SCIENTIFIC ARTICLES

Using Insurance Claims and Demographic Data for Surveillance of Children's Oral Health

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Abstract

Objectives: *This paper examines the utility of using private insurance and Medicaid dental claims as well as demographic data for assessing the oral health of children aged 5–12 years in Genesee County, Michigan, communities.* ***Methods:*** *Dental insurance claims data from Delta Plan of Michigan and Michigan Medicaid, plus demographic data from the 1990 US Census (percent poverty) and from the 1995 National Center for Educational Statistics (percent free or reduced lunch eligibility), were compared to findings from two school-based oral health surveys. These surveys were the 1995 Genesee County Oral Health Survey and the 1998–2001 Mott Children's Health Center oral health screenings. Data were analyzed using zip codes, representing communities, as the comparison unit. Statistical comparisons using correlation coefficients were used to compare the findings from the six data sets.* ***Results:*** *Using the insurance claims and school-based data, some communities consistently demonstrated high levels of dental caries or treatment for the primary dentition. The demographic measures were significantly associated with many of the primary dentition survey measures. The demographic data were more useful in identifying communities with high levels of dental disease, particularly in the primary teeth, than the insurance claims data.* ***Conclusions:*** *When screening is not practical, readily available demographic data may provide valuable oral health surveillance information for identification of high-risk communities, but these data do not identify high-risk individuals. In these analyses, demographic data were more useful than dental insurance claims data for oral health surveillance purposes. [J Public Health Dent 2004;64(1):5-13]*

Key Words: dental caries, dental insurance, epidemiology, oral health, poverty, surveillance, dental health survey.

Surveillance in public health is the systematic and ongoing collection, analysis, and interpretation of outcome-specific data for planning, implementation, and evaluation of public health practice (1). Healthy People 2010 (2) refers specifically to surveillance data collection for evaluation of progress toward the oral health objectives. Objective 21.16 is to "Increase the number of states and the District of Columbia that have an oral and craniofacial surveillance system." The Centers for Disease Control and Prevention (CDC) and the Association of State and Territorial Dental Directors (ASTDD) recently collaborated to develop the National Oral Health Surveillance System (NOHSS), a monitoring program for several indicators of oral health, using data from national and state-based surveys (3). CDC, in 2001 and 2002, also allocated $2.6 million to 12 states and one territory to improve their public oral health services, including the development of oral health surveillance systems (4,5).

Dental surveys involving complete oral examinations of sampled persons traditionally have been used to describe the oral health of a community (6). Dentistry has usually demanded, and depended upon, population surveys for its data. We have grown accustomed to using data that come from representative samples collected by standardized examiners, as in the National Health and Nutrition Examination Survey (NHANES) series (7), and some of the recent statewide surveys (8-10). These surveys usually yield excellent data, but are expensive and time consuming, require highly trained personnel, take time before data are available, and do not always have the data in a form that can be used readily for some public health purposes.

One approach to easing the burden of the traditional survey is to simplify the data collection. ASTDD recently introduced a simplified oral health survey method that has been used in some states (11). Practical and quick data collection approaches have proven useful for surveillance in Michigan (12) and Georgia (13). But even the World Health Organization's inexpensive and simplified "Pathfinder" survey methodology, with its bare-bones approach, is still not well accepted and not widely implemented in the industrialized countries.

This current project was developed to find quick and inexpensive methods for oral health surveillance for children. We realized that new surveillance procedures would require a different way of thinking about data collection and interpretation, including the use of data from nonrepresentative population groups and practitioners, and would most likely use only a few markers of oral health rather than a multitude of variables that are commonly collected in standard surveys. The purpose of this project was to

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evaluate the validity and utility of nontraditional data sources, in this instance dental insurance claims and demographic data, to conventional school oral health survey data for evaluating the oral health of a community. We were fortunate in having data from two school-based oral health surveys to compare to the insurance and demographic data. Using an ecologic approach, the objective of this study was to be able to identify communities, represented by zip codes, that demonstrated high levels of dental needs.

Methods

Data. Data from six different sources were utilized in this study and are described below. All protocols for this project were approved by Human Subjects Committees of the University of Michigan and Mott Children's Health Center (MCHC) in Flint, MI.

