

Early Preventive Dental Visits: Effects on Subsequent Utilization and Costs

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ABSTRACT. *Objective.* To determine the effects of early preventive dental visits on subsequent utilization and costs of dental services among preschool-aged children.

Design. This investigation studied North Carolina children who were enrolled continuously in Medicaid from birth for a 5-year period. Our research design was a longitudinal cohort study that relied on 4 large administrative datasets, including North Carolina composite birth records from 1992, Medicaid enrollment and claims files from 1992 to 1997, and the Area Resource File. Our outcome measures included type of use and dentally related costs.

Results. Of the 53 591 Medicaid-enrolled children born in 1992, 9204 were continuously enrolled for 5 years and met our inclusion criteria. Twenty-three children had their first preventive dental visit before 1 year of age, 249 between 1 and 2 years, 465 between 2 and 3 years, 915 between 3 and 4 years, and 823 between 4 and 5 years. Children who had their first preventive dental visit by age 1 were more likely to have subsequent preventive visits but were not more likely to have subsequent restorative or emergency visits. Those who had their first preventive visit at age 2 or 3 were more likely to have subsequent preventive, restorative, and emergency visits. The age at the first preventive dental visit had a significant positive effect on dentally related expenditures, with the average dentally related costs being less for children who received earlier preventive care. The average dentally related costs per child according to age at the first preventive visit were as follows: before age 1, \$262; age 1 to 2, \$339; age 2 to 3, \$449; age 3 to 4, \$492; age 4 to 5, \$546.

Conclusions. Our results should be interpreted cautiously, because of the potential for selection bias; however, we concluded that preschool-aged, Medicaid-enrolled children who had an early preventive dental visit were more likely to use subsequent preventive services and experience lower dentally related costs. In addition, children from racial minority groups had significantly more difficulty in finding access to dental care, as did those in counties with fewer dentists per population. *Pediatrics* 2004;114:e418–e423. URL: www.pediatrics.org/cgi/doi/10.1542/peds.2003-0469-F; *early childhood caries,*

preventive dental visit, cost, first dental visit, Medicaid dental use.

ABBREVIATIONS. ECC, early childhood caries; NC, North Carolina; DPCR, number of dentists per 10 000 population according to county of residence.

Early childhood caries (ECC) is defined as dental decay among children ≤ 5 years of age.¹ It is estimated that 2% of infants 12 to 23 months of age in the United States have at least 1 tooth with questionable decay, whereas 19% of children 24 to 60 months of age meet the criteria for ECC.²

ECC is much more prevalent among children from low-income families; for example, among children 3 to 5 years of age in Head Start, the prevalence of ECC has been reported to be as high as 90%.^{3,4} Untreated caries is concentrated disproportionately among children from the lowest family income levels, and the incidence decreases as income increases.² Among children 2 to 5 years of age who are living at or below the federal poverty level, almost 80% of their decayed primary teeth have not been restored.² Dental care is the most prevalent unmet health care need of poor US children of all ages, with preschool-aged children being especially vulnerable.⁵

ECC has far-reaching effects beyond the consequences of decayed teeth. Children with ECC are significantly more likely to weigh $< 80\%$ of their ideal body weight and to experience failure to thrive.⁶ Tooth decay not only affects children's overall health; it has other ramifications, including children's hours lost from school and parents' hours lost from work. The lost hours disproportionately burden lower-income, minority, and uninsured children.⁷

Anticipatory guidance is the process of providing practical, developmentally appropriate information about children's health to prepare parents for significant physical, emotional, and psychologic milestones.⁸ It is well accepted among physicians that using anticipatory guidance during well-child medical visits is an effective tool for educating parents about how to ensure the best possible health for growing children. Recently the American Academy of Pediatrics adopted new recommendations regarding the inclusion of oral health in anticipatory guidance during well-child visits.⁹ The recommendations specify that the first dental risk assessment should occur beginning at 6 months of age and that the establishment of a dental home should occur by 1

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year of age for children considered to be at risk for dental caries.⁹

