Published in final edited form as:

J Public Health Dent. 2013 ; 73(4): 289–296. doi:10.1111/jphd.12025.

The Effect of North Carolina Hospital Payor Mix on Dental-Related Pediatric Emergency Room Utilization

Jacqueline M. Hom, DMD¹, Lane F. Burgette, PhD², and Jessica Y. Lee, DDS, MPH, PhD¹

¹Departments of Pediatric Dentistry and Health Policy and Management, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

²Statistics Group, RAND Corporation, Arlington, VA, USA

Abstract

Objectives—We examined the effect of hospital payor-mix on the proportion of pediatric ED visits that were dental-related.

Methods—We used the NC Emergency Room Discharge Database from 2007 to 2009 to estimate the relationship between the percent of pediatric ED patients that were covered by Medicaid and the percent of pediatric ED visits that were dental-related. Hospital-level fixed effects controlled for unobserved hospital-level characteristics. Discharge claims from 110 ED facilities in NC were analyzed over the 3-year study period. Claims were limited to individuals under 18 years-old with dental disease-related ICD-9-CM diagnostic codes, 520.00-530.00.

Results—Using 327 hospital-years of data, 62% of ED visits for pediatric dental reasons were covered by Medicaid, a proportion over two times greater than for pediatric reasons overall, 26%. Hospitals with a greater proportion of Medicaid payors had a greater proportion of pediatric dental ED visits ($P<0.01$).

Conclusions—Hospitals serving a large population of children on Medicaid should be prepared to provide emergency dental services. Public health administrators should prioritize oral health resources at hospital communities with a high proportion of Medicaid payors.

Keywords

Hospital Emergency Service; Dental Care for Children; Medicaid

INTRODUCTION

In the United States, approximately 0.7% of emergency department (ED) visits from 1997 to 2000 were for dental reasons, and an estimated 4.1 million ED visits received an International Classification of Diseases, Ninth Edition, Clinical Modification (ICD-9-CM) discharge diagnosis related to dental disease.¹ While the percentage of cases is relatively small, studies found that the use of EDs for non-traumatic dental conditions increased from 1982 to 1991,² 1997 to 2001,³ 2001 to 2008,⁴ and 1997/1998 to 2007/2008.⁵ Compared to the 28% increase in ED visits for non-dental complaints, there was a 121% increase for dental complaints between 1997 and 2001.³

The use of EDs for dental complaints is particularly significant for children. Children under the age of 15 have the highest estimated number of visits for all payments to the ED nationally.⁶ Hospital emergency visits were the first contact with a dentist for 52% of children under 3.5 years at a pediatric teaching hospital.⁷

Dental conditions, primarily from untreated dental caries (tooth decay), are responsible for 35% to 96% of dental ED visits.^{8,9} Dental caries is largely preventable, and treating the sequelae of dental caries can be time-consuming, costly, and stressful for the child, family, and the dentist.^{8,10} Moreover, ED care for caries-related problems is generally not definitive compared to that provided in primary care dental settings and often results in referral to primary care dental sites.¹¹ With the rising incidence of childhood dental caries and only 45% of American children receiving at least one dental visit in 2009, the use of EDs for non-traumatic dental complaints in children is likely to be increasing.^{10,11}

Previous studies on dental-related pediatric ED utilization examine the association between ED visits and patient characteristics, such as race, income, education and payor type.^{1,3,8,12,13} Cohen and colleagues (2011) found an association between contacting an ED for a dental condition and a patient's income, education and race.⁸ In general, individuals who use the ED tend to be poor, less educated and belong to a racial and ethnic minority. Additionally, finances affect dental health seeking behavior.^{1,3,14,15} Compared to patients with private insurance, those who are uninsured or covered by Medicaid use disproportionately more ED services for dental reasons.^{9,13} An analysis of the National Hospital Ambulatory Medicare Care Survey (NHAMCS) found that patients with dental complaints were significantly more likely than patients with medical complaints to have Medicaid or no health insurance.¹

To date, no study has examined the characteristics of the hospital EDs used by pediatric patients with dental complaints. According to the health behavior model by Andersen and colleagues (1995), community-level characteristics are significant predictors for health behaviors, such as ED use for non-traumatic dental conditions in children.¹⁶ Hospital characteristics, such as payor mix, capture some of these previously unstudied community-level characteristics. We hypothesize that communities with a high proportion on Medicaid insurance are more likely to use the hospital ED for dental treatment and relief of pain resulting in a greater proportion of dental-related ED visits.

