JAMA | US Preventive Services Task Force | EVIDENCE REPORT

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.

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Supplemental content

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Oral 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 children[6] 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 adults[9]; the USPSTF addressed oral cancer screening separately[10] 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 those conditions (preventive interventions). The full report[13] 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 xylitol[15,16]; 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

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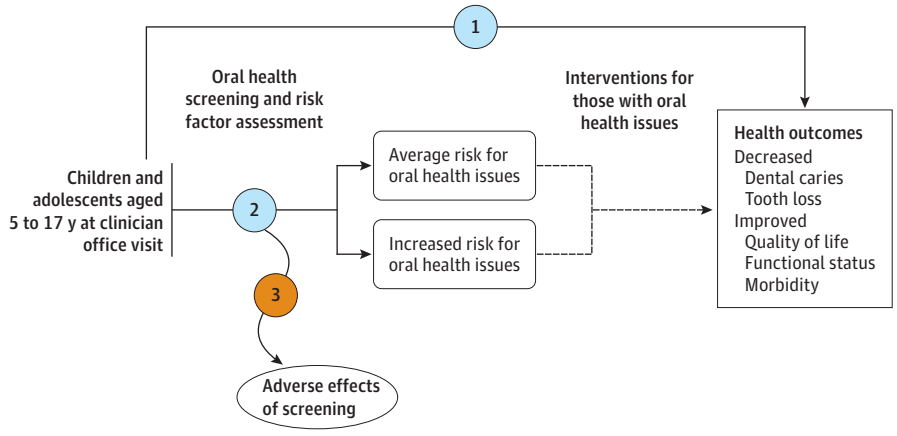
Figure 1. Analytic Framework and Key Questions: Screening for Oral Health in Children and Adolescents Aged 5 to 17 Years



Key questions

1. How effective is screening for oral health performed by a primary care clinician in preventing negative oral health outcomes?
2. 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?
3. What are the harms of screening for oral health performed by a primary care clinician?

Evidence reviews for the US Preventive Services Task Force (USPSTF) use an analytic framework to visually display the key questions that the review will address to allow the USPSTF to evaluate the effectiveness and safety of a preventive service. The questions are depicted by linkages that relate interventions and outcomes. A dashed line depicts a health outcome that follows an intermediate outcome. For additional information, see the USPSTF Procedure Manual.[14]

small study effects was not performed because the meta-analyses had fewer than 10 studies.[17]

Results

Across all KQs, 3 systematic reviews[18-20] (total of 20 684 participants) of 54 unique trials (53 publications)[21-73] and 23 additional studies (in 27 publications[15,16,74-98]; total of 15 026 participants) were included (**Figure 3**). One study assessed diagnostic accuracy of screening[74]; the systematic reviews[18-20] and other 22 studies (19 randomized clinical trials[15,16,75-91] and 3 nonrandomized trials[92-94]) 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 have oral health issues?

For identification of untreated caries in children aged 5 to 12 years, 1 fair-quality study[74] found visual screening by a registered nurse (n = 219) following 5 hours of training associated with sensitivity of 0.92 (95% CI, 0.84-0.97) and specificity of 0.993 (95% CI, 0.96-0.9998), and a 17-item questionnaire completed by children's parents or guardians (n = 305) associated with sensitivity of 0.69 (95% CI, 0.60-0.77) and specificity of 0.88 (95% CI, 0.83-0.93) (eTables 1 and 2 in the Supplement). The reference standard was a full dentist examination.

Key Question 2b. How accurate is screening for oral health performed by a primary care clinician in identifying children and adolescents who are at increased risk for future oral health issues?

No study addressed this KQ.

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, nonfluoridated water, or high caries burden (eTables 3 and 4 in the Supplement).[75-81,95] Trials were conducted in the US (3 studies),

