

# Provision of Preventive Dental Services in Children Enrolled in Medicaid by Nondental Providers

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abstract

**OBJECTIVES:** Aims of this study are to determine (1) the association of oral health services (OHS) provided by nontraditional providers with the percentage of Medicaid children 0 to 5 years of age who receive  $\geq 1$  preventive services from all provider types in the United States; and (2) characteristics of state Medicaid policies associated with provision of OHS.

**METHODS:** We conducted a time-series cross-sectional study of preventive services provided by nontraditional (OHS) and dental (PDS) providers for Medicaid-enrolled children from birth to 5 years of age in all states during 2010 to 2013 (204 observations). We applied panel data multiple regression analysis techniques to exploit year and state variation in aggregate data available in Centers for Medicare and Medicaid Services reports (form CMS-416). Total preventive dental services (TPDS = OHS + PDS) was predicted by months since state enactment of a policy to reimburse medical providers for OHS.

**RESULTS:** The 44 states with a policy reported 4.3% of children per state per year with any OHS. For all states, an average of 30.1% received PDS and 34.5% TPDS. The delivery of OHS was associated with a small increase in percentage with TPDS. One year of Medicaid OHS availability was associated with an increase of 1.5% in the percentage of children with TPDS per state per year.

**CONCLUSIONS:** Implementation of policies by Medicaid programs to support integration of OHS into primary care is associated with increases in overall TPDS use, but efforts are needed to improve implementation in practice to achieve national impact on access.

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**DOI:** 10.1542/peds.2015-3436

Accepted for publication Nov 19, 2015

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

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

**FUNDING:** Funding for Dr Arthur was provided by NYU Lutheran Dental Public Health Residency.

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

**WHAT'S KNOWN ON THIS SUBJECT:** Most state Medicaid programs reimburse medical providers for provision of preventive oral health services. Evidence from a few states suggests that these services in medical offices increase access to preventive dental services and reduce treatment, avert hospitalizations, and save money.

**WHAT THIS STUDY ADDS:** This study provides the first national estimates of the percentage of 0- to 5-year-old children enrolled in Medicaid who receive oral health services from nondental providers and the impact on overall use of preventive dental services from all types of providers.

**To cite:** Arthur T and Rozier RG. Provision of Preventive Dental Services in Children Enrolled in Medicaid by Nondental Providers. *Pediatrics*. 2016;137(2):e20153436

Concerns about the prevalence of dental disease among American children and barriers that prevent them from gaining access to dental care have contributed to a national discussion about potential solutions. Many highly visible organizations have highlighted the public health problems presented by dental disease and recommended strategies to help resolve problems.<sup>1-4</sup>

Much of the national discussion about oral health has centered on the performance of public insurance programs. In 2013, 37% of children in the United States were enrolled in Medicaid Early and Periodic Screening, Diagnostic, and Treatment (EPSDT) or Children's Health Insurance Program (CHIP), amounting to >38 million children.<sup>5</sup> An issue brief from the Children's Dental Health Project documented 7 hearings in the US Congress and 13 studies by the Government Accountability Office over 10 years starting in 2002 that focused on oral health issues.<sup>6</sup> One of these reports, published in 2008, estimated that 1 in 3 children 2 to 18 years of age enrolled in Medicaid was affected by oral disease. Approximately 1 in 9 had untreated disease, amounting to 6.5 million children.<sup>7</sup>

One innovative strategy used to increase dental access is to reimburse medical providers for providing preventive dental services (PDS). Medicaid programs have taken the lead in encouraging nondental professionals to include preventive oral health services (OHS) in well child care.<sup>8</sup> Because children frequently visit primary care doctors during their first 2 years of life, many opportunities exist to promote oral health in these settings.<sup>9</sup> By 2015, 49 of the 50 state Medicaid programs included this benefit for young children.<sup>10</sup>

Studies in  $\geq 6$  states suggest that preventive dental interventions provided in medical offices will increase access to preventive

services,<sup>11-15</sup> but their national impact on use of preventive dental services is unknown. All major dental organizations and most state Medicaid programs recommend that children initiate preventive dental visits by 12 months of age,<sup>16</sup> yet infants and toddlers are the least likely children of any age to have a dental visit. Griffin et al<sup>17</sup> reported that only 1.7% of 0- to 2-year-olds had preventive dental visits with fluoride applications.

The purpose of this study is to determine the impact of Medicaid program reimbursement policies for OHS provided by nontraditional dental providers on utilization of preventive services for young children 0 through 5 years of age. The specific aims are to examine (1) the association of OHS provided by nontraditional providers with the overall percentage of children enrolled in Medicaid who receive  $\geq 1$  preventive services provided by nondental and dental providers in the United States; and (2) characteristics of state policies associated with provision of OHS provided by nontraditional providers.