1. Genesee County Oral Health Project (GCOHP), 1995

These data were from a survey of 806 children in grades 1 to 4 in 11 school districts and 20 schools in Genesee County. A probability sampling method was used to obtain a representative sample for the county. Trained teams from the University of Michigan School of Public Health and MCHC conducted the school-based oral exams that included a caries examination using National Institute of Dental and Craniofacial Research (NIDCR) criteria (14). Passive (negative) parental informed consent was used, in which parents were required to sign and return a form requesting that their child not participate in the oral examinations. Response rate was 66.7 percent. Currently, passive consent is not considered appropriate for this type of screening survey. The data were entered during the examinations using portable personal computers and custom-made direct data entry software using Epi Info (15). Data were deidentified for analysis. From these data, the number of decayed and filled tooth surfaces (dfs) for the primary dentition of 6–7-year-old children and the number of decayed, filled, and missing tooth surfaces (DMFS) for the permanent dentition of 9–10-year-old children were calculated for the zip code of each school.

2. Mott Children's Health Center (MCHC) School Oral Health Screening, 1998–2001

These data were from a series of oral health screenings of elementary schoolchildren in grades K–6 in Genesee County as part of a school-based dental sealant program. In the 1998–99 school year 6,643 students participated from 27 schools. In the 1999–2000 school year 6,465 children participated from 28 schools. In the 2000–01 school year 6,027 children participated from 45 schools. All K–6 grade classrooms in the schools were included in the screenings. Screenings were conducted by trained MCHC pediatric dentist faculty and residents and included a full caries examination using NIDCR criteria (14). Children needing dental sealants had the opportunity to receive them through the MCHC sealant program conducted at the schools. Children with restorative needs were referred for further treatment. Examinations in the 1998–2000 school years were conducted with written parental passive (negative) consent, in which parents who did not wish their children to participate were required to sign and return the consent form. Because of changes in human subjects protocols, for the 2000–01 school year examinations, written positive parental consent was required, in which parents who did wish their children to participate were required to sign and return the consent form. No participation rate data was available for 1998–99, but participation was 74.2 percent for 1999–2000 and 42.0 percent for 2000–01. The data were entered during the examinations using portable personal computers and custom-made direct data entry software using Microsoft Access (16). Data were deidentified for analysis. From these data, dfs for the primary dentition of 6–7-year-old children and the DMFS for the permanent dentition of 11–12-year-old children were calculated for each zip code.

3. Delta Dental Plan of Michigan

TABLE 1
Sample Size, Primary Dentition Analyses

Zip Code Area	Delta Dental Plan of Michigan	Michigan Medicaid	Genessee Co. Oral Health Proj.	Mott Children's Health Ctr.
Atherton	59	80		
Beecher	258	2,442	66	1,407
Bendle	58	271	37	484
Bentley	118	89		337
Byron	37	249		
Carman—Ainsworth	230	174	40	
Clio	275	177	41	650
Davison	402	99	89	
Fenton	272	972		
Flint—Central	230	874	56	161
Flint—Kearsley	236	1,848		123
Flint—NW	465	646	57	635
Flint—South	257	92	31	155
Flushing	399			
Gaines	62		35	
Goodrich	72			
Grand Blanc	499	115	29	
Lakeville	84			222
Lennon	42	47		
Linden	159	38	46	289
Millington	88	56		
Montrose	73	74		
Mt. Morris	213	647	47	1,312
Swartz Creek	271	71		
All	4,859	9,061	574	5,775

TABLE 2
Sample Size, Permanent Dentition Analyses

Zip Code Area	Delta Dental Plan of Michigan	Michigan Medicaid	Genessee Co. Oral Health Proj.	Mott Children's Health Ctr.
Atherton	128	67		
Beecher	506	1,476	113	294
Bendle	120	198		74
Bentley	222	61		49
Byron	66			
Carman—Ainsworth	411	150	48	116
Clio	485	161	35	
Davison	651	117	80	
Fenton	473	76		
Flint—Central	381	656	101	39
Flint—Kearsley	498	532	52	
Flint—NW	775	1,191	47	145
Flint—South	447	388	56	35
Flushing	617	52		
Gaines	92		34	
Goodrich	122			
Grand Blanc	703	52	41	
Lakeville	125			114
Lennon	90	37		
Linden	178		33	68
Millington	175	47		
Montrose	204	68		
Mt. Morris	382	437	51	228
Swartz Creek	490	53		
All	8,341	5,819	691	1,162

