Adolescents Aged 5 to 17 Years

<table>
<thead>
<tr>
<th>Objective/intervention</th>
<th>No. of studies; study design (No. of participants)</th>
<th>Summary of findings by outcome</th>
<th>Consistency/precision; reporting bias</th>
<th>Overall quality</th>
<th>Body of evidence limitations</th>
<th>Strength of evidence</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Screening KQ1: Screening effectiveness</strong></td>
<td>No studies</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Screening KQ2: Screening accuracy</strong></td>
<td>A. 1 Cross-sectional study (n = 305)</td>
<td>Visual screen by registered nurse: sensitivity, 0.92 (95% CI, 0.84–0.97) and specificity, 0.993 (95% CI, 0.96–0.9998) for untreated caries</td>
<td>Unable to assess consistency (1 study)</td>
<td>Fair</td>
<td>Single study with methodological limitations; results unvalidated</td>
<td>Low</td>
<td>Nurses received 5 h of training; questionnaire based on report by children's parents or guardians; study conducted in rural setting with high prevalence of untreated caries (35%)</td>
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<td></td>
<td>B. No studies</td>
<td>17-Item questionnaire: sensitivity, 0.69 (95% CI, 0.60–0.77) and specificity, 0.88 (95% CI, 0.83–0.93) for untreated caries</td>
<td>Reasonably precise Reporting bias not detected</td>
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<tr>
<td><strong>Screening KQ3: Screening harms</strong></td>
<td>No studies</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>*<em>Prevention KQ1: Screening accuracy (identification of persons at risk for future caries)</em></td>
<td>No studies</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td><strong>Prevention KQ2: Behavioral counseling</strong></td>
<td>No studies</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td><strong>Prevention KQ3: Referral</strong></td>
<td>No studies</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td><strong>Prevention KQ4: Preventive interventions</strong></td>
<td>Supplements</td>
<td>7 Trials (n = 3382)</td>
<td>Fluoride supplements were associated with decreased DMFT/DFT increment at 1.5 y to 3 y (mean difference, −0.73 [95% CI, −1.30 to −0.19]; 6 trials) when administered in schools under supervision; however, the only trial in which fluoride supplements were administered at home reported low adherence and no benefit (mean difference, 0.13 [95% CI, −0.38 to 0.64])</td>
<td>Serious inconsistency Reporting bias not suspected</td>
<td>Fair</td>
<td>All trials had methodological limitations; substantial statistical heterogeneity</td>
<td>Low</td>
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<td></td>
<td>Fluoride gel</td>
<td>1 Systematic review (26 trials [n=8619]) and 1 subsequent RCT (n=986)</td>
<td>Systematic review found fluoride gels associated a DMFT/DFT-prevented fraction at outcomes closest to 3 y of 0.32 (95% CI, 0.19–0.46; I² = 91% [10 trials; n = 3198]); based on 4 placebo-controlled trials (n = 1525), the prevented fraction was 0.18 (95% CI, 0.09–0.27; I² = 6%)</td>
<td>Consistent (based on placebo-controlled trials) No imprecision Reporting bias not suspected</td>
<td>Fair</td>
<td>Most trials had methodological limitations; statistical heterogeneity when all (placebo-controlled and non-placebo-controlled) trials pooled; few placebo-controlled trials</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Objective/intervention</th>
<th>No. of studies; study design (No. of participants)</th>
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<th>Consistency/precision; reporting bias</th>
<th>Overall quality</th>
<th>Body of evidence limitations</th>
<th>Strength of evidence</th>
<th>Applicability</th>
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<tr>
<td><strong>Fluoride varnish</strong></td>
<td>1 Systematic review (14 trials [n = 6965]) and 1 subsequent RCT (n = 5397)</td>