## METHODS

We conducted a time-series cross-sectional study of preventive services provided by medical and dental providers for Medicaid-enrolled children from birth to 5 years of age in all states and the District of Columbia during 2010 to 2013. Four years of consecutive annual time series data for each of the 51 states provided a balanced panel of 204 observations for the primary analysis. Institutional review board disposition was obtained from Lutheran Medical Center Health System.

## Data Sources

We extracted data for use in the study from the State Annual EPSDT Participation Report (CMS-416) for

Federal Fiscal Years 2010 (October 2009 to September 2010) through 2013 (October 2012 to September 2013). This source provides aggregate administrative data reported by the states. We included the total unduplicated number of individuals who were enrolled in Medicaid or a CHIP Medicaid expansion program and determined to be eligible for EPSDT for  $\geq 90$  continuous days (line 1b), total number receiving PDS from a dentist or by a dental provider under the supervision of a dentist (line 12b), and total number receiving OHS provided by any health care provider who is not a dentist or not supervised by a dentist (line 12f) for 3 age groups (<1 year, 1-2 years, and 3-5 years).

We were unable to determine whether services reported in line 12f were delivered by medical providers or unsupervised dental hygienists. To test for bias in our estimates of policy effect, we conducted a sensitivity analysis in which we considered preventive services in states that allow direct access to dental hygienists and those that allow direct reimbursement of dental hygienists by Medicaid.<sup>18-20</sup> We considered the services reported in line 12f to be preventive services because of the young ages selected for study and dental practice acts, which prohibit treatment by nondentists. The time series started in 2010 because it was the first year that the Centers for Medicare and Medicaid Services (CMS) reported OHS provided by nondentist providers. The denominator for calculation of utilization rates was the number in the selected age group who were enrolled in EPSDT or CHIP for  $\geq 90$  continuous days as recommended by the Dental Quality Alliance.<sup>21</sup>

For the second study aim, we added information about reimbursement policies for nondentist OHS from state-specific information maintained by the American Academy of Pediatrics on its Web site<sup>10</sup> and from

1 published study on adoption of physician-delivered PDS.<sup>22</sup>

### Dependent Variables

The primary outcome variable for the first study aim was the proportion of enrolled children who received any PDS, calculated as the sum of the percentage of enrolled children 0 to 5 years of age who received  $\geq 1$  dental service from nondentists (referred to throughout as OHS, as recommended by CMS) and by or under the supervision of a dentist (referred to throughout as PDS). The sum of the 2 is referred to as total preventive dental services (TPDS). Preventive procedures are defined by Healthcare Common Procedure Coding System codes D1000 to D1999 (or equivalent Code on Dental Procedures and Nomenclature codes D1000 to D1999 or equivalent *Current Procedural Terminology* code).<sup>23</sup> For the second study aim, we limited the analysis to the subgroup of states that reported implementation of OHS and focused on these services alone.

### Independent Variables

The primary independent variable used for the first aim was number of months since state adoption of a policy to reimburse nondentists for OHS. For the second aim, we considered 2 variables calculated from the date of Medicaid program benefit adoption in addition to implementation months: baseline months of implementation and stage of adoption categories (1 = innovator/early adopter [before 2006]; 2 = majority adopter [2006 to 2009]; and 3 = late adopter [after 2009]). Binary variables were included in the analysis for the second aim to indicate the comprehensiveness of preventive OHS (fluoride varnish only versus other in addition to fluoride varnish, such as screening, risk assessment, or counseling) and training requirements (yes versus no). We included a variable for the

fee (in dollars) paid to nondentist providers for OHS by using the most recent estimate to adjust for inflation. We summed the rates for all dental procedures for those states that reimburse for  $>1$  procedure and averaged the rate for those states that pay  $>1$  rate for the same procedure.

### Statistical Analysis

#### Descriptive Analysis

State- and year-specific variations in outcomes were explored descriptively. For each state, we calculated the mean percentage of enrolled children 0 to 5 years of age per year with  $\geq 1$  OHS or PDS (Table 1). We also calculated mean change in these percentages by averaging differences in estimates for adjacent years. We display state estimates for the outcomes pooled across years in graphic form (Fig 1). Year effects for each of the outcomes were explored descriptively in pooled state data stratified by age group and overall (Table 2; Fig 2). Differences in means by year were tested by using analysis of variance (ANOVA) *F* tests.

The second aim was limited to states in which Medicaid programs had adopted a policy to reimburse nondentists and in which CMS-416 reports demonstrated evidence of provider-level implementation, defined as a value  $>0$  for the number of OHS in each of the reporting years. The percentage of children who received OHS was compared by the various levels of the independent variables and tested descriptively by using ANOVA.