The American Academy of Pediatric Dentistry and the American Dental Association recommend that the first dental visit should occur no later than 12 months of age.¹⁰ In dental anticipatory guidance, parents are counseled regarding infant oral hygiene, home- and office-based fluoride therapies, dietary factors, oral habits, and dental injury prevention.¹⁰ The dental profession embraces the concept that, with early intervention, it may be possible to reduce or eliminate future dental caries.¹¹

Because untreated dental disease increases in severity, necessitating more extensive and costly treatment secondary to postponing care, timely intervention has the potential to reduce overall costs associated with dental treatment among preschool-aged children. For example, Iowa Medicaid-participating children <6 years of age who were treated for ECC in hospital or ambulatory care settings represented <5% of those receiving dental care but consumed 25% to 45% of the dental resources.¹² The total cost to the Iowa Medicaid program for hospital-based general anesthesia was more than \$2000 per child in that investigation.¹² A similar study from Washington state concluded that 19% of the pediatric dental emergencies were related to ECC; of those cases, more than one-half involved children ≤ 3.5 years of age.¹³ These studies emphasize that early prevention can translate into significant cost savings for dental care, especially for families at or below the poverty level, among which caries rates are dramatically higher for children ≤ 3 years of age.

There is substantial evidence that our current oral health care strategies for high-risk, preschool-aged children in the United States need to be reassessed. ECC represents a significant financial and societal burden, but it is a preventable condition. ECC also is a condition for which the timeliness of prevention and/or early intervention is critical. To date, there have been no reported cost studies that have addressed the timing of the initial dental visit for high-risk children; therefore, the objectives of this investigation were to 1) characterize age at the first preventive dental visit in a large population of preschool-aged children at high risk for dental caries, 2) examine the effects of age at the first preventive dental visit on subsequent use of dental services, and 3) examine the effects of age at the first preventive dental visit on dentally related costs.

METHODS

Data and Sample Selection

This was a 5-year, institutional review board-approved, cohort study of Medicaid-enrolled children born in North Carolina (NC) in 1992, who were monitored longitudinally until their fifth birthday in 1997. We relied on 4 administrative NC datasets, 1) composite birth records from the 1992 calendar year, 2) individual Medicaid-eligibility files for all children born in 1992 and enrolled continuously in the Medicaid program from 1992 to 1997, 3) Medicaid dental claims data covering 1992–1997, and 4) the Area Resource File. Maternal age, education, marital status, and race were obtained from the composite birth record. We relied on the Area Resource File to obtain a workforce variable that was defined as the number of dentists per 10 000 population according to county of residence (DPCR). Children were excluded if 1) there

was >1 Medicaid identification number, 2) periods of Medicaid enrollment before the date of birth were indicated, or 3) the children were not enrolled continuously from 1992 to 1997.

Variable Definitions

Our outcome measures included claims filed through Medicaid for oral health care services. We categorized outcome variables according to 1) the type of subsequent visits (preventive, restorative, or emergency) and 2) dentally related costs. Contemporary Dental Terminology codes and associated reimbursement from the Medicaid dental claims dataset allowed us to determine the type of visit and cost of services. For example, claims for a periodic oral evaluation and dental cleaning were included as a preventive visit, whereas claims for a limited oral evaluation were included as an emergency visit. A limited oral examination was defined as a focused or emergency examination only.

Our major explanatory variable was age at the first preventive dental visit. This variable was measured as the age for the first preventive visit claim filed for each child. We examined the children according to age groups, as follows: <1 year, 1 to 2 years, 2 to 3 years, 3 to 4 years, and 4 to 5 years. We anticipated that some children would have a nonpreventive dental visit before having a preventive visit. To control for this eventuality, we created an independent variable for previous nonpreventive dental visits (restorative or emergency).

Statistical Analyses

We determined the relationship of early preventive dental visits to subsequent use and costs by using various multiple regression analyses with control variables. Several analytical challenges needed to be considered. Because our investigation monitored children for 5 years, the dataset contained multiple observations per child, which could result in correlated error terms and biased results. To control for this problem, we used robust SEs and controls for data clustering in all regression analyses.