<td>Systematic review found fluoride varnish associated with a DMFS/DFS-prevented fraction of 0.45 (95% CI, 0.30-0.57; 14 trials), a DMFT/DFT-prevented fraction of 0.44 (95% CI, 0.11-0.76; 5 trials); and a reduced risk of developing ≥1 cavies (RR, 0.75 [95% CI, 0.53-1.05]; I² = 89.2%; 5 trials)</td>
<td>Some inconsistency present; No imprecision; Reporting bias not suspected</td>
<td>Fair</td>
<td>Most trials had methodological limitations; statistical heterogeneity present</td>
<td>Moderate</td>
<td>Nine trials conducted in Europe (no trials conducted in the US); no trial focused on adolescents; varnish applied by dental professionals at school or in dental clinics; limited reporting of water fluoridation levels and SES; 7 trials published prior to 1998</td>
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<tr>
<td><strong>Sealants</strong></td>
<td>Resin-based sealant: 1 systematic review (15 RCTs; n = 4195 children) and 1 supplemental RCT (n = 50 children) Glass ionomer sealant: 1 Systematic review (3 RCTs; n = 905) and 2 subsequent RCTs (n = 237)</td>
<td>Resin-based sealants: systematic review found resin-based sealants associated with decreased risk of carious first molars at 24 mo (7 trials; OR, 0.12 [95% CI, 0.08-0.19]), 36 mo (7 trials; OR, 0.17 [95% CI, 0.11-0.27]); I² = 90%), and 48 to 54 mo (4 trials; OR, 0.21 [95% CI, 0.16-0.28]; I² = 45%) Glass ionomer sealants: systematic review (2 trials) and 1 subsequent trial found inconsistent effects of glass ionomer sealants vs no sealants on caries outcomes</td>
<td>Resin-based sealants: No inconsistency; No imprecision Glass ionomer sealants: Serious inconsistency; Serious imprecision Reporting bias (all sealants) not suspected</td>
<td>Fair</td>
<td>Open-label design; few trials of glass ionomer sealants</td>
<td>Moderate</td>
<td>Nine trials conducted in the US, Europe, Canada, or New Zealand; limited information on SES and fluoridation levels; higher caries burden settings; variability in sealants evaluated; 10 trials published prior to 1996; sealants applied by dental professionals</td>
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<tr>
<td><strong>Silver diamine fluoride</strong></td>
<td>1 RCT (n = 452)</td>
<td>Silver diamine fluoride associated with fewer new surfaces with active caries in deciduous dentition (mean, 0.3 vs 1.4; P &lt; .001) and first permanent molars (mean, 0.4 vs 1.1; P &lt; .001), and decreased likelihood of 1≥1 new decayed or filled teeth (26.1% vs 49.7%; RR, 0.52 [95% CI, 0.40-0.70])</td>
<td>Unable to assess consistency (1 trial); No imprecision; Reporting bias not suspected</td>
<td>Fair</td>
<td>One trial with methodological limitations</td>
<td>Low</td>
<td>Trial conducted in Cuba in a setting with high caries burden in children aged 6 y; training of person administering SDF not reported; children received oral health education and performed fluoride mouth rinses</td>
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<tr>
<td><strong>Xylitol</strong></td>
<td>10 Trials (n = 4267)</td>
<td>One fair-quality trial found no difference between xylitol vs no xylitol in caries outcomes at 4 y, and 1 fair-quality trial found no difference between xylitol vs placebo in DMFS increment at 3 y but a decreased DMFS increment vs no xylitol Eight other trials found xylitol associated with reduced DMFS increment vs no xylitol (mean difference, −2.38 [95% CI, −3.66 to −1.15]), but had serious methodological limitations and were rated poor-quality</td>
<td>Some inconsistency; No imprecision; Reporting bias not suspected</td>
<td>Fair (based on fair-quality trials)</td>
<td>Only 2 fair-quality trials; potential differences in outcomes based on control type</td>
<td>Low</td>
<td>Six trials conducted in Europe (no trials in the US); no trial focused on adolescents; xylitol administered under supervision at school in all trials except 1; 4 trials published in or prior to 1991; fluoride exposure varied; information on SES not provided</td>
</tr>
</tbody>
</table>