#### Model Selection and Specification

We estimated linear regression models to examine the effects of Medicaid preventive oral health benefits provided by nondentists on the percentage of 0- to 5-year-old children with TPDS. We applied panel data multiple regression analysis techniques to exploit both time-series and cross-sectional variation in the

data and to control for unobserved factors that might bias results.<sup>24</sup>

We followed the steps for the regression analyses<sup>25</sup> recommended by Park<sup>26</sup> and used PANEL Procedure Software, version 9.3, of the SAS System (SAS Institute, Cary, NC). We tested for state-specific and year-specific fixed effects with the *F* test, using dummy variables in separate regression models to determine the need to control for unexplained cross-sectional and time-series variation. We found state-specific fixed effects (Wald *F* test = 252.315;  $P < .001$ ) but no year-specific effects (Wald *F* test = 2.009;  $P = .570$ ). However, we rejected use of a 1-way state fixed-effect model based on the Hausman test ( $P > .1$ ) and other statistical and substantive considerations in favor of a 1-way state random effects model, which offers improved efficiency over fixed-effects models.<sup>24</sup> Statistically significant Breusch-Pagan Lagrange multiplier tests supported the use of random effects over a pooled analysis in all regression models.

### RESULTS

States demonstrated considerable variation in estimates for OHS, PDS, and TPDS (Table 1; Fig 1). In the 44 states adopting a policy to reimburse primary care providers for OHS, an average of 4.38% of children 0 to 5 years of age received OHS per state per year. This number increased by an average of 0.29 percentage points during the 4 years. The percentage of children 0 to 5 years of age with PDS for all 51 states averaged 30.1% per state per year. Most states experienced an increase in this percentage over time, resulting in an average increase of 1.14% per state per year.

The percentages of children who received services varied by age (Table 2; Fig 2). A larger percentage of 12- to 35-month-old children received OHS than the other 2 age