(DDPM), 1990–2000

These data came from de-identified dental insurance claims for children aged 1–12 years with Genesee County residence zip codes from 1990–2000. This data set included 1,187,902 procedures representing 35,586 persons treated by 2,382 dentists. Some of these children were treated outside of the Genesee County zip codes. For evaluation of the treatment of 7-year-old children, children had to have DDPM eligibility for at least one month per year from ages 1 to 7 years. From these data were calculated the total number of primary extracted or filled (restored) (efs) tooth surfaces. For evaluation of 12-year-old children, children had to have DDPM eligibility for at least one month per year from ages 6 to 12 and the total number of permanent extracted or filled tooth surfaces (EFS) of the permanent first and second molars was calculated. In addition, the proportion of the population enrolled for DDPM insurance in each zip code was calculated by dividing the number of children continuously enrolled in DDPM in 1995 with the number of children in the zip code area using the 1990 US Census population estimates for this age group.

4. Michigan Medicaid (MM), 1994–2001

These data consisted of de-identified dental insurance claims for children aged 1–12 years with Genesee County zip codes from 1994 to 2001. This data set included 517,423 procedures representing 31,086 persons and 886 dentists. For evaluation of the treatment of 7-year-old children, children had to have MM eligibility for at least one month per year from ages 1 to 7 years. For evaluation of 12-year-old children, children had to have MM eligibility for at least one month per year from ages 6 to 12 years. From these data, efs for ages 1–7 and EFS for ages 6–12 years were calculated. Additionally, the proportion of the population enrolled for MM insurance in each zip code was calculated by dividing the number of children continuously enrolled in MM in 1995 with the number of children in the zip code area using the 1990 US Census population estimates for this age group.

5. 1990 US Census

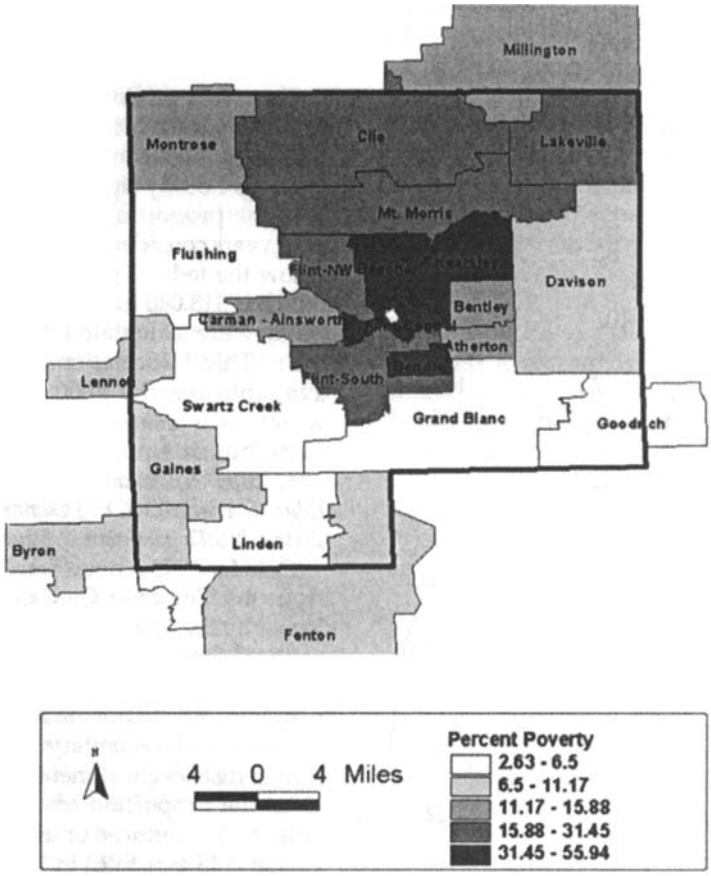
Data were obtained from STF3B zip code Census files accessed through the US Census Bureau Web site (17) for Genesee County zip codes. From these data the proportion of children aged 6–11 years considered to be living at or below the federal poverty level (FPL) which is $18,040 for a family of four in 2003, were calculated for each zip code. This information was not yet available for the 2000 US Census, which will use newly created Zip Code Tabulation Areas (ZCTA).

