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Preventive Services by Medical and Dental Providers and Treatment Outcomes

ABSTRACT

Objective: Nearly all state Medicaid programs reimburse nondental primary care providers (PCPs) for providing preventive oral health services to young children; yet, little is known about how treatment outcomes compare with children visiting dentists. This study compared the association between the provider of preventive services (PCP, dentist, or both) with Medicaid-enrolled children before their third birthday and subsequent dental caries-related treatment (CRT) and CRT payment. **Methods:** We conducted a retrospective study of young children enrolled in North Carolina Medicaid during 2000 to 2006. The annual number of CRT and CRT payments per child between the ages of 3 and 5 yr were estimated with a zero-inflated negative binomial regression and a hurdle model, respectively. Models were adjusted for relevant child- and county-level characteristics and used propensity score weighting to address observed confounding. **Results:** We examined 41,453 children with > 1 preventive oral health visit from a PCP, dentist, or both before their third birthday. Unadjusted annual mean CRT and payments were lowest among children who had only PCP visits (CRT = 0.87, payment = \$172) and higher among children with only dentist visits (CRT = 1.48, payment = \$234) and both PCP and dentist visits (CRT = 1.52, payment = \$273). Adjusted results indicated that children who had dentist visits (with or without PCP visits) had significantly more CRT and higher CRT payments per year during the ages of 3 and 4 yr than children who had only PCP visits. However, these differences attenuated each year after age 3 yr. **Conclusions:** Because of children's increased opportunity to receive multiple visits in medical offices during well-child visits, preventive oral health services provided by PCPs may lead to a greater reduction in CRT than dentist visits alone. This study supports guidelines and reimbursement policies that allow preventive dental visits based on individual needs.

INTRODUCTION

Nearly all state Medicaid programs reimburse nondental primary care providers (PCPs) for providing preventive oral health services (Sams *et al.*, 2013). Since 2000, the Into the Mouths of Babes program, funded by North Carolina Medicaid, has trained PCPs (*e.g.*, physicians, physician assistants, nurse practitioners) to provide screening and risk assessments, oral health counseling, and fluoride varnish to children < 3.5 yr old (North Carolina Oral Health Section 2012). Children suspected of having caries are referred to dentists in the community when they are available. These services are recommended to coincide with well-child visits occurring at or before age 3 yr. Into the Mouths of Babes and similar programs in other states have helped increase access to preventive services and have improved the oral health of young Medicaid enrollees (Okunseri *et al.*, 2009; Rozier *et al.*, 2010; Pahel *et al.*, 2011).

Despite widespread adoption of these programs, little is known about how treatment outcomes compare for children visiting PCPs and dentists, the traditional provider of preventive services. Prior studies suggest that PCP visits reduce dental caries-related treatment (CRT) (Pahel *et al.*, 2011; Stearns *et al.*, 2012). Additionally, having > 3 PCP visits was associated with lower Medicaid payments for CRT, suggesting fewer treatments within a treatment episode (Stearns *et al.*, 2012). While these findings suggest that PCP visits reduce CRT, these studies did not control for preventive services received from dentists nor examine whether PCP visits reduce CRT to the same extent as dentist visits.

Using North Carolina Medicaid claims, we examined whether the provider of preventive oral health services (PCP, dentist, or both) is associated with the annual number of CRT and CRT payments for children aged 3 to 5 yr, when children are no longer eligible to receive these services from PCPs. We examine CRT among young Medicaid enrollees because caries is prevalent among this population (Edelstein and Chinn 2009) and costly to treat (Nalliah *et al.*, 2010; Stearns *et al.*, 2012). We hypothesize that children who received preventive oral health services from dentists or PCPs will benefit equally from early screenings, anticipatory guidance, and fluoride varnish applications (American Academy of Pediatric Dentistry, 2013) and therefore have a similar number of CRT and payments. Because PCPs are instructed to refer children with caries to dentists and because having caries at an early age strongly predicts subsequent disease (Powell, 1998), we hypothesize that children who visit both dentists and PCPs before their third birthday will have more CRT and higher payments than children who visited only PCPs or dentists.