**TABLE 1** Mean Percentage Enrolled and Percentage With OHS or PDS by State, Birth Through 5 y of Age, 2010–2013

State	Policy Adoption Date	Mean Enrollment, <i>n</i> <sup>a</sup>	OHS <sup>b</sup>		PDS <sup>c</sup>	
			Mean % per Year <sup>d</sup>	Mean Change in Percentage Points	Mean % per Year <sup>d</sup>	Mean Change in Percentage Points
Alabama	January 2009	217 800	2.34 (0.17)	0.06 (0.27)	34.69 (0.75)	0.50 (1.27)
Alaska	July 2010	32 543	0 <sup>e</sup>	—	26.08 (1.44)	0.96 (1.18)
Arizona	—	282 696	— <sup>f</sup>	—	29.35 (1.13)	0.91 (1.24)
Arkansas	—	148 056	—	—	31.12 (1.62)	1.19 (0.77)
California	June 2006	1 598 631	3.16 (0.61)	0.24 (0.87)	25.96 (1.35)	1.03 (0.75)
Colorado	July 2009	168 347	6.00 (3.24)	2.39 (1.48)	39.21 (2.97)	1.98 (2.86)
Connecticut	November 2008	101 706	2.87 (1.62)	1.18 (0.77)	45.51 (2.12)	2.28 (1.64)
District of Columbia	—	32 415	—	—	37.63 (3.77)	2.32 (4.51)
Delaware	—	37 144	—	—	27.44 (2.90)	2.11 (1.18)
Florida	April 2008	771 299	6.32 (2.49)	1.59 (1.90)	10.95 (3.56)	2.19 (3.37)
Georgia	August 2010	461 891	1.84 (2.29)	1.58 (1.40)	32.55 (1.80)	1.29 (1.29)
Hawaii	—	50 078	—	—	35.34 (6.07)	−3.56 (7.58)
Idaho	November 2002	71 498	0.06 (0.04)	−0.3 (0.03)	34.31 (2.06)	1.09 (2.36)
Illinois	July 2007	537 485	2.79 (1.34)	1.01 (0.19)	42.81 (3.62)	2.48 (0.81)
Indiana	—	257 252	—	—	17.33 (2.94)	2.00 (3.72)
Iowa	January 2001	107 991	22.8 (14.53)	−8.49 (21.18)	32.13 (8.50)	6.19 (4.94)
Kansas	September 2005	103 273	4.93 (1.22)	−0.73 (1.39)	27.60 (2.42)	1.65 (2.13)
Kentucky	July 2007	184 284	0.81 (0.69)	−0.48 (0.34)	28.09 (1.85)	−0.37 (3.29)
Louisiana	September 2012	267 410	0.04 (0.05)	0.03 (0.98)	35.37 (2.86)	1.98 (2.42)
Maine	September 2008	41 325	15.28 (6.43)	3.55 (7.41)	20.07 (6.58)	5.30 (3.87)
Maryland	July 2009	215 202	6.67 (1.17)	0.95 (0.97)	38.83 (1.36)	0.92 (2.15)
Massachusetts	October 2008	187 013	4.02 (1.98)	1.52 (0.54)	35.09 (2.57)	2.03 (0.45)
Michigan	January 2008	386 431	3.86 (0.56)	−0.36 (0.81)	23.44 (1.34)	1.05 (0.51)
Minnesota	August 2008	164 597	9.99 (1.72)	1.40 (1.25)	22.04 (2.50)	0.06 (5.01)
Mississippi	July 2010	160 183	4.83 (3.23)	2.62 (1.58)	33.46 (2.30)	1.66 (1.13)
Missouri	November 2008	229 587	1.10 (0.67)	0.50 (0.92)	19.33 (1.95)	1.52 (0/43)
Montana	October 2008	31 137	6.00 (3.98)	−2.54 (4.84)	30.66 (4.25)	2.95 (2.16)
Nebraska	April 2009	66 977	2.96 (0.50)	0.31 (0.63)	32.33 (2.18)	1.70 (1.06)
Nevada	January 2007	94 524	7.06 (1.03)	−0.60 (1.42)	24.83 (2.75)	2.21 (0.91)
New Hampshire	—	31 790	—	—	37.42 (1.30)	1.02 (0.38)
New Jersey	July 2010	249 819	0	—	31.69 (2.91)	2.28 (2.14)
New Mexico	July 2009	124 124	3.30 (1.00)	−0.57 (1.06)	35.24 (2.84)	2.00 (1.40)
New York	October 2009	778 331	6.82 (0.85)	0.50 (0.85)	24.14 (1.75)	1.39 (0.69)
North Carolina	February 2000	431 302	20.62 (0.83)	0.56 (0.61)	33.12 (2.56)	1.83 (1.14)
North Dakota	January 2008	19 600	7.44 (2.79)	1.94 (2.53)	17.20 (0.94)	−0.57 (1.67)
Ohio	July 2006	429 799	2.36 (0.75)	−0.22 (1.34)	21.40 (7.93)	−5.85 (12.11)
Oklahoma	July 2011	203 249	0.36 (0.41)	0.24 (0.39)	28.51 (0.85)	−0.30 (1.59)
Oregon	July 2002	133 566	2.23 (0.82)	0.56 (0.67)	27.07 (2.22)	1.53 (1.76)
Pennsylvania	April 2010	397 929	1.94 (1.51)	1.19 (0.32)	25.18 (2.14)	1.51 (1.66)
Rhode Island	November 2008	34 905	1.53 (0.83)	0.45 (0.918)	26.04 (1.08)	−0.36 (1.86)
South Carolina	August 2007	217 087	1.88 (0.76)	0.53 (0.36)	36.26 (1.13)	0.26 (1.89)
South Dakota	January 2007	32 565	0.84 (0.33)	0.25 (0.07)	30.24 (1.76)	−0.01 (3.09)
Tennessee	July 2011	277 976	0	—	29/25 (2.20)	1.55 (1.37)
Texas	September 2008	1 297 099	9.35 (1.36)	0.098 (0.92)	34.57 (1.35)	−0.89 (0.91)
Utah	October 2006	97 783	0.71 (0.25)	0.07 (0.41)	34.47 (1.24)	0.79 (1.00)
Vermont	September 2008	19 596	4.12 (0.87)	0.66 (0.39)	39.17 (1.34)	0.85 (1.21)
Virginia	January 2008	233 059	1.84 (0.57)	0.43 (0.28)	32.59 (1.61)	1.21 (0.75)
Washington	April 1998	274 328	22.06 (3.31)	2.06 (4.85)	47.38 (2.39)	1.74 (1.69)
West Virginia	July 2012	72 307	0.02 (0.00)	−0.01 (0.00)	32.00 (1.85)	1.02 (2.01)
Wisconsin	February 2004	191 313	12.82 (2.26)	0.18 (3.92)	14.60 (0.73)	0.49 (0.59)
Wyoming	January 2007	21 813	6.41 (1.00)	−0.70 (0.50)	26.64 (2.11)	−1.13 (3.42)
All		246 630	4.38 (6.01)	0.29 (3.22)	30.15 (7.91)	1.14 (2.96)