We used probit analyses (logistic regression) for each type of oral health care service used. The type of service was classified as preventive, restorative, or emergency. If a child had a hospital emergency department claim with a primary diagnosis of dental caries (*International Classification of Diseases, 9th Revision*, code 521.0), then the claim was included as an emergency visit. These visit types were coded as 0 or 1, to represent each type of visit per year, as indicated by Medicaid claims. Because dentally related costs were continuous variables, we relied on a multivariate linear regression model.

Maternal age, education, marital status, and race have been reported consistently to be important variables related to access to oral health care services, and many of these variables were recorded in the composite birth record. Therefore, we included them in the estimation models. All analyses were performed with the Stata-7 statistical package (Stata Corp, College Station, TX), with a level of significance of $\alpha = .05$ for all statistical tests.

RESULTS

Sample Population

There were 81 518 live births in NC in 1992, with 53 591 of those children being enrolled in Medicaid. NC Medicaid income eligibility is 185% of the federal poverty level before 1 year of age and then decreases to 133% of the federal poverty level. Because of this policy, we expected a significant decrease in the number of Medicaid enrollees after the first birthday; in our sample, the number of enrollees decreased from 53 591 to 26 310. Approximately 17% of the children born in the Medicaid program remained enrolled continuously during the 5-year study period, yielding a final population of 9204 children for our study. At birth, the mothers' mean age was 23 years (range: 14–46 years), the mothers' mean educational level was grade 11 (range: grade 6 to grad-

uate degree), 73% of the mothers were unmarried, and 69% of the children represented a minority race. The mean DPCR was 7 (range: 0–27).

Dental Use by High-Risk, Preschool-Aged Children

Approximately one-third of the sample had a dental visit during the study period. Twenty-seven percent of the children had their first preventive visit before age 5, 18% had at least 1 restorative visit before age 5, and 14% had at least 1 emergency visit before age 5.

Figure 1 illustrates the profile of the first preventive visits. Twenty-three children (0.24%) had their first preventive dental visit before 1 year of age, 249 (2.7%) between 1 and 2 years, 465 (5.1%) between 2 and 3 years, 915 (9.9%) between 3 and 4 years, and 823 (8.9%) between 4 and 5 years.

Age at the First Preventive Dental Visit and Subsequent Use of Dental Services

Children who had their first preventive dental visit by age 1 were more likely to have subsequent preventive visits ($P < .05$) but were not more likely to have subsequent restorative ($P = .18$) or emergency ($P = .61$) visits. As Tables 1, 2, and 3 illustrate, this finding is in sharp contrast to the results for children who had their first preventive visit at age 2 or 3. Children in the latter age groups were more likely to have subsequent preventive visits but also were more likely to have subsequent restorative and emergency visits ($P < .05$).

Minority race and DPCR were the only independent variables consistently significant for each type of visit and all age groups ($P < .05$). Minority children were less likely to have subsequent preventive visits, restorative visits, or emergency visits, whereas children from counties with greater DPCRs were more likely to have subsequent dental visits of all types.

Age at the First Preventive Dental Visit and Dentally Related Costs

The average dentally related cost for each child during the 5 years of the study was \$147 per child. When we examined only the children who used dental services, the average cost to Medicaid was \$447 per child during the study period. Figure 2 illustrates the average dentally related cost per child according to the age at the first preventive dental visit. Our analysis revealed that the age at the first preventive

dental visit had a positive and significant influence on cost. The dentally related costs per child were \$262, \$340, \$450, \$492, and \$547 for the respective age groups. Minority race was associated with lower dentally related costs and greater DPCR was associated with higher dentally related costs ($P < .05$).

DISCUSSION

Population and Methods

Of the 53 591 NC children born in 1992 in the Medicaid program, 9204 met our inclusion criteria. This phenomenon was expected and is commonly observed in studies of this type. A change in eligibility criteria after year 1 reduced the sample size by ~50%. The sample size was reduced to 17% by our reliance on continuous enrollment during the study period. We relied on continuous enrollment to account for children who moved on and off the Medicaid records, because such changes in enrollment status had the potential to bias the results with unobserved visits when the children were not enrolled. Although it is not perfect, reliance on continuous enrollment is the accepted method for investigations using children's Medicaid claims data.^{14,15}