(continued)
### Table. Summary of Evidence: Oral Health Screening and Preventive Interventions in Children and Adolescents Aged 5 to 17 Years (continued)

<table>
<thead>
<tr>
<th>Objective/intervention</th>
<th>No. of studies; study design (No. of participants)</th>
<th>Summary of findings by outcome</th>
<th>Consistency/precision; reporting bias</th>
<th>Overall quality</th>
<th>Body of evidence limitations</th>
<th>Strength of evidence</th>
<th>Applicability</th>
</tr>
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<tbody>
<tr>
<td><strong>Prevention</strong> KQ5: Harms of preventive interventions</td>
<td>Supplements: 1 trial (n = 349) Gel: 2 trials (n = 490) Varnish: 6 trials (n = 8574) Sealants: 3 trials (n = 775) SDF: 1 trial (n = 452) Xylitol: 1 trial (n = 296)</td>
<td>Supplements: 1 trial reported no adverse events Gels: no difference between gel vs placebo or no treatment in acute toxicity (nausea, gagging, or vomiting); absolute risk difference, 0.01 (95% CI, −0.01 to 0.02) Varnish: 5 trials reported no adverse events and 1 trial reported 0.04% of children allocated to varnish reported a self-limited adverse event (most commonly nausea), with 4 withdrawals due to mild adverse events Sealants: 3 trials of resin-based sealants reported no adverse events SDF: SDF associated with increased likelihood of inactive caries and black stain in deciduous teeth (97% vs 48%, P &lt; .001) and first permanent molars (86% vs 67%, P &lt; .001) Xylitol: 1 trial reported 1 withdrawal from xylitol due to diarrhea</td>
<td>Consistency uncertain, due to sparse data Serious imprecision Potential reporting bias, as few trials reported harms</td>
<td>Poor</td>
<td>Few trials reported harms or harms reporting was suboptimal</td>
<td>Low</td>
<td>Evidence on harms was very sparse, limiting assessments of applicability</td>
</tr>
</tbody>
</table>

**Abbreviations:** DFS, decayed or filled surfaces; DFT, decayed or filled teeth; DMFS, decayed, missing, or filled surfaces; DMFT, decayed, missing, or filled teeth; KQ, key question; NA, not applicable; OR, odds ratio; RCT, randomized clinical trial; RR, relative risk; SDF, silver diamine fluoride; SES, socioeconomic status.

* This is the same as KQ2b from the screening framework.
been published since 2000, potentially reducing applicability to current US practice.

Of note, all trials evaluated oral health preventive interventions administered by dental health professionals or in supervised school settings, with unknown effectiveness and feasibility in primary care. Barriers to provision of oral health preventive interventions in primary care include uncertain acceptability and uptake; potential need for additional training and equipment (particularly for sealants); and uncertain reimbursement. Some evidence indicates increased uptake in 2018 compared with 2008 of primary care administration of fluoride varnish in children younger than 5 years, suggesting feasibility for older children and adolescents, and limited evidence indicates that applying SDF in primary care settings is feasible.

Conclusions

Administration of fluoride supplements, fluoride gels, varnish, and sealants in dental or school settings improved caries outcomes. Research is needed on the effectiveness of oral health preventive interventions in primary care settings and to determine the benefits and harms of screening.

ARTICLE INFORMATION

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Author Contributions: Dr Chou had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: Chou.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Chou, Bougatos, Selph, Ahmed, Fu, Schwarz.

Critical review of the manuscript for important intellectual content: Chou, Bougatos, Griffin, Nix, Schwarz.

Statistical analysis: Chou, Griffin, Fu.

Obtained funding: Chou, Bougatos.

Administrative, technical, or material support: Bougatos, Griffin, Schwarz.

Supervision: Chou, Bougatos.

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Editorial Disclaimer: This evidence report is presented as a document in support of the accompanying USPSTF recommendation statement. It did not undergo additional review after submission to JAMA.

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Clinical Review & Education

US Preventive Services Task Force