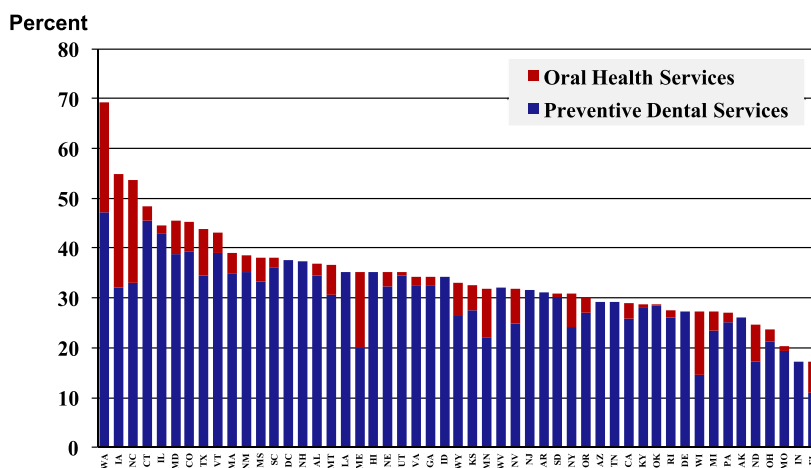
<sup>a</sup> Mean of 4-y enrollment for ≥90 continuous days each year.<sup>b</sup> *n* = 176.<sup>c</sup> *n* = 204.<sup>d</sup> Mean (SD) of 4 y for each state.<sup>e</sup> Reimbursement policy adopted but no OHS services reported.<sup>f</sup> No reimbursement policy adopted by state Medicaid program.

groups, and a larger percentage of 36- to 71-month-old children received PDS compared with other ages.

### Aim 1: Impact of Policy for OHS on TPDS

The average number of months since program adoption for the complete panel of 204 observations was 47.3 months (SD 40.93). In pooled bivariate analyses, number of months of program adoption was positively correlated with percent of 0-year-olds (Pearson correlation coefficient [ $r$ ] = 0.507;  $P < .001$ ), 1- to 2-year-olds ( $r = 0.557$ ;  $P < .001$ ), 3- to 5-year-olds ( $r = 0.316$ ;  $P < .001$ ), and all ages combined ( $r = 0.454$ ;  $P < .001$ ) receiving  $\geq 1$  TPDS.

Months since program adoption was associated at a statistically significant level with the provision of TPDS in regression models stratified by age and for all ages combined in the complete panel of 204 observations (Table 3). On average, 1 year of policy adoption was associated with a 1.5-percentage-point increase in TPDS.



**FIGURE 1** Mean percentage of children 0 to 5 years of age enrolled in Medicaid with any OHS or PDS, United States, 2010–2013.

### Aim 2: Factors Associated With Provision of Preventive OHS

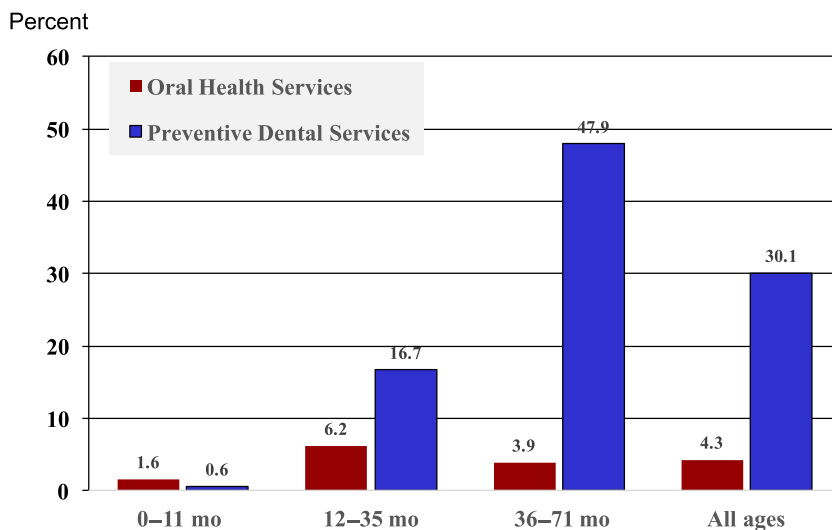
The analysis for the second aim was limited to the 38 states that had reported use of OHS for all 4 years, or a balanced panel of 152 observations. Of these observations, 32 (21.0%) were classified as early adopters, 108 (71.0%) as majority adopters, and 12 (7.8%) as late adopters. The majority of state observations (108; 71.0%) provided reimbursement for

fluoride varnish only and required training of some type ( $n = 100$ ; 65.7%). The average number of months per state per year that the program had been in place before 2010 was 32.3 (SD 34.37), and the average reimbursement amount per state per year was \$25.80 (SD \$13.22; minimum \$9.00; maximum \$55.46). Table 4 displays the association of each of the predictor variables with the percentage of children receiving