Effects of Dental Providers on Access to Care

We found DPCR to have a significant relationship with the use of dental services, suggesting that the availability of dental providers played a significant role in access to dental care for young children at high risk. This seems intuitively correct because, in counties with fewer dentists per population, low-income families such as those on Medicaid might have difficulty accessing dental care. These findings corroborate those of the NC Institute of Medicine study, which reported that the availability of dental providers in NC had a significant effect on access to dental care for low-income children.¹⁶ The implications of these findings are significant for this state, where population growth trends suggest an increasing number of low-income infants and young children, who are highly likely to be at risk for dental caries. The situation is worse because NC is ranked 47th in the nation in the number of dentists per population.

Taken together, our findings suggest that addressing the oral health needs of low-income children will require a team approach, with a commitment from all pediatric health care providers. This underscores

Fig 1. Age at the first preventive dental visit for the study sample.

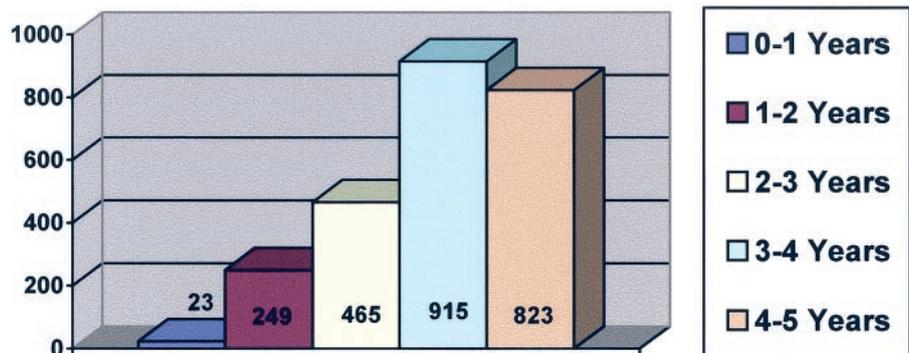


TABLE 1. First Preventive Visit by Age 1 Year and Type of Subsequent Visits

	Regression Coefficient (SE)		
	Preventive	Restorative	Emergency
Preventive visit by age 1 y	4.64* (0.750)	1.137 (0.849)	0.160 (0.311)
Control variables			
Maternal education	0.0148 (0.0015)	-0.0082 (0.0118)	-0.0003 (0.004)
Maternal age	0.0089 (0.0069)	0.0141 (0.0078)	0.0026 (0.0020)
DPCR	0.068† (0.0097)	0.0540* (0.0110)	0.0139* (0.0040)
Unmarried	-0.222‡ (0.099)	-0.0207 (0.112)	-0.0418 (0.04)
Nonwhite	-0.342* (0.0918)	-0.586† (0.103)	-0.0951† (0.038)
Constant	2.79* (0.221)	2.06* (0.244)	0.444* (0.87)

* Significant, $P < .01$ level.† Significant, $P < .05$ level.‡ Significant, $P < .10$ level.**TABLE 2.** First Preventive Visit by Age 2 Years and Type of Subsequent Visits

	Regression Coefficient (SE)		
	Preventive	Restorative	Emergency
Preventive visit at age 1–2 y	4.08* (0.214)	2.89* (0.246)	0.677* (0.0919)
Control variables			
Previous restorative visit	1.26 (1.33)	-0.305 (1.54)	0.496 (0.575)
Previous emergency visit	0.353† (0.566)	0.807 (0.652)	0.302 (0.242)
Maternal education	0.014 (0.099)	-0.0081 (0.0114)	-0.0088 (0.0043)
Maternal age	0.008 (0.0066)	0.0146 (0.0077)	0.0027 (0.0028)
DPCR	0.067† (0.0093)	0.0535* (0.0107)	0.0134* (0.0040)
Unmarried	-0.229‡ (0.095)	-0.0246 (0.109)	-0.0441 (0.0408)
Nonwhite	-0.190‡ (0.088)	-0.475* (0.101)	-0.0785† (0.0379)
Constant	2.52* (0.211)	1.85* (0.244)	0.407* (0.091)