METHODS

Claims-level discharge data from hospital emergency room departments in North Carolina (NC) were obtained from the NC Emergency Room Discharge Database. The data were collected by the Cecil G. Sheps Center for Health Services Research in contract with the NC Division of Health Service Regulation. The NC Emergency Room Discharge Database contained ED discharge data retrieved from claim forms at 110 ED facilities in NC from 2007 to 2009. This information is traditionally used by facilities to bill payers. Among the 110 ED facilities, one facility had two years of data, one facility had only one year of data, and 108 facilities had all three years of data. A dental ED visit was defined using International Classification of Diseases, Ninth Edition, Clinical Modification (ICD-9-CM)

diagnostic codes, 520.00-530.00. These dental codes ranged from dental caries and periapical abscess to the loss of teeth due to trauma. Claims were limited to individuals under 18 years-old with any dental disease-related ICD-9-CM diagnostic code, 520.00-530.00. Payor data for non-dental visits were only available aggregated by hospital and year, so person-level claims were collapsed by hospital and year. The Biomedical Institutional Review Board at the University of NC at Chapel Hill approved this research project.

The major outcome variable was the percent of pediatric ED visits that were dental-related. The percent of dental ED visits was defined as the number of dental ED visits per year divided by the total number of pediatric hospital ED visits per year. The percent of pediatric dental ED visits was log transformed in the fixed effects model to achieve a linear and normally-distributed error term. For eight hospital years, there were no pediatric dental ED visits. To avoid problems with taking the logarithm of a zero, such rates were calculated using 0.5 divided by the number of pediatric ED visits.

The major independent variable was percent of ED visits covered by Medicaid insurance. Insurance status was determined at the time of ED visit and retrieved in claims from NC Emergency Room Discharge Database. The percent of ED visits with Medicaid insurance was defined as a ratio of the number of ED visits covered by Medicaid per year divided by the number of total Hospital ED visits per year. There were no missing data for insurance status; however 'unknown' insurance was not included in the numerator but in the denominator of this measure.

Other independent variables included in the model were averages of person-level demographic characteristics collected in the claims data. Age was measured in years and coded as a continuous variable. Gender was coded as a two-level categorical variable: male and female. Race was coded as a five-level categorical variable: White, Black, American Indian and Eskimo, Asian Pacific Islander, and Other race. Many hospitals did not report data on the race of their admissions. Of 327 hospital years of data that were otherwise available, 97 did not include demographic data for race. To handle the missing data, we performed a multiple imputation of the missing values using the "mi" package in R.¹⁷ Our imputation model for race was imperfect because we were unable to control for hospital effects of any kind since some hospitals do not report any demographic data. Therefore, we checked the robustness of our results on race using a complete-case analysis.

Ordinary least squares regression was performed using fixed effects for hospital and year. A hospital-level fixed effects model was used to control for unobserved hospital characteristics that do not vary over time. It is reasonable to assume that unmeasured hospital and community characteristics, such as urban versus rural, private versus public, university or managed care affiliation, hospital size or services offered, are relatively constant over the three-year time period, meaning that the effects of these variables are accounted for via fixed effects even though such variables are not explicitly included in the model. The hospital fixed effect model omits independent variables that do not vary over time because they are perfectly collinear with the fixed effects terms. Therefore, the hospital fixed effects model reflects variations in the number of pediatric dental ED visits between hospitals during the

three-year sample period. All analyses were conducted using R (R Core Development Team, Vienna, Austria).

RESULTS

We obtained data for a total of 10,314,610 pediatric emergency department visit claims from 110 NC hospitals between 2007 and 2009 (Figure 1). During this three-year time frame, NC residents made 16,868 visits for dental complaints, accounting for 0.23% of all pediatric ED visits (Figure 1). There were no significant differences between patient visits over the three-year study period with regard to the patient's sex, age, or race and ethnicity (Table 1). For the combined study period, majorities of visits were from children who were male (52%) and White (54%) (Table 1). The mean age was 7.3 years (Table 1).

