# Dental Caries and Treatment Need in Schoolchildren Related to Medicaid Enrollment

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## Abstract

Objectives: This study compared dental caries status and treatment need in four groups of children: those not enrolled in Medicaid, those enrolled in Medicaid who used dental services prior to a dental survey, those enrolled in Medicaid who used services after the survey, and those enrolled in Medicaid who did not use dental services. Methods: This study used data on 6,620 children 5 to 18 years of age, who were representative of North Carolina schoolchildren and who participated in a statewide oral health survey in 1986-87. Clinical results from the survey were linked with a separate data base of Medicaid claims and enrollment files from 1984 to 1992. With this link, the surveyed children were classified into the four study groups and dental status compared. Results: Medicaid-enrolled children who used services prior to the survey had the highest caries prevalence of all groups (DMFS=1.74 at ages 6 to 11 years), and had fewer treatment needs (D/DMFS=19%) than children outside of Medicaid (DMFS=0.95, D/DMFS=33%). Enrolled children who never used dental services had a caries prevalence (DMFS=0.83) similar to children outside of Medicaid, yet had greater unmet treatment need (D/DMFS=62%). Conclusions: Caries prevalence did not differ substantially among groups; however, the level of unmet treatment did vary. Some Medicaid-enrolled children had a significant portion of their restorative treatment needs met. [J Public Health Dent 1997;57(3):163-70]

Key Words: oral health status, dental caries, treatment need, Medicaid population, children.

Most children below the federal poverty level who receive dental care do so through the Medicaid program, a federal-state-administered program that provides health care for certain low-income individuals (1). In 1991, more than \$709 million were spent to provide dental services to approximately 5.2 million Medicaid recipients nationwide (2). All states are required by federal law to provide some level of emergency, preventive, and restorative dental care to children who are enrolled in the Early and Periodic Screening, Diagnosis, and Treatment Program (EPSDT). The intent of EPSDT is to provide screening, preventive services, and comprehensive care to all Medicaid-eligible children from birth to 21 years of age (3).

Medicaid dental data bases rarely have been used for analytic or evaluative research. The reports available present limited aggregate data on the annual number of recipients, number of dental procedures, and costs of care (4-7). Little information is available at the national or state level regarding the dental status and treatment needs of Medicaid-enrolled children. No data are available comparing the dental status of enrolled children who use Medicaid dental benefits with enrolled children who do not use them.

Although national surveys show a general decline in children's dental caries levels, higher levels of disease and unmet treatment need remain in minority and in lower socioeconomic status (SES) populations (8). In these studies, different criteria have been used to define SES—for example, the level of parental education or the child's participation in a subsidized school lunch program (9). Assumptions about the dental status of children in Medicaid can be drawn from these studies; however, the criteria used may define a different population of lower SES children than the Medicaid-enrolled population.

This study is the first to examine the dental status of a sample of children who are defined according to their Medicaid enrollment. Its purpose is to compare the sociodemographic characteristics, dental status, and treatment needs of the following groups of North Carolina schoolchildren: children not enrolled in Medicaid, children who used Medicaid dental services prior to a dental survey, children who used Medicaid dental services after the survey, and children enrolled in Medicaid who never used services.

## Methods

Study Design. This study is a secondary data analysis of three data bases linked together for the purposes of the study. The first data base is derived from a cross-sectional, statewide, epidemiologic survey of the oral health status of North Carolina children in grades K through 12, which was conducted in 1986–87 (10). The second and third data bases are North Carolina Medicaid claims and enrollment files, respectively, which were constructed during 1984–92 as part of the state's Medicaid Management Information System.

**Oral Health Survey.** This survey was based on a probability sample with a stratified cluster design in which the sampling unit was the class-

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Caries experience in the primary and permanent dentitions was measured using diagnostic criteria from the 1968 Conference on the Clinical Testing of Cariostatic Agents (11). Sealants were recorded as present when any portion of a sealant remained, regardless of the caries or restoration status of that surface. Treatment need was determined using the NIDR Dental Restorative Treatment Need (DRTN) Index (12). A permanent tooth was determined to need a sealant if an explorer "caught" in a pit and fissure area without any obvious signs of decay. In this study, treatment need refers to restorations and extractions and excludes the need for other types of preventive care, sealants, or periodontal treatment. Examiner reliability was assessed by determining the percent agreement and kappa statistic for assigned scores at the level of the tooth surface, the tooth, and the person. A more detailed account of the sampling, examination, and examiner reliability methods has been reported in the survey document (10).