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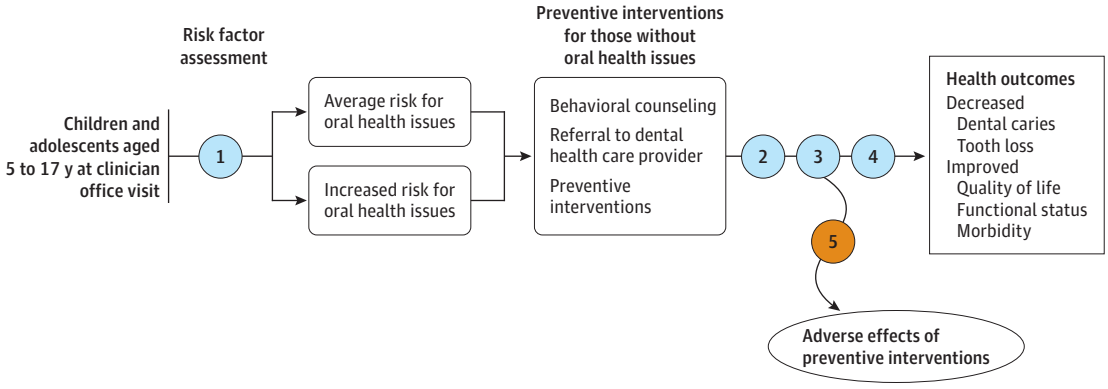
Figure 2. Analytic Framework and Key Questions: Interventions to Prevent Oral Health Issues in Children and Adolescents Aged 5 to 17 Years



Key questions

1. How accurate is screening for oral health performed by a primary care clinician in identifying children and adolescents who are at increased risk of future oral health issues?[a]
2. How effective is oral health behavioral counseling provided by a primary care clinician in preventing oral health issues?
3. How effective is referral by a primary care clinician to a dental health care provider in preventing oral health issues?
4. How effective are preventive interventions in preventing oral health issues?
5. What are the harms of specific interventions (behavioral counseling, referral, and preventive interventions) to prevent oral health issues?

Evidence reviews for the US Preventive Services Task Force (USPSTF) use an analytic framework to visually display the key questions that the review will address to allow the USPSTF to evaluate the effectiveness and safety of a preventive service. The questions are depicted by linkages that relate interventions and outcomes. For additional information, see the USPSTF Procedure Manual.[14]

[a] This is the same as KQ2b from the screening analytic framework (Figure 1).

the UK (3 studies), and Taiwan (1 study). All trials recruited children from schools and were published before 1990 except for 1 (published in 2013).[79] Fluoride supplements were administered daily as acidulated phosphate fluoride or sodium fluoride tablets. In 1 trial of older children (mean age, 12.5 years),[76] fluoride supplements were taken at home; all other trials evaluated supervised supplement administration at school. All trials had unclear randomization and allocation concealment methods and were rated fair-quality. Other methodological limitations included open-label design and high attrition.

Fluoride supplements were associated with a decreased DMFT or DFT increment compared with placebo or no supplement at 1.5 to 3 years (6 trials; effective n = 1395; mean difference, −0.73 [95% CI, −1.30 to −0.19]) (eFigure 1 in the Supplement); however, statistical heterogeneity was substantial (I^2 = 80%).[75-81,95] In a stratified analysis, supplements were not associated with reduced DMFT/DFT increment in 1 trial[76] of home administration in adolescents that reported low adherence (n = 178; mean difference, 0.13 [95% CI −0.38 to 0.64]), but all school-administered trials reported reduced DMFT/DFT increment (5 trials; effective n = 1217; pooled mean difference, −0.88 [95% CI, −1.43 to −0.40]; I^2 = 74%; P = .15 for interaction) (eFigure 2 in the Supplement). There were no statistically significant interactions between control type, follow-up duration, or age and effects of supplements on DMFT/DFT increment, although analyses were limited by small numbers of trials (eTable 5 in the Supplement).

Fluoride Gel

A good-quality systematic review[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 hygienist 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