MATERIALS & METHODS

We conducted a retrospective study to examine the association between the provider of preventive oral services and CRT and payments for young Medicaid enrollees, adhering to STROBE guidelines for cross-sectional studies.

Data Sources

The North Carolina Division of Medical Assistance provided Medicaid enrollment and claims files from 2000 to 2006. Because we are comparing providers of preventive oral health services, we excluded 112,760 children with no preventive oral health visits before age 3 yr. To allow time to observe outcomes, we included children enrolled in Medicaid before 1 yr of age, enrolled for at least 12 mo before their third birthday, and enrolled for at least 7 mo following their third birthday. Receiving > 3 preventive oral health visits before age 3 yr has been shown to reduce CRT (Pahel *et al.*, 2011; Stearns *et al.*, 2012); however, < 1% of our sample ($n = 246$) had > 3 preventive dentist visits. Therefore, we included children with > 1 visit to PCPs, dentists, or both before their third birthday. The study included 93,986 child-year observations for 41,453 children aged 3 to 5 yr.

Measures

We examined 2 outcomes: number of CRT and total payments for CRT. We identified CRT using Current Dental Terminology codes beginning with D2, D3, D4, D5, D6, D7, D8, and D9—which

include nonpreventive services provided in both hospital- and office-based settings, such as amalgam restorations, composite restorations, extractions, stainless steel crowns, and nerve-related treatments (pulpotomies/pulpectomies). Claims for cleft palate surgery or mouth injury were excluded. Annual number of CRT for children was summed at each age (3, 4, and 5 yr). CRT payments were identified in claims based on the aforementioned codes and summed to provide annual CRT payments during ages 3, 4, and 5 yr. To account for inflation, payments were adjusted to constant 2006 U.S. dollars according to the gross domestic product price index (Bureau of Economic Analysis, 2013).

The main explanatory variable was operationalized as a 3-category variable indicating > 1 visit to dentists only (reference group), PCPs only, or both dentists and PCPs before age 3 yr. We examined oral health visits before age 3 yr because during the study period Medicaid reimbursed up to 6 PCP visits before age 3 yr. A visit in a dental office with preventive services was defined as having paid claims for a comprehensive or periodic evaluation (D0150, D0120) with fluoride (D1203, D1201), allowed once per child every six months. PCP visits were identified with any of the following paid claims filed by PCPs for preventive oral health services: D0120, D0150, D1201, D1203, D1330. These codes changed over time but represent clinical oral evaluation and topical fluoride treatment (North Carolina Oral Health Section, 2012).

We constructed a categorical variable indicating the child's age in years (3 yr [reference group], 4 yr, 5 yr) and included the interaction of this variable with the provider of preventive services. Child-level covariates measured at baseline included sex, race (white, black, other [reference group]), Hispanic ethnicity, months enrolled in Medicaid per year, number of well-child visits, indicators of special health care needs, whether any preventive oral health services were received in a public clinic, and year that treatment was received. County-level covariates included proportion of population with access to fluoridated drinking water; indicators of rural or urban status (Economic Research Service, 2003); and the number of dentists, pediatricians, and family practice physicians (Cecil G Sheps Center for Health Services Research 2007), as well as Medicaid-eligible children < 18 yr, per 10,000 population (North Carolina Division of Medical Assistance 2011).

Propensity Score Estimation

Dental claims lack standardized diagnostic terms (Kalenderian *et al.*, 2011), which makes it difficult to determine if visits are due to existing disease or demand for preventive services. To address confounding due to observed systematic differences among children, we estimated propensity scores and constructed inverse probability of treatment weights (see Appendix Table 1; Hirano and Imbens, 2001); see Appendix for full description of the estimation of propensity scores and inverse probability of treatment weights.