Each child's age, race, sex, and participation in the subsidized school lunch program were obtained from school records. Educational level of the child's mother or guardian was obtained through a question included on the form requesting parental consent for the child's participation in the survey. The degree of urbanism of the child's residence was based on characteristics of the county in which the sampled classrooms were located. "Urban" was defined at the county level where 50 percent or more of the total population resided in cities having a minimum population of 50,000 or in places of 2,500 or more inhabitants outside of urbanized areas.

Medicaid Files. Medicaid claims and enrollment files for state fiscal years 1984–92 were linked to the epidemiologic survey data from 1986–87. The claims file contained information on all dental services reimbursed by Medicaid from 1984 to 1992 for persons under 21 years of age. Sociodemographic variables on the claims file included name, date of birth, sex, race, and county of residence. This file had a yearly average of 126,000 paid claims for 62,000 patients under 21 years of age and a total of approximately 2.4 million procedures over the entire study period.

The enrollment file was a listing of those persons living in North Carolina who had applied to the Department of Social Services, who were determined to be eligible for benefits at any period of time during 1984–92 and who elected to enroll in the program. The variables of name, date of birth, sex and county of residence were included on these files.

Merging Data Bases. The oral health survey, claims, and enrollment files had no unique identifiers, such as a social security number, for data linkage purposes. They did have the following nine items in common: first name, middle initial, last name, day of birth, month of birth, year of birth, sex, race, and county of residence. For linkage purposes, two additional matching variables were created-the first four letters of the last name and year of birth plus or minus one year—for a total of 11 potential matching variables. A computer algorithm was devised to link the survey and Medicaid claims files based on the number of variables they had in common. In step one, an exact match was made on all 11 matching variables. The remaining unmatched records were involved in the second step where the matching criteria were allowed to relax by one variable. Multiple computerized iterations were made that progressively relaxed the matching criteria to eight matching variables. Records with 10, nine, or eight matching variables were hand matched.

Out of 775 schoolchildren whose survey and claims files matched, 42 percent matched on all 11 variables, 39 percent matched on 10 variables, 15 percent matched on nine variables, and the remaining 4 percent matched on eight variables. Using the same computer algorithm, the survey file was then matched with the enrollment file to identify another 727 children who had a period of enrollment, but who did not generate a claim. Visual inspection of records with seven or fewer matched variables between the survey file and the claims and enrollment files revealed a substantial probability of a false match. These records were deemed nonmatches and assigned to the non-Medicaid group. The procedure followed for maintaining confidentiality of records was approved by the Division of Medical Assistance.

Definition of Terms. As a result of linking claims and enrollment files to the survey file, the 8,026 children in the survey were categorized into four groups: (1) non-Medicaid—a group who had no history of Medicaid enrollment from 1984-92; (2) pre-users-Medicaid users who were enrolled at some period of time from 1984 to 1992 and who used dental benefits prior to their examination for the survey in 1986-87, and also possibly after the survey; (3) post-users-Medicaid users who were enrolled at some period of time from 1984 to 1992 and who used benefits after the survey only; and (4) nonusers-Medicaid children who were enrolled at some period of time from 1984-92 and who never used dental services. For purposes of this study, enrollees were defined as children who were Medicaid eligible, whose parents or guardians applied on their behalf for Medicaid benefits, and who were enrolled as a result of the state's eligibility determination process. The non-Medicaid group contained children who were not eligible for Medicaid services, as well as those who were eligible, but who did not enroll in the program. It was not possible to distinguish eligible, nonenrolled children as a separate group in the data bases available for this study.

All children classified as Medicaid users (both pre- and post-survey) and Medicaid nonusers had at least one period of enrollment. Users were individuals who generated at least one Medicaid-covered dental claim, while nonusers generated no claims. The users were divided into pre- and postsurvey, since it is only in pre-survey users that an association between prior Medicaid dental care and subsequent dental status, as measured in the 1986-87 survey, could be made. Eighty-six percent of the pre-user group also had a dental claim after the survey.

Medicaid eligibility in North Carolina is determined every six months with the result that a child can come in and out of eligibility, thus interrupting continuity of care. Not all children who are eligible for Medicaid benefits become enrolled in the program and not all enrolled children use benefits. In 1989, while approximately 77 percent of North Carolina's Medicaid-enrolled adults and children used medical benefits, 23 percent used dental benefits (13).

Sample Population. The epidemiologic survey was designed to be representative of all school-going children in North Carolina in 1986–87. The subsequent determination of enrollment status by linking the survey with Medicaid files does not affect the representativeness of the original survey sample. The four groups are regarded as subsets of the survey population that had the additional feature of information on their Medicaid status.