6. 1995 National Center for Educational Statistics (NCES) Common Core of Data—US Department of Education

Data for 1995 schools were obtained from the Common Core of Data collected by the National Center for Educational Statistics for the US Department of Education (18). This database contains information on all public elementary and secondary schools and school district enrollment. From these data, the proportion of children participating in reduced or free lunch programs (185% of FPL) in 1995 was calculated for schools in the Genesee County zip codes. We chose 1995 because that year was within the data collection years of 1990–2001 in this study.

Data Management and Analysis. Dental measures of dfs and DMFS from the two traditional school-based surveys were directly calculated from the database files. Management of the DDPM and MM data files included the transfer of claims and enrollment files from mainframe computer systems to personal computer compatible media. The claims data files were then merged with the enrollment data files to limit the analyses to children with at least one month of enrollment per year between ages 1–7 years for the primary dentition measures and ages 6–12 years for the permanent dentition measures. These files were then used to calculate the cumulative number of tooth surfaces with restorative or extraction procedures for primary teeth of children aged 1–7 years and for permanent teeth of children aged 6–12

FIGURE 1
Percent Poverty for Genesee County, MI, zip codes, 1990 US Census (16) (Community names have been used to identify the zip code areas. The thick boundary line is the Genesee County border.)



years for each insurance enrollee. Only children with at least one dental insurance claim over the six-year time periods were included in the analyses.

This project used an ecological, or correlational, study design. Our objective was to identify communities in which high levels of dental needs were demonstrated; therefore, zip codes, representing communities, were the comparison unit. Statistical comparisons using Spearman rank correlation coefficients and general linear models with Tukey multiple comparison tests were used to compare demographic characteristics and dental measures from the six different data sources. SAS statistical software (19) was used for all statistical analyses. Arc View version 3.1 was used to analyze and display graphically the zip code-based findings (20). Personal computers were used for all data management and analysis.

The data sources and the variables compared included:

1. GCOHP—dfs (ages 6–7 years) and DMFS (ages 9–10 years)
2. MCHC—dfs (ages 6–7 years) and DMFS (ages 10–11 years)
3. DDPM—efs (ages 1–7 years), EFS (ages 6–12 years), and the proportion of children in each zip code area enrolled in DDPM (% DDPM).
4. MM—efs (ages 1–7 years), EFS (ages 6–12 years), and the proportion of children in each zip code area enrolled in MM (% MM).
5. US Census—the proportion of children living at or below the US poverty level (% Pov)
6. NCES—proportion of children eligible for free or reduced cost lunch programs (% FRL)

Results

Number of Children. Tables 1 and 2 present the number of children by zip code included in the primary and permanent dentition analyses, respectively, from the GCOHP, MCHC, DDPM, and MM data sets. Zip codes were excluded if they had a sample size less than 25. The DDPM data set included persons from 24 Genesee County zip codes. Data from MM and the GCOHP included persons from 20 and 12 zip codes, respectively. For the MCHC primary dentition data, 11 zip codes were represented, while for the permanent dentition data 10 zip codes were represented. Data from the US Census and NCES included all Genesee County zip codes.

Socioeconomic Status (SES) Measures. Demographic comparisons were carried out for the Genesee County zip code areas. The proportion of children aged 6–11 years whose family income fell below the federal poverty level (US Census data), the proportion of elementary schoolchildren eligible for free or reduced lunch programs (NCES data), and the proportion of children aged 6–11 years enrolled in DDPM and MM dental insurance programs are shown in Table 3. The proportions of children in families below the poverty level are illustrated in the map of Genesee County (Figure 1). Community names have been used to identify the zip code areas. High concentrations of poverty are focused around the Flint metropolitan area, which is located in the center of the county. The Beecher and Bendle zip code areas and the Flint metropolitan area zip code areas (Flint Central, Flint Northwest, Flint Kearsley, and Flint South) demonstrated consistently low socioeconomic status (SES) measures with high proportions of children under the poverty level, high proportions of children eligible for free or reduced lunch, high proportions of children enrolled in Michigan Dental Medicaid, as well as low proportions of children enrolled in DDPM. Conversely, Flushing, Goodrich, Grand Blanc, Linden, and Swartz Creek zip code areas showed consistently high SES measures.