**TABLE 2** Mean Enrollment and Percentage With Use of OHS or PDS by Age Group, 2010–2013

Age, mo	Year			
	2010	2011	2012	2013
0–11				
Enrollment, <i>n</i>	34 845 (43 053)	35 108 (44 303)	34 647 (43 219)	34 893 (43 569)
OHS, %	1.40 (2.94)	1.68 (3.27)	1.86 (3.62)	1.54 (2.62)
PDS, %	0.68 (1.12)	0.54 (0.73)	0.57 (0.77)	0.92 (1.98)
Both, %	2.09 (3.11)	2.22 (3.47)	2.43 (3.83)	2.46 (3.40)
12–35				
Enrollment, <i>n</i>	90 499 (111 769)	89 048 (108 569)	86 948 (106 517)	86 068 (107 089)
OHS, %	4.76 (7.77)	6.03 (8.65)	7.26 (9.53)	6.80 (9.00)
PDS, %	15.44 (7.85)	16.00 (7.95)	16.83 (8.33)	18.61 (6.56)
Both, %	20.21 (11.42)	22.03 (12.50)	24.10 (13.59)	25.41 (13.36)
36–71				
Enrollment, <i>n</i>	118 258 (143 856)	124 593 (149 364)	126 441 (152 766)	125 147 (156 073)
OHS, %	3.32 (5.62)	4.08 (6.80)	4.54 (7.54)	3.66 (5.30)
PDS, %	46.53 (10.15)	47.22 (10.49)	48.63 (10.28)	49.58 (9.88)
Both, %	49.86 (10.57)	51.30 (11.25)	53.17 (11.41)	53.25 (10.38)
0–71				
Enrollment, <i>n</i>	243 622 (298 279)	248 750 (301 820)	248 037 (302 077)	246 109 (306 301)
OHS, %	3.56 (5.39)	4.42 (6.27)	5.09 (6.93)	4.44 (5.39)
PDS, %	28.42 (7.53)	29.51 (7.94)	30.80 (8.00)	31.85 (7.95)
Both, %	31.99 (8.93)	33.94 (9.94)	35.92 (10.43)	36.29 (9.81)

Values are expressed as mean (SD).  $n = 51$  for each year. OHS delivered by nondental provider; PDS delivered by dental provider; Both, sum of OHS and PDS. Denominators for OHS and PDS are not unduplicated.  $P$  values for trends by year in OHS, PDS, and Both for each age group are  $>.1$  based on ANOVA  $F$  test.



**FIGURE 2** Mean percentage of children enrolled in Medicaid with any OHS or PDS, by age, United States, 2010–2013.

OHS in a descriptive analysis by using data pooled by state and year. Most variables were associated with the outcome in all age groups. The only variable associated with OHS at a statistically significant level in any of the panel regression models was early adoption (Table 5). For all ages, the average effect of early adoption on OHS across time and between states compared with majority adopters was 8.1 percentage points.

## DISCUSSION

This study provides the first attempt to determine the reach of Medicaid reimbursement policies for preventive OHS provided by nondentist providers into the young Medicaid population. We found that 44 state Medicaid programs reimbursed for provision of OHS in medical settings by 2013. Yet

nationally, implementation in primary care settings is low, with an average of only 4.3% of children 0 to 5 years of age receiving any OHS during 2010 to 2013.

We found large state-to-state variation in the delivery of OHS. The gap between having state-level policies in place and delivery of services at the practice level observed in the overall sample has been narrowed in some individual states. More than 10% of children 0 to 5 years of age received OHS in 5 states (Iowa, Maine, North Carolina, Washington, and Wisconsin). With the addition of OHS, 5 states (Iowa, North Carolina, Maine, Minnesota, and Nevada) improved their state rankings in access to PDS by >10 positions. For example, Maine improved from 46th based on the average percent of children with PDS (mean = 20.1% per year) to 19th

based on TPDS (mean = 36.4% per year), or 27 places in the rankings. These findings suggest that the diffusion of OHS into medical practice can be increased, but little research has been done to understand characteristics of effective dissemination and implementation strategies for OHS.

Maine,<sup>15</sup> North Carolina,<sup>27</sup> and Washington<sup>11</sup> are 3 of the more successful states that have documented their activities. All formed interprofessional coalitions of medicine, dentistry, and public health to participate in program development, but with a clearly identified lead organization to manage the activities. These partnerships refined existing networks to document the oral health problem and identify dissemination and implementation strategies, usually through an iterative participatory process of pilot testing, feedback, and resolution. To facilitate implementation, quality improvement efforts were undertaken and decision support tools were made available. Finally, ongoing monitoring and evaluation activities at state and local levels provided feedback on predetermined implementation benchmarks and outcomes.