* Significant, $P < .01$ level.† Significant, $P < .05$ level.‡ Significant, $P < .10$ level.**TABLE 3.** First Preventive Visit by Age 3 Years and Type of Subsequent Visits

	Regression Coefficient (SE)		
	Preventive	Restorative	Emergency
Preventive visit at age 2–3 y	2.59* (0.114)	2.35* (0.125)	1.004* (0.054)
Control variables			
Previous restorative visit	2.47* (0.351)	2.22* (0.381)	0.567* (0.164)
Previous emergency visit	-0.151 (0.313)	0.541 (0.341)	0.242‡ (0.146)
Maternal education	0.014 (0.0089)	-0.0073 (0.0097)	-0.0010 (0.0042)
Maternal age	0.0103 (0.0059)	0.0176 (0.0065)	0.0032 (0.0027)
DPCR	0.0554* (0.0084)	0.038* (0.009)	0.0111* (0.0039)
Unmarried	-0.194† (0.095)	-0.0499 (0.093)	-0.0351 (0.0400)
Nonwhite	-0.0351‡ (0.078)	-0.217* (0.086)	-0.0521‡ (0.0331)
Constant	1.91* (0.191)	1.05* (0.207)	0.269* (0.089)

* Significant, $P < .01$ level.† Significant, $P < .05$ level.‡ Significant, $P < .10$ level.

the wisdom of the recommendations of the recently adopted American Academy of Pediatrics policy, which urges pediatricians to embrace oral health guidance during well-child visits starting at 6 months of age.⁹ Pediatricians offer great potential to add to the workforce of oral health care providers, because they can help address oral health through anticipatory guidance and refer high-risk infants and young children. As an example of a statewide program to address a workforce problem, a statewide NC prevention program (Into the Mouth of Babes) that encourages primary care physicians and community health clinics to provide early preventive dental services was initiated in 2001. This program provides reimbursement to physicians for oral health risk assessment, screening, fluoride application, and

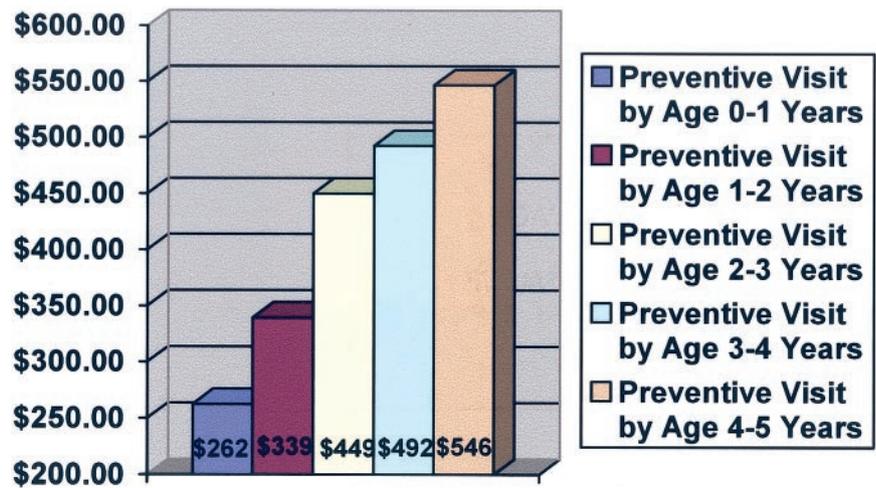
provision of oral health education to NC children on Medicaid. The goals of this program are to increase access to preventive dental services for children on Medicaid, who tend to have limited resources and limited access to dental care.¹⁷

We hope that our findings will help mobilize the dental profession to provide support for the age 1 dental visit, as recognized by the American Dental Association and the American Academy of Pediatric Dentistry. Our findings underscore the potential impact of preventive intervention for high-risk school-aged children.