Analysis. Dental caries in the primary teeth was described with the decayed and filled surface index (dfs) and in the permanent teeth with the decayed, missing, and filled surface (DMFS) index. The percent of the dfs or DMFS score represented by untreated caries was calculated as the individual count of decayed surfaces divided by the individual count of dfs or DMFS, after selecting on those individuals with dfs or DMFS greater than zero. A measure of missing teeth due to caries was calculated as the percent of children with one or more missing permanent teeth.

Tests for differences among groups were conducted for four parameters: (1) mean dfs and DMFS scores, (2) the proportion of children with no caries experience (dfs=0 or DMFS=0), (3) the proportion of children needing any treatment (restorations and/or extractions), and (4) the percent of dfs or DMFS scores represented by untreated caries. The percentage of children with sealants and with missing permanent teeth were reported for the groups. Comparisons of mean DMFS scores were made with survey linear regression based on ANOVA. Comparisons of proportions were made with Pearson's chi-square tests. Comparisons of pairwise d/dfs and D/DMFS ratios were made with Ttests. An overall significant F or chisquare test for the comparison of multiple groups was followed by pairwise testing. Significance was determined through a two-sided P-value at the .05 level. Estimations for the final population parameters for the dental vari-

		Medicaid		
Characteristic	Non-Medicaid (n=6,385)	Presurvey Users (n=337)	Postsurvey Users (n=436)	Nonusers (n=720)
Age (Years)				-
5-12	54	69	70	58
13–18	46	31	30	42
Race				
Nonwhite	25	72	64	63
Sex				
Female	47	50	59	62
School lunch				
Subsidized	21	81	73	63
Not subsidized	72	14	22	32
Unknown	7	5	5	5
Residence				
Urban	55	58	58	60
Mother's education				
<high school<="" td=""><td>15</td><td>31</td><td>36</td><td>29</td></high>	15	31	36	29
≥ High school	71	48	50	51
Unknown	14	21	14	20

ables were computed using SUDAAN (14). The survey design was taken into account by applying weights that reflect the probabilities of subject selection and by calculating corrected standard errors to adjust for intraclass-room correlation (10).

## Results

**Sociodemographic Characteristics.** Out of 8,026 subjects in the survey aged 5 to 20 years, 1,502 (19%) were linked with the Medicaid data base. Sociodemographic information was obtained from all 8,026 subjects aged 5 to 20 years. Out of 8,026 subjects, 6,649 participated in the clinical examination, for an overall response rate of 83 percent. The response rate was similar across the four study groups, being 84 percent, 81 percent, 86 percent, and 85 percent for non-Medicaid, pre-survey users, post-survey users, and nonusers, respectively.

Individuals aged 19 and 20 years (n=148) were excluded from this analysis due to their small number. Sociodemographic information is reported for the remaining 7,878 children aged 5 to 18 years. From a total of 6,649 subjects who participated in the clinical examination, 29 individuals aged 19 and 20 years were excluded

and dental parameters are reported for 6,620 children aged 5 to 18 years. Among these 6,620, information was complete for all variables except parental education and the school lunch program, which was available for 87 percent and 90 percent of children, respectively.

Table 1 summarizes the demographic characteristics of the 7,878 subjects aged 5 to 18 years who were selected for the survey. Compared to the non-Medicaid group, children in the three Medicaid enrolled groups were slightly younger and predominantly nonwhite and female. The mean ages in years (and standard deviations) for non-Medicaid, pre-user, post-user and nonuser groups were 11.6 (3.9), 10.4 (3.7), 10.3 (3.7), and 11.3 (3.8), respectively. The Medicaid groups had a greater percent of participants in the subsidized school lunch program compared to the non-Medicaid group. All groups were similar in the degree of urbanism of their residence. Approximately onehalf of Medicaid-enrolled children had mothers with a high school education, compared to 71 percent of children in the non-Medicaid group.

Dental Status. A comparison of the status of the primary dentition in chil-

TABLE 2 Status of Primary Teeth in Children Aged 5–9 Years, by Study Group

		Medicaid		
Status	Non-Medicaid	Presurvey	Postsurvey	Nonusers
Measure	(n=2,008)	Users (n=131)	Users (n=188)	(n=222)
Mean dfs (SE)*	4.03 (0.20) <sup>a</sup>	7.97 (0.84) <sup>b</sup>	4.84 (0.54) <sup>c</sup>	3.94 (0.38) <sup>d</sup>
% with dfs=0†	49 <sup>a</sup>	24 <sup>b</sup>	39 <sup>c</sup>	37 <sup>d</sup>
d/dfs x 100‡	38 <sup>a</sup>	29 <sup>b</sup>	67 <sup>c</sup>	53 <sup>d</sup>

\*F-test (Wald) for group effect (3df) F=8.72, P<.001. Pairwise comparisons: (a to b) P<.001; (a to c) P=.17; (a to d) P=.83; (b to c) P<.001; (c to d) P=.18; (b to d) P<.001.