Primary Dentition Caries and Treatment Measures. Comparisons of the primary dentition measures of dfs and efs from the GCOHP, MCHC, DDPM, and MM data sets are shown in Table 4. All four groups showed significant differences ($P<.05$) between the zip codes using general linear models analyses. Tukey multiple comparison tests showed significant differences between many of the zip codes within each data set. Beecher, Bendle, and Flint Northwest were in

the top five rankings for both the GCOHP and MCHC data. From Table 4, no clear patterns appeared in either the DDPM or MM data for high primary tooth treatment rankings in comparison to the GCOHP and MCHC data. Interestingly, there apparently was an inverse ranking, with Beecher, Flint Central, and Flint Northwest appearing as the lowest rankings in the MM primary dentition data.

Permanent Dentition Caries and Treatment Measures. Comparisons of the permanent dentition measures of DMFS and EFS are shown in Table 5. Note that these data are only for permanent first and second molars in order to eliminate counting treatment for traumatic injuries to the anterior teeth or extractions for orthodontic purposes. No clear patterns appeared for high permanent tooth treatment rankings. While there were statistically significant differences ($P<.05$, General Linear Models) in scores in the GCOHP, MCHC, and MM data, the DDPM permanent tooth data showed no significant differences ($P=.3757$).

Associations Between Primary Dentition Measures and SES Measures. Spearman rank correlation coefficients between the primary dentition measures and the SES measures are shown in Table 6. For GCOHP dfs, MCHC dfs, and DDPM efs, most of the associations with the SES measures (% Pov, % FRL, % DDPM, % MM) were statistically significant or close to being significant. No significant associations were found between MM efs and the SES measures, which generally had inverse associations. Beecher, Bendle, Flint Northwest, and Flint Kearsley zip code areas had consistently low SES scores and corresponding high primary dentition measure scores. Swartz Creek, Goodrich, and Flushing zip code areas had high SES levels and generally low primary dentition measure scores. In general, the SES measures correlate highly with the school-based screening scores and the DDPM insurance claims primary tooth treatment measures, but not well with MM claims data findings.

Associations Between Permanent Dentition Measures and SES Measures. Spearman rank correlation coefficients between the permanent dentition measures and the SES measures are shown in Table 7. No significant associations were observed between these measures. The SES measures did not correlate highly with the permanent tooth measures.

TABLE 3
Demographic Measures of Genesee County Communities

Zip Code Area	% Poverty*	% MM†	% DDPM‡	% FRL¶
Atherton	11.7	27.6	35.6	37.4
Beecher	55.9	58.5	15.1	80.1
Bendle	32.2	37.2	14.0	43.0
Bentley	15.7	17.0	35.9	16.5
Byron	8.1	8.1	25.8	9.6
Carman—Ainsworth	15.3	19.5	30.1	21.9
Clio	16.9	17.6	32.7	21.6
Davison	7.8	12.8	35.5	14.7
Fenton	10.4	8.2	28.3	10.1
Flint—Central	41.5	45.3	19.7	62.4
Flint—Kearsley	32.5	37.2	20.8	51.1
Flint—NW	31.5	51.6	23.6	62.5
Flint—South	27.8	25.5	18.6	52.9
Flushing	5.1	6.9	37.4	8.1
Gaines	8.0	8.4	39.3	9.5
Goodrich	3.3	2.9	25.3	1.9
Grand Blanc	2.6	6.9	40.1	6.7
Lakeville	17.7	14.8	41.3	19.6
Lennon	11.2	20.2	29.3	13.9
Linden	6.5	5.9	23.8	8.4
Millington	15.9	12.3	25.4	20.4
Montrose	12.4	20.7	32.3	24.3
Mt. Morris	27.9	32.3	18.9	50.0
Swartz Creek	2.6	8.3	41.4	15.2
All	17.5	21.1	28.8	27.6

*Percent of children aged 6–11 years whose family income was below the federal poverty level (17).
†Percent of children aged 6–11 years enrolled in Michigan Medicaid.
‡Percent of children aged 6–11 years enrolled in Delta Dental Plan of Michigan.
¶Percent of elementary schoolchildren eligible for free or reduced lunch programs (18).

Discussion

Strengths and Limitations. The insurance claims data used in this project represent treatment, rather than disease, and were intended for dentists' reimbursement, not epidemiologic research. Several assumptions had to be made about these data. We assumed that the children were continuously covered by their dental insurance if they had at least one month of dental coverage per year. For MM, however, many children had sporadic periods of coverage. The populations utilized in these analyses could likely differ from noncontinuous users in SES status, access to services, and utilization of services. It is likely that these continuous users had higher treatment levels than would noncontinuous users. The DDPM and MM data are pooled for the years that we have data. While various minor changes may have occurred in eligibility and coverage in both programs, it does not seem these changes would bias the results.