Analytic Approach

We used 1-way analysis of variance to test for differences in CRT and payments among children visiting dentists, PCPs, or both over the entire follow-up period. We estimated a zero-inflated

Table. Characteristics of North Carolina Medicaid Enrollees Aged 3 to 5 Yr (N = 41,453)

Variable	Provider of Preventive Oral Health Services before 3 Yr of Age			
	All (N = 41,453)	Dentist Visits Only (n = 4,196)	PCP Visits Only (n = 29,642)	Dentist + PCP Visits (n = 7,615)
Dependent variables				
Percentage of children with any CRT between ages 3 to 5 yr*	33	51.8	26.7	47.6
Annual no. of dental treatments*	1.05 ± 3.10	1.48 ± 3.17	0.87 ± 2.96	1.52 ± 3.48
Annual payment for dental treatment*	\$197 ± \$894	\$234 ± \$853	\$172 ± \$1865	\$273 ± \$1018
Explanatory variables				
Child-level characteristics				
No. of preventive oral health visits before age 3 yr*	2.77 ± 0.90	2.29 ± 0.53	2.69 ± 0.78	3.30 ± 1.21
No. of mo enrolled in Medicaid per yr*				
3 yr of age	11.3 ± 1.8	11.3 ± 1.8	11.3 ± 1.8	11.3 ± 1.7
4 yr of age	9.3 ± 3.8	9.2 ± 3.9	9.3 ± 3.8	9.1 ± 3.9
5 yr of age	8.5 ± 4.0	8.6 ± 3.9	8.5 ± 4.0	8.2 ± 4.0
Race (%)*				
White	36.2	29.4	37.8	33.8
Black	39.1	39.3	39.1	39
Hispanic ethnicity (%)*	14.4	20.1	12.6	18.2
Male (%)	51.5	51.1	51.3	52.8
Child has special health care needs (%)	4	3.4	4.1	3.8
No. of well-child visits before 3 yr of age*	4.7 ± 1.4	3.9 ± 1.9	4.8 ± 1.3	4.6 ± 1.4
Any dental services received in a public clinic (%)*	12.9	10.4	12.6	15.4
Year*				
2004	26.7	27	27.6	22.7
2005	52.9	52	53.9	49.5
2006	89.7	88.3	89.5	91.4
County-level characteristics (per 10,000 population)				
Medicaid eligible < 18 yr*	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1
Dentists*	3.9 ± 1.8	5.2 ± 1.8	3.6 ± 1.6	4.3 ± 1.9
Primary care providers*	4.4 ± 1.9	5.1 ± 2.0	4.2 ± 1.8	4.6 ± 2.1

Values in mean ± standard deviation or percentage. Explanatory variables not presented in this table include the rural/urban status of the child's county of residence and the percentage of the county population with fluoridated drinking water.

PCP, primary care provider; CRT, caries-related treatment.

*p < .001; p values by analysis of variance for continuous variables and chi-square test for binary/categorical variables.

negative binomial regression model to compare the mean number of CRT per child for ages 3, 4, and 5 yr by provider type (Cameron and Trivedi, 2009a). This model included an offset term equal to the logged number of months that the child was enrolled in Medicaid at each age. Annual Medicaid payments for CRT at ages 3, 4, and 5 yr were estimated via a 2-part hurdle model, which is appropriate for a continuous dependent variable with excess zeroes (Cameron and Trivedi, 2009b). First, a logistic regression model was used to estimate the likelihood of having any treatment payments during a year. Second, an ordinary least squares regression model was used to estimate expected logged payments at each age for children having any CRT. These results were transformed through a smearing estimator for heteroskedastic and normal errors.

For the zero-inflated negative binomial and hurdle model, estimates were combined to obtain the adjusted marginal (i.e., overall) mean expected outcome per child (Preisser *et al.*, 2012) during ages 3 to 5 yr by provider type with 95% confidence intervals (CIs) obtained via 500 bootstrap replications. All standard errors were clustered at the child level to adjust for repeat

observations over time. Analyses were performed in Stata/IC 12 (Statacorp, College Station, TX, USA) based on a 0.05 significance level. This study was approved by the Institutional Review Board at the University of North Carolina at Chapel Hill.

RESULTS

This study included 41,453 children enrolled in Medicaid for an average of 2.5 yr between the ages of 3 and 5 yr. About 28% of children received preventive oral health services before their third birthday during dentist visits (dentist only = 4,196; both dentist and PCP = 7,615). Nearly 72% of children received preventive oral health services during only PCP visits (n = 29,642). Among these children, about 16% (n = 6,728) had 4 or more PCP visits.

Thirty-three percent of children received CRT during ages 3 to 5 yr (Table). Children who had early preventive dentist visits were more likely to have CRT. Analysis of variance indicated that CRT and payments differed significantly among children visiting PCPs, dentists, or both before their third birthday.