<sup>†</sup>Chi-square for general association (3df)=41.05 P < .001. Pairwise comparisons: (a to b) P < .001; (a to c) P = .02; (a to d) P < .001; (b to c) P = .01; (c to d) P = .79; (b to d) P = .02.

 $\ddagger$ T-test for difference in paired ratio estimates: all pairwise comparisons significant at *P*<.001 except (c to d) *P*=.06.

TABLE 3	
Status of Permanent Teeth in Children Aged 6-11 Years, by Study Group	р

Status Measure		Medicaid		
	Non-Medicaid (n=2,379)	Presurvey Users ( <i>n</i> =157)	Postsurvey Users (n=202)	Nonusers (n=280)
Mean DMFS (SE)*	0.95 (0.07) <sup>a</sup>	1.74 (0.30) <sup>b</sup>	0.98 (0.18) <sup>c</sup>	0.83 (0.12) <sup>d</sup>
% with DMFS=0†	74	63	73	73
D/DMFS x 100‡	33 <sup>a</sup>	19 <sup>b</sup>	63 <sup>c</sup>	62 <sup>d</sup>
% with missing teeth	0.1	0.6	0.0	0.4

\*F-test (Wald) for group effect (3df) F=2.75, P=.02. Pairwise comparisons: (a to b) P=.01; (a to c) P=.83; (a to d) P=.32; (b to c) P=.03; (c to d) P=.45; (b to d) P<.001.

<sup>†</sup>Chi-square for general association (3df)=6.16 P=.11.

 $\pm$ T-test for difference in paired ratio estimates: all pairwise comparisons significant at P<.001 except (c to d) P=.76.

ment need was for restorations, with 6 to 8 percent of children needing extractions.

Table 6 shows treatment requirements in the permanent dentition for children aged 6 to 18 years. Medicaid post-users and nonusers have similar proportions of treatment need (32% and 27%), which are significantly higher than the other two groups. The pre-user group has the lowest level of treatment need (15%) compared to the other Medicaid groups. Virtually all of the treatment need was for restorations. The need for extractions was approximately 1 percent in all groups.

The prevalence of sealants in permanent teeth of children aged 6 to 18 years varied across groups. The non-Medicaid group (13%) and pre-user group (11%) had a similar sealant prevalence. Lower sealant prevalence was found in post-users (7%) and nonusers (5%). The percent of children needing sealants was 36 percent, 30 percent, 49 percent, and 43 percent in the non-Medicaid, pre-user, post-user, and nonuser groups, respectively.

## Discussion

During the past two decades, a dramatic decline in the prevalence of dental caries has occurred among schoolaged children (15). This decline is attributed primarily to fluoride intake from various sources (16,17). However, millions of children still have significant levels of dental caries, with 75 percent of this disease concentrated in 25 percent of the population (18).

Previously reported results from North Carolina's three statewide dental surveys (1960–62, 1976–77, and 1986–87) are pertinent to this study (10). All children have experienced a substantial decline in DMFT scores

dren aged 5 to 9 years (Table 2) shows that the pre-user group had the highest caries experience, with a mean of 7.97 dfs per child. This score was significantly different from scores in the other groups. Scores for the non-Medicaid, Medicaid post-survey, and Medicaid nonuser groups did not differ. When compared to the non-Medicaid group, all three Medicaid groups showed lower proportions of children who were free of caries and restorations (dfs=0) in primary teeth. Medicaid pre-users and post-users showed extremes in the percent of the dfs score represented by untreated decay, with pre-users having the lowest percent of untreated decay (29%) and post-users having the highest percent (67%). All groups showed significant differences in untreated decay except for post-users (67%) and nonusers (53%).

Table 3 shows the status of permanent teeth for children at ages 6 to 11 years. The mean DMFS score was significantly higher in the pre-user group (1.74) compared to the other three groups (0.83–0.98). The proportions of children with no caries experience (DMFS=0) showed no statistically significant differences across groups. The untreated caries component of the DMFS score was lowest in the pre-user group (19%) and highest in the postuser group (63%). The post-user and nonuser groups did not differ in the untreated caries component.