We also assumed that if a child went to his or her dentist: (1) caries would be detected if present, (2) caries would be treated if detected, (3) an insurance claim would be submitted for the treatment. Unlike the school survey data where caries is recorded, there is no way to ensure that treatment represents actual caries status in the insurance data. There could be overtreatment in which teeth are treated unnecessarily, or undertreatment if caries is not detected or left untreated. Addi-

tionally, the insurance data will underestimate actual dental caries status if the enrollees do not go to the dentist. It was evident that utilization of services in the Medicaid population was much less than utilization for the DDPM population. The MM results that showed lower efs and EFS in low SES communities could represent not lower disease levels, but rather lower utilization of dental services.

The insurance claims data represent two very different populations from the opposite ends of the SES spectrum. This is both a strength and a limitation. While perhaps not being representative of the population as a whole, these data represent a large proportion of children in these communities (approximately 50%), represent children in all the zip code areas, and represent actual treatment provided to the children.

In contrast to the dental insurance claims data, standard oral health survey protocols were used for the GCOHP and MCHC data, with trained examiners and standardized criteria. This provided us the rare opportunity to test the utility of insurance claims and demographic data against traditional screening and survey data. In addition to describing the oral health status of the communities, these findings could also be used for identifying high-risk individuals for targeted preventive or treatment care, as was done in the MCHC project.

The GCOHP was based on a representative probability sample design; however, it should be noted that the sampling was based on Genesee County school enrollment, not zip codes. Zip code sample sizes varied considerably, with some having small sample sizes. In contrast to the sampling method used in the GCOHP, MCHC intentionally selected schools for the screenings based on their perceived oral health needs (particularly untreated caries). This was, therefore, not a representative sample of schoolchildren in Genesee County. No high SES areas were included in the MCHC surveys, and sample sizes also varied greatly with some zip codes having small sample sizes. Only 12 zip code areas were represented in the GCOHP survey, and 11 zip code areas in the MCHC surveys. It should also be noted that because the addresses of the children were not available, the school zip codes were used as a proxy for the actual zip codes of the children's residences.

TABLE 4
Mean Primary Dentition Measures

	dfs*		efs†	
Zip Code Area	Genessee Co. Oral Health Project	Mott Children's Health Center	Delta Dental Plan of Michigan	Michigan Medicaid
Atherton			7.80	6.65
Beecher	4.09	5.27	9.79	4.29
Bendle	8.27	6.41	6.50	9.16
Bentley		4.22	6.74	6.70
Byron			6.40	
Carman—Ainsworth	3.03	4.41	5.60	8.27
Clio	4.61		6.87	5.28
Davison	3.89		6.44	5.67
Fenton			5.92	7.78
Flint—Central	5.27	4.68	7.32	4.88
Flint—Kearsley		6.87	9.27	5.81
Flint—NW	4.83	5.43	7.75	4.57
Flint—South	3.65	4.48	8.26	6.63
Flushing			5.03	4.52
Gaines	1.83		6.56	
Goodrich			5.08	
Grand Blanc	2.00		7.09	6.77
Lakeville		4.08	10.25	
Lennon			7.69	6.09
Linden	4.04	3.96	7.32	6.47
Millington			8.30	5.28
Montrose			8.01	6.07
Mt. Morris	3.81	5.69	9.36	4.82
Swartz Creek			6.13	7.18
All	4.11	5.05	7.31	6.14
P-value‡	.0008	<.0001	<.0001	<.0001

*Number of decayed or filled primary tooth surfaces.
†Number of extracted or filled primary tooth surfaces.
‡*P*-value, *P*>F, generalized linear models.

Zip code areas are of sufficient population and land area size to be readily recognized as distinct areas representing communities, but small enough and sufficiently homogeneous to provide useful information for targeting of preventive or treatment programs. Zip codes, however, are for the sole purpose of efficient mail delivery. They are not geopolitical Census-based statistical boundary areas such as Census tracts, block groups, or blocks. They are poorly defined and can be changed frequently. Zip code area use in public health research is increasing because it is convenient for many purposes, but must be done with some care because of the chance of mismatches between the geopolitical boundary-based data and zip code-based data. Krieger et al. (21) found that zip code level analysis of colon cancer incidence yielded results contrary to those found using Census tract and block group levels. The 2000 Census has initiated the replacement of zip codes with "Zip Code Tabulation Areas" (ZCTA), which are based on Census blocks to overcome these discrepancies. However, these ZCTAs cannot be assumed always to correspond to address-derived reported zip codes.