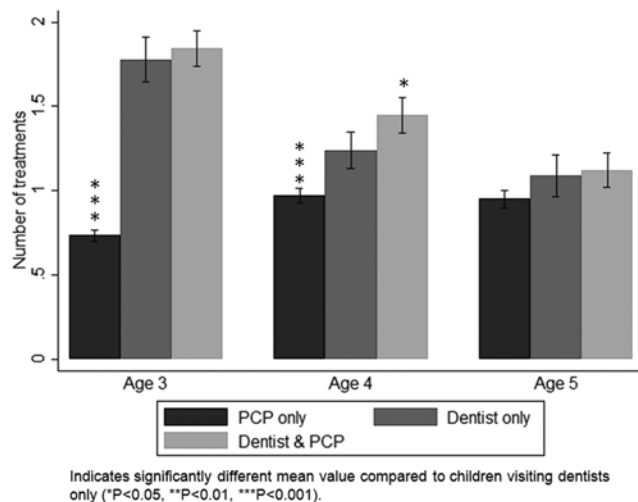


Figure 1. Adjusted mean number of caries-related treatment (CRT) per child, by age and provider.

Unadjusted mean \pm SD annual CRT and payments were lowest among children who had only PCP visits (CRT = 0.87 ± 2.96 ; payment = $\$172 \pm \$1,865$) and higher among children with only dentist visits (CRT = 1.48 ± 3.17 ; payment = $\$234 \pm \853) and both PCP and dentist visits (CRT = 1.52 ± 3.48 ; payment = $\$273 \pm \$1,018$).

Expected Number of CRT

Results from the regression model predicting mean CRT are provided in Appendix Table 2. Children with dentist visits with or without PCP visits had a significantly greater predicted number of mean CRT at ages 3 and 4 yr than children having only PCP visits; however, these differences attenuated each year after age 3 yr (Figure 1). The average expected annual number of CRT decreased 39% for children who had dentist visits: dentist only, 1.78 at 3 yr (95% CI = 1.64, 1.91) to 1.09 at 5 yr (95% CI = 0.97, 1.22); both, 1.84 at 3 yr (95% CI = 1.74, 1.95) to 1.12 at 5 yr (95% CI = 1.02, 1.23). Children who had only PCP visits before age 3 yr experienced a 29% increase in mean CRT from ages 3 to 5 yr: 0.74 at 3 yr (95% CI = 0.70, 0.77) to 0.95 at 5 yr (95% CI = 0.90, 1.00).

Expected CRT Payment

Results from the hurdle model are provided in the far right columns of Appendix Table 2. The probability of having any CRT payments was significantly lower for children who received only PCP visits compared with children who visited dentists before age 3 yr at all ages; however, the probability of CRT for children with only PCP visits increased 81% from 3 to 5 yr of age (Figure 2). Among children with CRT, annual expected payments decreased over time by more than 30% for all children.

Mean annual Medicaid payments for CRT—calculated by multiplying the probability of having any CRT and the expected annual payment conditional on having CRT—were lowest at all ages for children who had PCP visits before age 3 yr: 3 yr = $\$132$ (95% CI = $\$123, \140), 4 yr = $\$157$ (95% CI = $\$149,$

$\$166$), and 5 yr = $\$148$ (95% CI = $\$139, \157) (Figure 3). For children who received prevention during dentist visits, the highest payments occurred at age 3 yr—dentist only = $\$282$ (95% CI = $\$256, \309) and both = $\$301$ (95% CI = $\$280, \323)—but decreased by about 41% by age 5: dentist only = $\$166$ (95% CI = $\$145, \187) and both = $\$173$ (95% CI = $\$158, \188). At age 5 yr, CRT payments for children who had only PCP visits or only dentist visits were not significantly different.