At ages 12 to 18 years (Table 4), the mean DMFS score for the pre-user group (7.60) was significantly higher than scores of the three other groups, which did not differ. Although the nonuser group had the lowest caries experience in their permanent teeth (34% with DMFS=0), the percent of their mean DMFS score represented by untreated decay was relatively high (31%). Post-users had the highest percent of untreated decay (45%), while pre-users had the lowest percent (9%).

Table 5 shows the percent of children aged 5 to 9 years who required some treatment in the primary dentition. The three Medicaid groups had a similar and significantly higher percent of children who needed some treatment than the non-Medicaid group. Although the proportion of children needing dental treatment varied between non-Medicaid and Medicaid groups, the distribution of kinds of treatment needed was similar. In all groups the majority of treatand in treatment need over time; however, these declines have differed by race. In 1960, 12- to 17-year-old whites had a mean of 2.2 more DMFT per child than nonwhites of the same age. Over two decades, scores for white children declined more steeply, with the result that whites and nonwhites had similar scores in 1986. Nonwhites have experienced the greatest change in the percent of the DMFT score represented by F (fillings), with the proportion increasing from approximately 10 percent in 1960 to 65 percent in 1986. In whites, the corresponding figures are 40 percent in 1960 and 85 percent in 1986. In addition, the 1986 survey found that the prevalence of dental caries was greatest in those children whose parents had low education and that treatment need was greatest in those with low parental education who were also nonwhite (10)

Dental Status in Medicaid and non-Medicaid Groups. This study found that the absolute difference between caries experience scores in Medicaid and non-Medicaid groups was less than one surface per person in the permanent teeth. This finding suggests that children from a broad range of SES levels have benefited from the decline in caries prevalence in North Carolina, as they have nationally, over the past two decades.

Caries in the primary dentition is considered a serious problem in Medicaid children because of the finding of low proportions (24% to 39%) of caries-free children aged 5 to 9 years. Health Care Financing Administration data from 1993 show that only 19 percent (4.2 million out of 21.2 million) of eligible Medicaid children received EPSDT-mandated preventive dental services in 1993, a slight decrease from the 22 percent who received services in 1992. Children younger than 5 years of age were less likely to be reached with EPSDT dental services than children aged 6 to 20 years (19). Given the problems of high disease in primary teeth found in this study, more programmatic focus should be placed on reaching younger children with EPSDT-mandated screening and preventive services.

The greatest absolute difference in scores was in the primary dentition within the Medicaid population, being slightly more than four dfs (7.97 dfs in pre-users vs 3.94 dfs in nonusers). The

Status Measure		Medicaid			
	Non-Medicaid (n=2,692)	Presurvey Users (n=104)	Postsurvey Users (n=137)	Nonusers (n=293)	
Mean DMFS (SE)* % with DMFS=0† D/DMFS x 100‡	5.19 (0.16) <sup>a</sup> 27 <sup>a</sup> 17 <sup>a</sup>	7.60 (0.69) <sup>b</sup> 16 <sup>b</sup> 9 <sup>b</sup>	5.30 (0.54) <sup>c</sup> 23 <sup>c</sup> 45 <sup>c</sup>	4.79 (0.42) <sup>d</sup> 34 <sup>d</sup> 31 <sup>d</sup>	
% with missing teeth	5.1	7.7	8.8	7.5	

\*F-test (Wald) for group effect (3df) F=4.67, P<.001. Pairwise comparisons: (a to b) P<.001; (a to c) P=.84; (a to d) P=.35; (b to c) P=.01; (c to d) P=.46; (b to d) P<.001.

†Chi-square for general association (3df)=13.21 P=.01. Pairwise comparisons: (a to b) P=.02; (a to c) P=.30; (a to d) P=.02; (b to c) P=.28; (c to d) P=.02; (b to d) P<.001.

 $\ddagger$ T-test for difference in paired ratio estimates: all pairwise comparisons significant at *P*<.001 except (c to d) *P*=.04.

 

 TABLE 5

 Percent of Children Aged 5–9 Years Requiring Treatment in Primary Teeth, by Study Group

Treatment Needed		Medicaid		
	Non-Medicaid (n=2,008)	Presurvey Users (n=131)	Postsurvey Users (n=188)	Nonusers (n=222)
None needed Some*	76 24 <sup>a</sup>	65 35 <sup>b</sup>	55 40 <sup>c</sup>	59 41 <sup>d</sup>

\*Chi-square for general association (3df)=39.31 P<.001. Pairwise comparisons: (a to b) P=.04; (a to c) P<.001; (a to d) P<.001; (b to c) P=.08; (c to d) P=.39; (b to d) P=.31.