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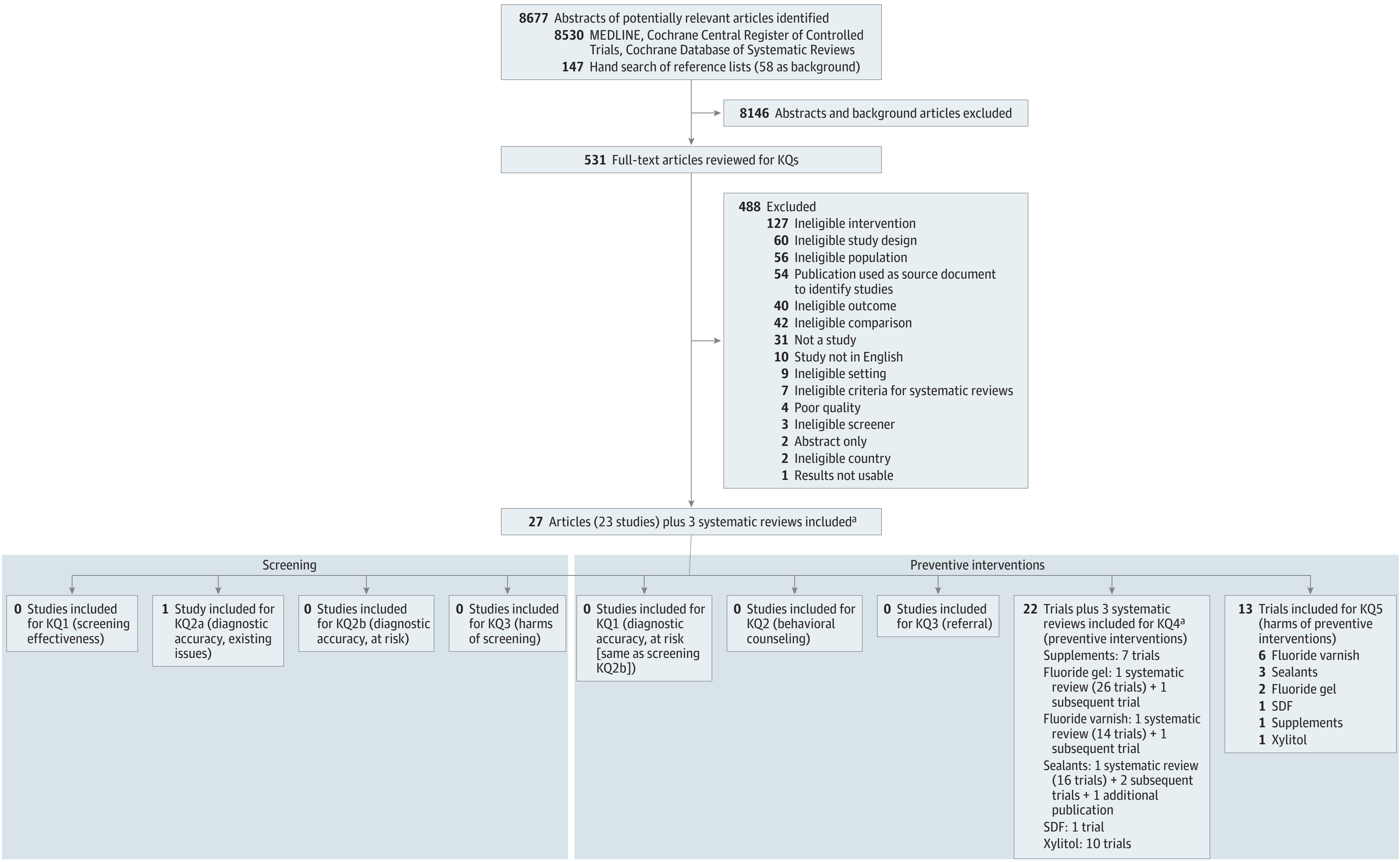
Figure 3. Literature Search Flow Diagram: Screening and Interventions to Prevent Oral Health Issues in Children and Adolescents Aged 5 to 17 Years



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.

[a] Fifty-four trials included in the systematic reviews (in 53 publications).

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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[82] (n = 986) reported results consistent with the systematic review (eTables 8 and 9 in the Supplement).

Fluoride Varnish

A good-quality systematic review[19] (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, 0.11-0.76]; 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 carious first molars at 24 months 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[84,85] (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

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effects on caries burden at 4 years vs no xylitol based on the D_3MFS (DMFS with caries lesions extending into the dentin) increment (mean, 3.02 for xylitol for 2 years vs 2.74 for no xylitol; $P > .05$) or likelihood of D_3MFS 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 (nonxylitol gum in DMFS increment [all stages] at 3 years; mean, 8.1 vs 8.3; $P > .05$). However, xylitol gum was associated with decreased DMFS increment vs no gum (mean, 8.1 vs 12.4; $P < .05$). Xylitol and placebo gum were also associated with similar likelihood of experiencing a DMFS increment of 14 or greater.