Disparities in Dental Use

We found that minority race had a negative impact on all measures of use. The lower utilization of ser-

Fig 2. Predicted, dentally related, cumulative costs according to age at the first preventive visit.



vices by minority children on Medicaid was substantiated by Dasanayake et al,¹⁸ who found that, among Alabama children on Medicaid, fewer blacks than whites received dental care. Several issues might have influenced the low utilization rates among our minority children. Lack of transportation and limited appointment availabilities were reported by caregivers as 2 reasons they felt discouraged from seeking dental care for their children covered by Medicaid.¹⁹ In addition, it has been reported that dental patients feel more comfortable with a provider of their own race.¹⁹ This could have influenced minority utilization in our study, because <10% of the practicing dentists in NC represent minorities,²⁰ whereas ~38% of NC residents ≤5 years of age are of minority populations.²¹

Timing of the First Preventive Visit

Children who had their first preventive dental visit by age 1 were more likely to have subsequent preventive visits but were not more likely to have subsequent restorative or emergency visits. Children who had their first preventive visit at age 2 or 3 were more likely to have subsequent preventive, restorative, and emergency visits. This finding raises the following question: what factors might have been operating to explain why children who started dental care by age 1 followed a pattern of less invasive care than did those who started dental care later? There are several explanations to be considered. The first explanation is selection bias. It is possible that children who were examined by age 1 were the children of parents who were the most motivated to provide the best possible oral health care for their children. This parental behavior would be expected to carry over into home care, diet, and nutrition, all factors that would lead to improved oral health.

A second rationale to explain why children who started preventive care earlier fared better might be related to positive outcomes from the oral health anticipatory guidance given to the parents who took their children to an early preventive visit. Oral health anticipatory guidance has not been the subject of systematic investigation but, as in the case of pediatric medicine, there are good reasons to hypothesize

that early parental education and timely intervention and/or referral can lead to improved health outcomes and reduced costs.

Delay of the First Preventive Visit and the Effect on Costs

Our most noteworthy results revealed that the average dentally related costs were less for children who received earlier preventive care. As illustrated in Fig 2, the average cost per child showed a clear trend toward escalation as the first preventive visit was delayed. The average dentally related cost per child during the 5 years of the study was \$447 for those who used dental services; however, for children who had their first preventive visit before age 1, the average cost per child was \$263.

Many factors contribute to the costs of dental care. Although our findings cannot explain all of the reasons for escalating costs secondary to delay of the first dental visit, our data clearly indicate that this phenomenon occurs. We did find that the average cost per child could be dramatically increased with increases in the number of children treated in the operating room. In our study, 348 children were treated in the operating room before age 5, and 70% of those children had not had a previous preventive visit.

The use of anticipatory guidance in the context of well-child medical visits during the first 2 years of life has been shown to decrease the number of hospitalizations among poor and near-poor children, irrespective of race and health status.²² Our findings suggest that oral health anticipatory guidance may follow a similar trend.

Limitations

Our results must be viewed in light of their limitations. The first limitation was that this was a retrospective cohort study and there was potential for selection bias, as discussed already. This issue was addressed previously. We recognize that a prospective study would be the ideal design for examination of our research questions; however, undertaking such a study and obtaining the same sample size would be a daunting task. A second shortcoming of

our study was that we could not determine caries levels for each child, because we relied on dental claims data for our outcome measures. On the basis of previous research among low-income children,^{2,3,5} we anticipated that this population would be at high risk for dental disease and would benefit from an early preventive dental visit. Knowledge of disease rates would have allowed us to determine how early preventive services affected subsequent caries rates.

A third limitation was that we limited our sample to children who were continuously enrolled in the NC Medicaid program from birth to their fifth birthday, which substantially reduced our sample population. However, this did allow us to control for children who had gaps in their Medicaid coverage and might have had dental visits outside the Medicaid program during those gaps. Such unobserved dental visits would have limited our ability to describe accurately the subsequent use of dental services and the costs of dental services during the 5-year study period.

CONCLUSIONS

This investigation examined preschool-aged children with Medicaid dental coverage who were at high risk for dental disease. Broad generalization of our findings should be made with caution; under the conditions of this study, however, we conclude the following. 1) Preschool-aged children were more likely to receive dental services of all types in counties with greater DPCRs. 2) Preschool-aged children from racial minority groups had greater difficulty in finding access to dental care. 3) Preschool-aged children who had an early preventive dental visit were more likely to use preventive services subsequently. 4) Preschool-aged children who used early preventive dental care incurred fewer dentally related costs, compared with children who began care at a later time.

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