 TABLE 6

 Percent of Children Aged 6–18 Years Requiring Treatment in Permanent Teeth,

 by Study Group

		Medicaid		
Treatment	Non-Medicaid	Presurvey	Postsurvey	Nonusers
Needed	(n=5,071)	Users (n=261)	Users (n=339)	(n=573)
None needed	82	85	68	73
Some*	18 <sup>a</sup>	15 <sup>b</sup>	32 <sup>c</sup>	27 <sup>d</sup>

\*Chi-square for general association (3df)=44.86 P<.001. Pairwise comparisons: (a to b) P=.32; (a to c) P<.001; (a to d) P<.001; (b to c) P<.001; (c to d) P=.12; (b to d) P<.001.

finding that presurvey users had both the highest mean dfs and DMFS scores and the lowest proportion of untreated decay in both dentitions warrants further study. The pre-user group could have had more disease initially, and their scores could have become inflated through greater dental utilization. This group may have had more continuous Medicaid enrollment, which enabled greater utilization, and possibly had greater access to dental services through local county and school programs.

The higher level of DMFS among the pre-user group compared to the post-user group cannot be attributed to the lack of sealant reimbursement in Medicaid prior to 1986 and to an anticipated increase in sealant use after 1986. Providers used both restorations and sealants in the pre-user group; sealant prevalence as captured by the 1986–87 survey showed similar levels in the pre-user group (11%) and the non-Medicaid group (13%). Even after the sealant benefit was introduced in 1985, sealant application continued at a low level in the Medicaid population.

The possibility of overtreatment as an explanation for higher dfs and DMFS scores in the pre-user group cannot be addressed by this study. A longitudinal analysis at the tooth level would be required to address this possibility. Despite the substantial amount of restorative care the preuser group received, 35 percent of children in this group still had remaining unmet treatment need in primary teeth.

Unmet Treatment Need. One of the most important findings of this study is the difference in unmet treatment needs among the four groups. The Medicaid pre-user group had the greatest percentage of restorative treatment needs met at all ages (the decayed components of their dfs and DMFS scores were lowest, and the filled components were the highest). The post-user group had the greatest level of unmet treatment need at all ages. The finding that one segment of the Medicaid population experienced more access to care and had greater utilization while other enrollees did not is an important area for further study.

Studies indicate that the low-income child's access to dental services is restricted by a number of factors, including low provider participation (1). The number of dentists in North Carolina who filed at least one Medicaid dental claim from 1983 to 1988 declined. To increase provider participation, the state enacted fee increases of 7 percent in 1988 and 5 percent in 1989 and 1990 (20). For the 1989 to 1992 period, both general and pediatric dentists saw larger numbers of recipients and received higher average reimbursement rates (21). During the 1983–88 decline in provider participation, it is possible that post-survey users failed to identify dentists willing to provide treatment, while they succeeded in doing so after 1988, when provider participation increased. An important research question is whether post-users and nonusers tried

and failed to identify a provider willing to provide treatment or did not try to access care. The question of why children who were enrolled in Medicaid did or did not obtain dental care cannot be answered by this study. Additional studies involving interviews of children, parents, providers, and program administrators would be required to pursue the underlying reasons for different utilization patterns.

The differences in unmet treatment need between users and nonusers might be due to the dynamics of Medicaid eligibility. Research indicates that a Medicaid population is composed of two populations: "short-term" enrollees experiencing short spells of poverty, and continuous enrollees experiencing persistent poverty (22). In North Carolina, eligibility status (and enrollment) is redetermined for an individual every six months during an interview. Perhaps the nonuser group in this sample was composed of shortterm enrollees who dropped in and out of eligibility, causing a disruption in their access to care. The finding that 86 percent of the pre-user group also had a dental claim after the survey suggests that this group had continuity in enrollment, which led to greater utilization.

Little research is available regarding the effectiveness of Medicaid as a dental care delivery system and the adequacy of care that children receive. Past reports on barriers to care, low utilization of dental benefits, and low provider participation have led to the perception that Medicaid dentistry does not serve its target population well (1,19). The low level of missing teeth and low need for extractions in North Carolina enrollees suggest that treatment through the Medicaid system is not emergency, extraction-oriented dentistry. While the Medicaid program resulted in a significant amount of restorative care for one group of enrollees, more research is needed to determine whether the program promotes oral health. This study underestimated overall treatment need by focusing only on restorative treatment need.