Key Question 5. What are the harms of specific interventions (behavioral counseling, referral, and preventive interventions) to prevent 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[18] reported on tooth surface staining. Two trials in the systematic review reported on acute toxicity (nausea, gagging, or vomiting), with 1 trial reporting no events and a pooled analysis finding no difference between gel vs placebo or no treatment (n = 490; absolute risk difference, 0.01 [95% CI −0.01 to 0.02]; $I^2 = 0\%$).[30,38] The systematic review also found no difference between fluoride gel vs placebo in risk of study withdrawal (19 trials; n = 8695; relative risk, 1.03 [95% CI, 0.89-1.19]).

For fluoride varnish, 5 of 16 trials included in a good-quality systematic review[19] reported adverse events. Four trials[46,54,56,58] (n = 1704) reported no adverse events, and 1 trial[55] (n = 2967) reported 12 of 1473 children assigned to varnish reported adverse events (the most common adverse event was nausea, occurring in 7 children). All adverse events were described as self-limited, although 4 children were withdrawn due to mild adverse events. One subsequent trial of varnish (n = 5397) reported no adverse events.[83]

Only 3[54,61,67] of 16 trials of sealants vs no sealants included in a good-quality systematic review[20] reported harms. All (n = 775) evaluated a resin-based sealant and reported no adverse events. One trial (n = 452) found SDF associated with increased likelihood of black-stained inactive caries in deciduous teeth (97% vs 48%, $P < .001$) and in first permanent molars (86% vs 67%, $P < .001$),[86] and 1 trial (n = 296) of xylitol reported 1 withdrawal due to diarrhea.[15]

Discussion

The **Table** summarizes the evidence reviewed for this report. Evidence on screening was limited to 1 study[74] that found oral health visual screening by a trained nurse associated with high sensitivity and specificity for untreated caries and a parent- or guardian-reported questionnaire associated with moderate sensitivity and high specificity.

Several oral health preventive interventions improved caries outcomes when administered in school or dental settings. Supervised administration of fluoride supplements in school was associated with a small decrease in the DMFT/DFT increment (mean difference, <1 affected tooth) in settings with low socioeconomic status, nonfluoridated water, or high caries burden. Fluoride gels, fluoride varnish, and sealants were each associated with improved caries outcomes when administered in schools or in dental clinics. Gels were administered by dental professionals or were self-administered with supervision by a dental or nondental professional; varnish and sealants were administered by dental professionals. The reduction in caries burden was larger for varnish[19] than for gels,[18] and resin-based sealants were associated with a strong reduction in the likelihood of developing carious first molars.[20] Evidence on SDF for prevention was limited to a single trial[86] suggesting benefit in a setting with high baseline caries burden and with inadequate water fluoridation. Two fair-quality trials of xylitol either found no benefit of xylitol (vs no xylitol[15]) or reported results that varied depending on the control type (large benefit vs no gum but no benefit vs placebo gum[16]).

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 primary care counseling or referral to a dental professional. Trials of preventive interventions did not evaluate health outcomes (eg, quality of life or function), and factors that could potentially affect the effectiveness of oral health preventive interventions—such as water 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,[99] the single trial[86] 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 articles 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 relying exclusively on primary studies. However, the systematic reviews 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 brushing or flossing, as these are routinely recommended and performed outside the primary care setting. Rather, the review addressed the effectiveness of oral health counseling, which includes counseling on tooth brushing, flossing, and diet. Fifth, meta-analyses had substantial statistical heterogeneity. To address statistical heterogeneity, random-effects models were used and stratified 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