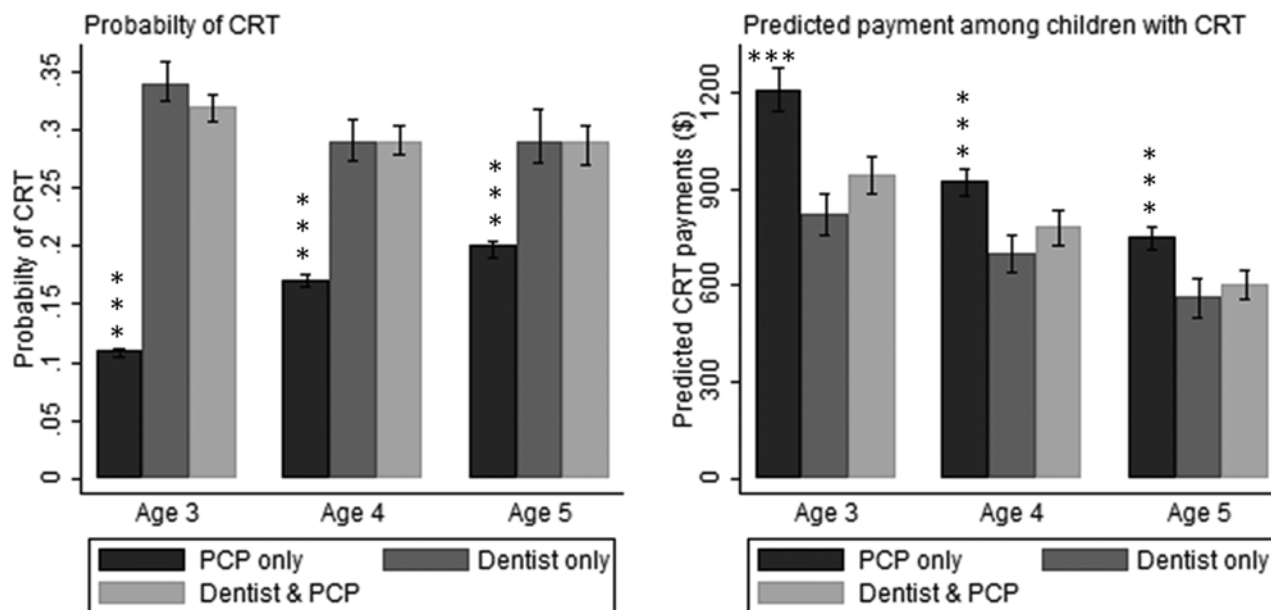
DISCUSSION

Most state Medicaid programs reimburse PCPs for delivering preventive oral health services in medical offices (Sams *et al.*, 2013), yet little is known about how treatment outcomes may differ for children visiting PCPs compared with dentists. Using Medicaid claims, we examined whether the provider of preventive oral health services (PCP, dentist, or both) before 3 yr of age is associated with the number of CRT received and CRT payments during ages 3 to 5 yr.

Contrary of our hypothesis, children who had only PCP visits before their third birthday received fewer CRT and had lower CRT payments on average than children who received preventive services from dentists. We hypothesize that CRT may be lower for children with PCP visits because of improved oral health, poor access to dental treatment, or a combination of both factors.

PCP visits may reduce CRT because of children's increased opportunity to receive multiple fluoride varnish applications, which can prevent caries, especially when applied as new teeth emerge (Holve 2008; Lawrence *et al.*, 2008; Slade *et al.*, 2011; Stearns *et al.*, 2012). Oral health services were allowed during approximately 3 PCP visits per year after most teeth erupt. In this sample, children who visited only PCPs before age 3 yr had more visits on average (2.7 visits) than children visiting only dentists (2.3 visits). With this reimbursement model and young children's increased likelihood of visiting medical offices compared with dentist offices, Into the Mouths of Babes and similar programs can provide more opportunities to reduce CRT than dentist visits alone. Twenty-five state Medicaid programs have dental periodicity schedules based on American Academy of Pediatric Dentistry (2013b) guidelines recommending that visits begin at age 1 yr and continue per risk status. However, 21 states' schedules do not specify referral to a dentist by age 1 yr (Hom *et al.*, 2013). If, as research suggests, multiple fluoride varnish applications at an early age reduce caries, insurers should promote reimbursement policies allowing preventive dental visits as indicated by individual needs.