Utility of Demographic and Insurance Claims Data for Children's Oral Health Surveillance. Surveillance data are used to track changes in health status over time, compare health status of different populations,

TABLE 5
Mean Permanent Dentition Measures

Zip Code Area	DMFS*		EFS†	
	Genessee Co. Oral Health Project	Mott Children's Health Center	Delta Dental Plan of Michigan	Michigan Medicaid
Atherton			3.33	6.13
Beecher	1.65	1.69	3.04	1.66
Bendle		1.95	2.73	3.26
Bentley		1.51	2.90	3.86
Byron			3.29	1.40
Carman—Ainsworth	1.35	1.47	2.85	3.58
Clio	0.80		3.36	3.14
Davison	1.16		2.60	1.58
Fenton			2.63	2.78
Flint—Central	1.36	1.84	2.88	2.46
Flint—Kearsley	1.13		2.91	1.59
Flint—NW	0.98	1.68	2.98	2.13
Flint—South	1.39	1.23	3.16	3.22
Flushing			2.91	2.44
Gaines	0.68		3.38	2.11
Goodrich			3.18	1.40
Grand Blanc	2.51		2.79	5.21
Lakeville		1.90	3.38	2.96
Lennon			2.39	1.65
Linden	1.58	1.66	2.60	2.60
Millington			2.67	3.43
Montrose			3.16	2.06
Mt. Morris	1.88	1.73	2.97	2.23
Swartz Creek			3.16	1.46
All	1.41	1.71	2.93	2.27
P-value‡	.0012	<.0001	.3757	<.001

*Number of decayed, filled, or missing permanent tooth surfaces.
†Number of extracted or filled permanent tooth surfaces.
‡*P*-value, *P*>F, generalized linear models.

and to compare health status to set standards or goals such as Healthy People 2010. In the case of screenings such as those done by MCHC, these findings can be used for identifying high-risk individuals for targeted preventive and treatment programs. Demographic and claims data alone would currently be of little utility for these purposes because standardized protocols for their collection and analysis have not yet been developed and these data are not useful for individual assessment.

Surveillance data can also be used for assessing oral health needs for targeting communities for preventive or treatment programs. Ideally, the selection of communities is determined by using traditional epidemiologic surveys that include complete oral examinations (22). When direct assessment of dental caries levels is not possible, however, it has been recommended that proxy measures for high caries risk, such as low income, may be used (23).

In this study, primary tooth caries and treatment were strongly associated with lower SES. Similar observations have been noted in recent reports from US data (24-28). Gilcrist found most dental indices, with the exception of permanent tooth caries experience, to be related to community SES. Several international studies have reported the practical use of SES and spatially based demographic data for identifying areas of high dental needs (29-38).

High caries and treatment levels in the permanent dentition were not associated with lower SES. This perhaps

TABLE 6
Spearman Rank Correlation Coefficient Analysis of Primary Dentition Measures and SES Measures

	dfs*		efs†	
	Genessee County Oral Health Project	Mott Children's Health Center	Delta Dental Plan of Michigan	Michigan Medicaid
% poverty‡	**0.6643¶ (.0185)§**	**0.7364 (.0098)**	**0.6384 (.0008)**	–0.3768 (.1050)
% FRL•	0.5245 (.0800)	0.5909 (.0556)	**0.6149 (.0014)**	–0.3437 (.1378)
% DDPM∞	**–0.5804 (.0479)**	**–0.6636 (.0260)**	–0.3153 (.1334)	0.2339 (.3209)
% MM**	**0.6014 (.0386)**	**0.7363 (.0098)**	**0.5775 (.0031)**	–0.3272 (.1591)

*Number of decayed or filled primary tooth surfaces.
†Number of extracted or filled primary tooth surfaces.
‡Percent of children aged 6–11 years whose family income was below the federal poverty level (17).
¶Spearman rank correlation coefficient.
§*P*-value, Spearman rank correlation (*P*-values <.05 in bold).
•Percent of elementary schoolchildren eligible for free or reduced lunch programs (18).
∞Percent of children aged 6–11 years enrolled in Delta Dental Plan of Michigan.
**Percent of children aged 6–11 years enrolled in Michigan Medicaid.