Translation of evidence-based knowledge into widespread use is slow and often incomplete.<sup>28</sup> Theories and conceptual frameworks identify important steps that can help accelerate the translation process.<sup>29,30</sup> Several appear to align with approaches used in states that have been most successful in

**TABLE 3** Regression Model Estimates for the Effect of Number of Months With State Providing OHS on TPDS, by Age Group, 2010–2013

Model	Age, mo	Cross-Sectional Variance	Error Variance	Intercept	Coefficient (SE) for Months Implemented	<i>P</i>	<i>R</i> <sup>2</sup>	Hausman <i>M</i>
1	0–11	8.76	1.50	1.20	0.023 (0.005)	<.001	0.071	0.015
2	12–35	97.92	15.88	14.68	0.174 (0.019)	<.001	0.285	0.994
3	36–71	91.24	17.34	47.32	0.096 (0.019)	<.001	0.107	0.628
4	0–71	67.60	11.29	28.52	0.127 (0.016)	<.001	0.230	0.436

*n* = 51 states × 4 y = 204 observations. One-way state random effects model with variance components estimated by using Wansabeek and Kapteyn method (groupwise heteroscedastic regression). *F* test for state 1-way fixed effects for all age groups, *P* < .001. Breusch-Pagan Lagrange multiplier test *P* values for time random effects all > .1.

**TABLE 4** Mean Percentage of Children With Any OHS Provided by Nondentist Provider, by Predictor Variables and Age Group, 2010–2013

Variable Category	Sample Size (Column %) <sup>a</sup>	Age, mo			All Ages
		0–11	12–35	36–71	
Implementation, mo					
0–39	49 (32.2)	1.73 (2.27)	5.60 (4.97)	3.32 (3.96)	3.89 (3.17)
40–64	52 (34.2)	1.79 (2.26)	7.07 (6.16)	3.92 (4.77)	4.70 (4.10)
65–186	51 (33.5)	2.98 (4.96)	12.20 (13.07) <sup>b</sup>	8.40 (9.42) <sup>b</sup>	8.95 (8.86) <sup>b</sup>
Baseline implementation months					
0–11	48 (31.5)	1.52 (1.81)	5.57 (4.49)	2.71 (3.25)	3.52 (2.48)
12–30	48 (31.5)	2.29 (2.76)	7.58 (6.69)	4.60 (5.43)	5.30 (4.50)
31–138	56 (36.8)	2.63 (4.76)	11.31 (12.75) <sup>b</sup>	7.92 (9.06) <sup>b</sup>	8.365 (8.68) <sup>b</sup>
Adoption stage					
Early	32 (21.0)	4.05 (5.91)	15.76 (15.12)	11.75 (10.31)	12.06 (9.78)
Majority	108 (71.0)	1.68 (2.19)	6.53 (5.56)	3.64 (4.34)	4.36 (3.61)
Late	12 (7.8)	1.54 (2.08) <sup>b</sup>	4.57 (4.28) <sup>b</sup>	2.08 (2.54) <sup>b</sup>	2.87 (2.64) <sup>b</sup>
Comprehensiveness					
Fluoride varnish only	108 (71.0)	1.38 (3.28)	5.70 (6.02)	4.71 (6.41)	4.56 (5.39)
Fluoride varnish and other	44 (28.9)	4.12 (3.06) <sup>b</sup>	14.75 (12.25) <sup>b</sup>	6.49 (7.84)	9.07 (7.27) <sup>b</sup>
Training required					
Yes	100 (65.7)	2.64 (4.03)	9.55 (10.48)	5.41 (7.64)	6.47 (7.11)
No	52 (34.2)	1.27 (1.52) <sup>b</sup>	5.94 (5.55) <sup>b</sup>	4.86 (5.13)	4.70 (4.21)
Reimbursement amount					
\$9–\$16	52 (34.2)	1.53 (4.41)	5.73 (7.57)	5.59 (8.144)	5.07 (7.27)
\$17–\$29	48 (31.5)	1.40 (1.85)	5.62 (4.72)	2.88 (3.676)	3.60 (2.59)
\$30–\$56	52 (34.2)	3.52 (3.10) <sup>b</sup>	13.39 (11.61) <sup>b</sup>	7.04 (7.249) <sup>b</sup>	8.75 (6.70) <sup>b</sup>

Values are expressed as mean (SD). Seven nonadopting states; 3 adopted but no evidence of implementation (ie, no reimbursement); 3 states partial years of implementation.

<sup>a</sup> Pooled analysis;  $n = 38$  states  $\times$  4  $y = 152$  observations.

<sup>b</sup> ANOVA  $P$  value  $< .05$ .