The case mix of children utilizing each provider type may influence our results. Children who had only PCP visits before age 3 yr may be at low risk of developing caries due to the benefit of oral health services received or other unmeasured behavioral and social factors. Beil *et al.* (2012) reported that most children could likely delay their first dentist visit until age 3 without experiencing additional problems; when the dental workforce is constrained, the researchers recommend early dentist visits for children with caries and at highest risk. We adjusted for observed confounding by using propensity scores



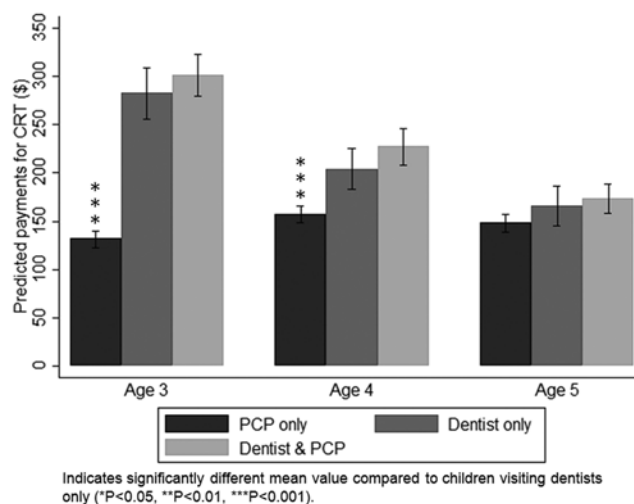
Indicates significantly different mean value compared to children visiting dentists only (*P<0.05, **P<0.01, ***P<0.001).

Figure 2. Adjusted probability of caries-related treatment (CRT) and expected payment (results for each part of hurdle model), by age (yr) and provider.

with inverse probability of treatment weights, but unobserved factors could still bias our estimates due to reverse causality.

Poor access to treatment could also explain why PCP visits were associated with fewer CRT. North Carolina implemented this program to improve access to preventive oral health services for young children who faced barriers to dentists, such as workforce shortages and dentists' low rate of Medicaid participation (Seale and Casamassimo, 2003; U.S. Government Accountability Office, 2010; Fraher *et al.*, 2012). As children aged, we observed a decrease in CRT for children with dentist visits and an increase for children with only PCP visits. This finding suggests different treatment patterns, where CRT is possibly delayed for children visiting PCPs. Although we lack information about disease severity, children with only PCP visits had the lowest probability of receiving CRT and the highest expected payments among children receiving CRT (Figure 2), suggesting that extensive treatment is received by a select group of children. If some children received only PCP visits because they were unable to visit a dentist, then untreated dental problems may compound and lead to more extensive and costly treatment.

As hypothesized, children who visited both dentists and PCPs tended to have more CRT and higher payments, likely because PCPs refer children with caries. Notably, 99% of children with both dentist and PCP visits first visited a PCP, suggesting that a referral played a role in many of these dentist visits. This physician referral behavior is consistent with American Academy of Pediatrics guidelines recommending that physicians faced with a limited dental workforce immediately refer young children with caries and provide preventive services to low-risk children until a regular dental provider can be established (American Academy of Pediatrics, 2008).



Indicates significantly different mean value compared to children visiting dentists only (*P<0.05, **P<0.01, ***P<0.001).

Figure 3. Adjusted mean caries-related treatment (CRT) payment (combined results from hurdle model), by age (yr) and provider.

This study has several limitations. Administrative claims data do not provide information on clinical status; thus, we cannot comment on CRT needed but not received. Additional information about children, such as clinical status, brushing practices, and caregiver characteristics, would help us to better understand utilization decisions and treatment outcomes. Although data were from a single state, 46 state Medicaid programs reimburse fluoride varnish delivered in medical offices. Additional research is needed to examine the current, widely implemented Into the Mouths of Babies program (Rozier, 2012).

As the number of nondental PCPs delivering preventive oral health services grows, it is important to compare CRT and associated payments for children receiving preventive oral health services from PCPs, dentists, or both before age 3. We found that PCP visits were associated with fewer CRT and lower payments than dentist visits. PCP visits provide more opportunities to reduce CRT than dentist visits due to the current reimbursement model and children's increased likelihood of visiting medical offices. Additional work is needed to determine if CRT differs because of improved oral health, poor access to dental treatment, or a combination of both factors.

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