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

Objective/ intervention	No. of studies; study design (No. of participants)	Summary of findings by outcome	Consistency/ precision; reporting bias	Overall quality	Body of evidence limitations	Strength of evidence	Applicability
Screening KQ1: Screening effectiveness							
	No studies	NA	NA	NA	NA	NA	NA
Screening KQ2: Screening accuracy							
A. In persons who have oral health issues B. In persons who are at increased risk for future oral health issues	A. 1 Cross-sectional study (n = 305) B. No studies	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 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	Unable to assess consistency (1 study) Reasonably precise Reporting bias not detected	Fair	Single study with methodological limitations; results unvalidated	Low	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%)
Screening KQ3: Screening harms							
	No studies	NA	NA	NA	NA	NA	NA
Prevention KQ1: Screening accuracy (identification of persons at risk for future caries)[a]							
	No studies	NA	NA	NA	NA	NA	NA
Prevention KQ2: Behavioral counseling							
	No studies	NA	NA	NA	NA	NA	NA
Prevention KQ3: Referral							
	No studies	NA	NA	NA	NA	NA	NA
Prevention KQ4: Preventive interventions							
Supplements	7 Trials (n = 3382)	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])	Serious inconsistency No imprecision Reporting bias not suspected	Fair	All trials had methodological limitations; substantial statistical heterogeneity	Low	Supplements administered in school under supervision in all trials except 1; all trials published prior to 1990 except for 1; no trial of adolescents and all trials but 1 focused on children aged <10 y; trials conducted in settings with high caries burden, low SES, or low fluoridation levels; 6 trials conducted in the US or UK and 1 trial conducted in Taiwan
Fluoride gel	1 Systematic review (26 trials [n=8619]) and 1 subsequent RCT (n=986)	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; I^2 = 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; I^2 = 6%) One subsequent trial reported consistent results	Consistent (based on placebo-controlled trials) No imprecision Reporting bias not suspected	Fair	Most trials had methodological limitations; statistical heterogeneity when all (placebo-controlled and non-placebo-controlled) trials pooled; few placebo-controlled trials	Moderate	Eighteen trials conducted in the US, Europe, or Canada; only 1 trial focused on adolescents; gels were applied by dental professional or under supervision and applied in dental clinics or schools; limited reporting of water fluoridation levels and SES; most trials conducted in settings with high caries burden; 22 trials published prior to 1990

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

Objective/ intervention	No. of studies; study design (No. of participants)	Summary of findings by outcome	Consistency/ precision; reporting bias	Overall quality	Body of evidence limitations	Strength of evidence	Applicability
Fluoride varnish	1 Systematic review (14 trials [n = 6965]) and 1 subsequent RCT (n = 5397)	Systematic review found fluoride varnish associated with a DMFS/DFS-prevented fraction of 0.43 (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 caries (RR, 0.75 [95% CI, 0.53-1.05]; I^2 = 89.2%; 5 trials) One subsequent trial reported results consistent with the systematic review	Some inconsistency present No imprecision Reporting bias not suspected	Fair	Most trials had methodological limitations; statistical heterogeneity present	Moderate	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
Sealants	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)	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]; I^2 = 90%), and 48 to 54 mo (4 trials; OR, 0.21 [95% CI, 0.16-0.28]; I^2 = 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	Resin-based sealants: No inconsistency No imprecision Glass ionomer sealants: Serious inconsistency Serious imprecision Reporting bias (all sealants) not suspected	Fair	Open-label design; few trials of glass ionomer sealants	Moderate	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
Silver diamine fluoride	1 RCT (n = 452)	Silver diamine fluoride associated with fewer new surfaces with active caries in deciduous dentition (mean, 0.3 vs 1.4; P < .001) and first permanent molars (mean, 0.4 vs 1.1; P < .001), and decreased likelihood of ≥1 new decayed or filled teeth (26.1% vs 49.7%; RR, 0.52 [95% CI, 0.40-0.70])	Unable to assess consistency (1 trial) No imprecision Reporting bias not suspected	Fair	One trial with methodological limitations	Low	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
Xylitol	10 Trials (n = 4267)	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	Some inconsistency No imprecision Reporting bias not suspected	Fair (based on fair-quality trials)	Only 2 fair-quality trials; potential differences in outcomes based on control type	Low	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

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

Objective/ intervention	No. of studies; study design (No. of participants)	Summary of findings by outcome	Consistency/ precision; reporting bias	Overall quality	Body of evidence limitations	Strength of evidence	Applicability
Prevention KQ5: Harms of preventive interventions							
	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)	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%, $P < .001$) and first permanent molars (86% vs 67%, $P < .001$) Xylitol: 1 trial reported 1 withdrawal from xylitol due to diarrhea	Consistency uncertain, due to sparse data Serious imprecision Potential reporting bias, as few trials reported harms	Poor	Few trials reported harms or harms reporting was suboptimal	Low	Evidence on harms was very sparse, limiting assessments of applicability

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.

[a] This is the same as KQ2b from the screening framework.

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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,[101] and limited evidence indicates that applying SDF in primary care settings is feasible.[102]

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.

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Concept and design: Chou.
Acquisition, analysis, or interpretation of data: All authors.
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