According to US national surveys, the prevalence of sealants in children aged 5 to 17 years has increased from 7.6 percent in 1986–87, to 19 percent in 1988–91 (23,24). Sealants were introduced in North Carolina as a Medicaid benefit in 1985, approximately one year before the statewide dental survey. Evidence that the level of sealant utilization in Medicaid pre-users (12%) reached nearly the level in the non-Medicaid group (13%) after one year is encouraging. However, sealants were underutilized in all groups, regardless of Medicaid status. This finding raises concern over the possibility of achieving the US Public Health Service year 2000 oral health objective targeting a sealant prevalence of 50 percent among 8- and 14-year-olds (25).

The year 2000 objectives also state that at age 6 to 8 years, no more than 30 percent of lower SES children (parents with less than a high school education) and 20 percent of higher SES children (parents with high school or greater) should have untreated decay in their primary or permanent teeth. In our sample of 6- to 8-year-olds, 54 percent of children with parents having low education and 28 percent of children with parents having higher education had untreated decay in their primary or permanent teeth, regardless of Medicaid status. Forty-nine percent of Medicaid children and 29 percent of non-Medicaid children at 6 to 8 years of age had untreated decay in their primary teeth. These findings highlight substantial differences in unmet treatment need by SES.

Accuracy of Medicaid Files. The accuracy of the Medicaid files can be measured to a limited extent through reviews conducted by the federally mandated Medicaid Management Information System (MMIS). Each Medicaid claim is subjected to a series of checks to determine the validity of claims reimbursements and eligibility status. Federal guidelines impose penalties if more than 3 percent of program payments are made in error on an annual basis. During 1988, North Carolina's error rate was the second lowest in the nation, and fifth lowest for the prior year (13).

The accuracy of linking the survey and Medicaid files can be estimated indirectly. The computer algorithm was designed to capture all potential matches and each match was visually checked. The accuracy of the link also depended upon the accuracy of the nine matching variables (name, age, sex, etc.) that were recorded on the survey form and on the Medicaid files. The survey data were judged to be accurate because they were recorded by classroom teachers who were familiar with the children and then optically read onto computer files. Quality control procedures on reimbursement and eligibility status and the prior approval requirement for most dental services would contribute to the accuracy of the Medicaid files.

Strengths and Limitations. Any association between dental status and Medicaid classification must be made with caution. This association depends on the assumption that the four groups are different from one another and that characteristics that distinguish them, such as Medicaid enrollment and utilization behavior, remained fairly constant over time. Only in the pre-survey user group can the association between Medicaid dental care received in the past and survey findings be determined.

The retrospective classification of children into four groups by evidence of a single dental claim or enrollment episode most likely resulted in some misclassification. For example, children close to poverty in the non-Medicaid group and children in the three Medicaid groups could be similar. A child with only one dental claim in the pre- or post-user group could be similar to a nonuser in dental status. The impact of different patterns of enrollment upon utilization of dental services and oral health status is an area for future investigation.

This study assumes that users obtained their dental care from Medicaid providers and that providers filed claims for reimbursement for all care provided under the Medicaid system. If users went outside the Medicaid system to obtain treatment, the extent to which the Medicaid system met their needs has been overestimated by the survey results. If dentists provided "charity" care to Medicaid enrollees and did not file claims because of administrative barriers, the extent to which Medicaid provided care also was estimated incorrectly. Survey findings of restorations and missing teeth in the post-user and nonuser groups indicate that these children have sought dental care outside of the Medicaid system, or have received "charity" care. There is no information available to determine the extent to which these events took place.

Because Medicaid policies regarding benefits, eligibility, and reimbursement vary from state to state, the results of this study cannot be generalized to situations found in other state programs. However, the general findings and methods used in this study will be of interest to other state programs. The sample population was unique in that it was representative of the state's school-going children who had experience with the Medicaid program.

Although the DRTN index has been used in two national surveys, its internal and external validity have not been established (26). The use of this index has its limitations because disagreement about needed treatment can exist among examiner-epidemiologists, between the epidemiologist and the clinician, and among clinicians. The DRTN does not predict needed treatment precisely, yet it gives an adequate approximation for the purposes of policy development, program planning, and evaluation. The validity of the sealant need score used during the survey also has not been established.

This study makes use of a unique opportunity to link and analyze existing data bases. The merging of epidemiologic data with claims and eligibility data provides a key component that is missing from other Medicaid data bases. The findings of this study emphasize the need for improving access to dental care for Medicaid-enrolled children and for increasing the utilization of sealants.