**TABLE 5** Regression of Predictors of Percentage of Children With OHS Among State Medicaid Programs With Policy Implemented, by Age Group, 2010–2013

Variable	Age Group, mo						All Ages	
	0–11		12–35		36–71		Estimate (SE)	$P$
	Estimate (SE)	$P$	Estimate (SE)	$P$	Estimate (SE)	$P$		
Adoption status								
Early versus majority	2.52 (1.10)	.024	10.138 (2.65)	$<.001$	8.43 (2.27)	$<.001$	8.19 (1.00)	$<.001$
Late versus majority	0.02 (1.68)	.989	−2.155 (4.05)	.322	−9.71 (3.47)	.571	−1.70 (2.74)	.534
Fluoride varnish only versus comprehensive	−2.09 (1.43)	.146	−5.322 (3.44)	.124	−0.96 (2.96)	.744	−2.78 (2.33)	.235
Training required	1.15 (0.95)	.228	2.340 (2.29)	.310	−0.47 (1.97)	.811	0.80 (1.55)	.606
Reimbursement amount, \$	0.03 (0.05)	.459	0.200 (0.12)	.097	0.05 (0.10)	.594	0.09 (0.08)	.223
Intercept	1.40 (2.24)	.531	3.400 (5.37)	.528	3.18 (4.61)	.491	3.14 (3.64)	.390
Cross-section variance	6.45		38.49		28.30		17.04	
Error variance	3.34		14.06		10.47		9.30	
$R^2$	0.098		0.191		0.096		0.179	

Estimated with 1-way random effects model and Fuller and Battese variance components.  $n = 38$  states with evidence of implementation and 4 time periods (balanced) = 152 observations. Seven states without adoption and 6 states with partial years or adopt but no implementation excluded from the analysis.

improving access to OHS and can provide guidance in undertaking dissemination interventions and related research.

Adoption stage, comprehensiveness of OHS included in the insurance benefit, training requirements, and reimbursement amounts were all associated with the provision of OHS in bivariate analyses. Adoption stage was the only variable significant in the

multivariate analysis. An average of 12.0% of children 0 to 5 years of age per state per year used OHS among early-adopting states, compared with 4.3% for majority-adopting states and 2.8% for late-adopting states. After adoption of state Medicaid policies, OHS visits appear to be low initially but increase with time.<sup>12</sup> The national rate of OHS is likely to increase as majority- and late-adopting states gain more experience.

The percentage of children 0 to 5 years of age with PDS visits averaged 30% per state per year. Dental visits by Medicaid children increased substantially during the last decade or more.<sup>31–34</sup> Implementation of policies to support integration of OHS into primary care by state Medicaid programs appears to be associated with only a small portion of a continuing increase in use during

2010 to 2013. On average, having a Medicaid policy in place for 1 year was associated with a 1.5-percentage-point increase in children receiving PDS from nondental and dental providers.

The literature and results of our study suggest that states that undertake comprehensive interventions to improve the delivery of preventive services in medical, dental, and public health settings can improve access.<sup>35</sup> Delivery of OHS in primary care can provide a temporary dental home for those children who lack access or the motivation to seek care in a dental office and increase use of preventive services in the dental office if effective referral practices are followed.<sup>36,37</sup> Studies show that physicians underrefer for oral health problems,<sup>38,39</sup> so further research is needed to improve the linkage between medical and dental homes to help ensure continuous access to dental services beginning at ~1 year of age.

The CMS national reporting system did not allow us to unduplicate TPDS by service provider type, so we summed the separate counts of OHS and PDS to get an overall estimate of TPDS. A comparison of the reported unduplicated number of enrolled

children 0 to 5 years of age receiving any oral health or dental services, including diagnostic and treatment services, for the 2013 fiscal year with the sum of separately reported unduplicated medical and dental services suggests that the duplication rate is only ~7%.

Most analysts believe that the CMS-416 system underreports utilization.<sup>40,41</sup> The potential also exists for misclassification of OHS, because we were unable to separate preventive services provided in medical settings from those provided by unsupervised dental hygienists in public health settings. Our sensitivity analysis found that the coefficient for implementation months was unchanged when we included a covariate in regression models for direct access states or direct Medicaid reimbursement states for dental hygienists. The prevalence estimate for the percentage with OHS might be overestimated, but the effect of implementation months should be biased only to the extent that misclassification results in an attenuation of the effect. Finally, preventive services are not reported separately from treatment services for nontraditional providers, but this is unlikely to represent a concern.

## CONCLUSIONS

Our study finds that policies to support integration of OHS into nontraditional settings such as medical practice are widespread among state Medicaid programs and are associated with an overall increase in preventive services for children 0 to 5 years of age. But diffusion into primary care is progressing slowly, and only a small percentage of Medicaid-enrolled children are receiving OHS. Little translational research has been done on dissemination and implementation of OHS, but early-adopting states can provide insights into successful strategies that can be used to improve access to PDS in medical and dental settings.

## ABBREVIATIONS

ANOVA: analysis of variance  
CHIP: Children's Health Insurance Program  
CMS: Centers for Medicare and Medicaid Services  
EPSDT: Early and Periodic Screening, Diagnostic, and Treatment  
OHS: oral health services  
PDS: preventive dental services  
TPDS: total preventive dental services

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*Pediatrics* 2016;137;

DOI: 10.1542/peds.2015-3436 originally published online January 22, 2016;

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