TABLE 7
Spearman Rank Correlation Coefficient Analysis of Permanent Dentition Measures and SES Measures

	DMFS*		EFS†	
	Genessee County Oral Health Project	Mott Children's Health Center	Delta Dental Plan of Michigan	Michigan Medicaid
% poverty‡	0.0165¶ (0.9573)§	0.4303 (0.2145)	0.0496 (0.8181)	–0.0351 (0.8866)
% FRL•	–0.0303 (0.9218)	0.2364 (0.5109)	–0.0109 (0.9598)	–0.1228 (0.6165)
% DDPM∞	–0.4044 (0.1705)	0.1152 (0.7544)	0.1031 (0.6318)	0.1213 (0.5722)
% MM**	0.0495 (0.8724)	0.2485 (0.4888)	0.2104 (0.3236)	–0.2123 (0.3829)

*Number of decayed or filled primary tooth surfaces.
†Number of extracted or filled primary tooth surfaces.
‡Percent of children aged 6–11 years whose family income was below the federal poverty level (17).
¶Spearman rank correlation coefficient.
§P-value, Spearman rank correlation (P-values <.05 in bold).
•Percent of elementary schoolchildren eligible for free or reduced lunch programs (18).
∞Percent of children aged 6–11 years enrolled in Delta Dental Plan of Michigan.
**Percent of children aged 6–11 years enrolled in Michigan Medicaid.

was due to access issues; wealthier, older children were more likely to go to the dentist and therefore to have treatment, or dentists were more likely to restore questionable permanent tooth lesions when the parents had either private insurance or the ability to pay for the treatment. Our permanent dentition treatment and caries measures, DMFS and EFS, also may not have been sufficiently sensitive to identify children with high oral health needs.

The most important findings from this research were that the demographic measures (poverty, school free and reduced lunch eligibility, and the proportion of children enrolled in the dental insurance programs) were significantly associated with many of the primary tooth surfaces measures (caries experience in the first seven years of life). While not a new finding, it is important to recognize the utility of being able to use these readily available poverty indicators to identify neighborhoods where children are likely to have experienced high levels of dental disease in the primary teeth. These demographic data identified the zip code areas of Beecher, Bendle, Flint Northwest, and Flint Kearsley as having high measures of poverty as well as high primary tooth surface caries and treatment; and Swartz Creek, Goodrich, and Flushing as having low measures of poverty and low primary tooth treatment. These findings have important utility; MCHC has used this information to prioritize schools for targeted preventive and treatment programs.

This study found that dental insurance claims data alone were not particularly valuable for identifying high-risk communities. That was likely due to those treatment data being highly affected by dental utilization levels. The DDPM data, however, did appear to be slightly better than the MM data in this regard. While this report describes our use of mean surface-based measures (dfs, efs, DMFS, and EFS), other measures such as tooth-based measures (dft, eft, DMFT, and EFT), median values, untreated decay (in the MCHC and GCOPH data), and proportions of children with caries levels at various cut-points also were examined. Results using these measures generally were similar for these measures and therefore not used in this report. In the future we would also like to investigate how factors such as insurance eligibility, insurance utilization, insurance coverage, and dentist's treatment patterns may be associated with oral health status. The recent moves to add diagnostic codes to dental insurance information may be of value for this type of research.

From a practical standpoint, Census data and school free and reduced lunch eligibility data are readily available, can be freely downloaded from the Internet, and are easier to work with than the insurance claims data. The insurance claims data are more difficult to obtain, require close cooperation from the insurance companies and manipulation to ensure subject anonymity, and are also technically more challenging for data management and analysis. Implementation of the Health Insurance Portability and Accountability Act also may make it more difficult to obtain and work with these data because of additional privacy and security issues.

Valid and practical surveillance systems are vital for assessing the oral health status of communities and for program planning and evaluation. Due to resource, regulatory, and consent issues, traditional surveys have become increasingly difficult to conduct. An ecologic, geographic targeted, approach using population-based data, particularly demographic data, was shown in this study to be useful in identifying communities of likely high and low oral health needs in Genesee County Michigan and could be easily adopted for other communities. Previous studies have identified the strong associations between oral health status and SES measures; this project utilizes these observations for practical surveillance purposes. With further refinement of the analytical techniques and more and better data, such techniques will likely be even more useful in the future.

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