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#### References

- 1. US Congress, Office of Technology Assessment. Children's dental services under the Medicaid program—background paper. Washington, DC: US Government Printing Office, 1990: report no OTA-BO-H-78.
- Health Care Financing Administration, Office of the Actuary. A statistical report on Medicaid. Baltimore, MD: HCFA, 1992.
- 3. Yudkowsky BK, Fleming GV. Preventive health care for Medicaid children. Health Care Fin Rev 1990;Suppl:89-96.
- Waldman HB. Is Medicaid dentistry worth the effort? Compendium 1991;12: 515-18.
- 5. Waldman HB. Some results of the increases in NY state dental fees. NY State Dent J 1989;55:32-3.
- 6. King-Sutton B. The North Carolina dental Medicaid program: ongoing effects of

the 1981 congressional budget cuts. J Nat Dent Assoc 1985:9-16.

- Faine R, Isman R. The use of dental sealants in the Washington State medical assistance program: a second-year report. ASDC J Dent Child 1989;56:450-1.
- Capilouto E. Improving the oral health of at-risk children. J Health Care Poor Underserv 1991;2:132-45.
- Clark BJ, Graves RC, Webster DB, Triol CW. Caries and treatment patterns in children related to school lunch program eligibility. J Public Health Dent 1987;47: 134-8.
- Rozier RG, Dudney GG, Spratt CJ. The North Carolina school oral health survey, 1986-87. Raleigh, NC: NC Division of Dental Health, 1991.
- 11. Radike AW. Criteria for diagnosis of dental caries. In: Proceedings of conference on the clinical testing of cariostatic agents, Oct 14-16, 1968. Chicago: American Dental Association, 1972.
- 12. National Institute of Dental Research. Dental treatment needs of United States children 1979-1980. The National Dental Caries Prevalence Survey. Bethesda, MD: National Institutes of Health, 1982; NIH pub no 83-2246.
- Division of Medical Assistance. Medicaid in North Carolina: annual report state fiscal year 1989. Raleigh, NC: NC Department of Human Resources, 1989.
- Shah BV, LaVange LM, Barnwell BG, Killinger JE, Wheeless SC. SUDAAN: procedures for descriptive statistics user guide. Research Triangle Park, NC: Research Triangle Institute, 1989.
- White BA, ed. Toward improving the oral health of Americans: an overview of oral health status, resources, and care delivery. Public Health Rep 1993;108:657-72.
- Brunelle JA, Carlos JP. Recent trends in dental caries in US children and the effect of water fluoridation. J Dent Res 1990; 69(Spec Iss):723-7.
- Burt B. Trends in caries prevalence in North American schoolchildren. Int Dent J 1994;44(Suppl 1):403-13.
- National Institute of Dental Research. Oral health of United States children: the National Survey of Dental Caries in US Schoolchildren, 1986-87. Bethesda, MD: NIDR, 1989; NIH pub no 89-2247.
- Department of Health and Human Services, Office of the Inspector General. Access and utilization of children's dental services in the EPSDT program. Working draft. Washington, DC: DHHS, Oct 1995; OEI-09-93-00240.
- Jones JL. The use of pit-and-fissure sealants in the North Carolina Medicaid population. Raleigh, NC: Division of Dental Health, NC Department of Environment, Health and Natural Resources, 1989.
- Venezie RD, Vann WF, Cashion SW, Rozier RG. Pediatric and general dentists' participation in the North Carolina Medicaid program: trends from 1986-92. Pediatr Dent 1997;19:114-17.
- Short PF, Cantor JC, Monheit AC. The dynamics of Medicaid enrollment. Inquiry 1988;25:504-16.
- 23. Brunelle JA. Prevalence of dental sealants in US schoolchildren [Abstract].

- J Dent Res 1989;68(Spec Iss):183. 24. Selwitz RH, Winn DM, Kingman A, Zion GR. The prevalence of dental sealants in the US population: findings from NHANES III, 1988-91. J Dent Res 1996; 75(Spec Iss):652-60.
- 25. Public Health Service. Healthy People 2000: national health promotion and dis-ease prevention objectives. Washington, DC: USPHS, 1990; DHHS pub no (PHS) 91-50212.
- 26. Pollick HF, Pawson IG, Martorell R, Men-

doza FS. The estimated cost of treating unmet dental restorative treatment needs of Mexican-American children from southwestern US HHANES, 1982-83. J Public Health Dent 1991;51:195-204.