Medicaid was the most common payment source for children in every year of the three-year study period, constituting approximately 62% for dental-related pediatric ED visits and only 26% for total pediatric ED visits (Table 1 and Figure 1). The percentage of pediatric dental ED visits covered by Medicaid was over two times greater than the percentage for pediatric ED visits overall (Table 1 and Figure 1).

While the demographic and insurance characteristics of the study population remained constant, there was an increase in the percent of dental ED visits made by Medicaid recipients from the 2007 to 2009, 58.9% and 65.4% respectively (Table 1 and Figure 1). The annual number of pediatric dental ED visits rose by 200 visits between 2007 ($n=5,576$) and 2009 ($n=5,780$) (Table 1 and Figure 1). The change in the number of pediatric dental ED visits from 2007 to 2009 was significant when controlling for gender, age, race and year ($P<0.01$)(Table 2).

The increase in the number of dental emergency department visits made by Medicaid recipients outstripped population growth. Pediatric dental ED visits covered by Medicaid increased from a rate of 1.50 per 1000 population (3,252/2,166,616) in 2007 to 1.66 per 1000 population (3,690/2,216,249) in 2009, where the numerators were derived from our data, and the state population numbers (denominators) are from the North Carolina Office of State Budget and Management.¹⁸ In contrast to the increase in dental ED visits by Medicaid recipients, the rate of total dental ED visits remained steady during the same time period. Dental pediatric ED visits occurred at a rate of 2.6 per 1000 population (5,576/2,166,616) in 2007, 2.5 per 1000 population (5,513/2,198,622) in 2008 and 2.6 per 1000 population (5,780/2,216,249) in 2009.

In the hospital-level analysis, there was a significant association between Medicaid payor and dental ED visits ($P<0.01$)(Table 2). As the percentage of patients covered by Medicaid increased as a proportion of all patients who go to the ED for pediatric reasons, the likelihood of pediatric dental ED visit increased. When controlling for hospital, year, age, gender, and race, the percent of total ED visits that were dental-related increased by 3.2% for every percentage point increase in ED visits that were covered by Medicaid ($N=327$) ($P<0.01$)(Table 2). Although the model is fit using yearly data, the regression coefficient on

the main explanatory variable can be interpreted in terms of the relative percent of dental ED admissions in any two temporal periods with differing levels of Medicaid coverage.

When controlling for hospital, percent Medicaid, age, gender, and race, the percent of dental ED visits decreased in 2008 and 2009 ($N=327$) ($P<0.1$) (Table 2). The decrease was weakly significant, and occurred when overall rates of dental ED visits were increasing.

The causes of pediatric dental-related ED visits were mostly related to pain and/or infection (Table 3). Dental caries accounted for the majority of ED visits for dental care (Figure 3). Although ICD-9-CM diagnosis codes were included for most dental diseases (traumatic and non-traumatic), only a small percentage of dental visits were for traumatic reasons. For example, loss of teeth due to trauma (525.11) was listed as an ICD-9-CM diagnosis code 27 times in 2007, 37 times in 2008, and 29 times in 2009, for a total of 93 cases over the 3-year study horizon (data not shown).

DISCUSSION

Our main finding is that there was a significant association between Medicaid payor and dental ED visits. More specifically, the percent of total ED visits covered by Medicaid increased by 3.2% for every percentage point increase in dental ED visits ($P<0.01$) (Table 2). When translated into numbers of visits, 3.2% corresponds to an increase of approximately four dental ED visits using the median hospital values over the three-year study period. For example, for the median values of all covariates (across all years) and using the median hospital fixed effect, our model predicts 0.172% of ED visits were dental-related in 2009. From 2007 to 2009, the median percent increase in ED visits covered by Medicaid was 2.6%. With this typical increase in percent Medicaid, our model predicts that 0.187% of the ED cases would be dental-related, all else being equal. For the median-sized ED (with 25,500 admissions in 2007) this corresponds to an increase from approximately 44 to 48 pediatric dental ED visits.

Increased number of ED visits covered by Medicaid

The number of pediatric dental ED visits made by Medicaid recipients in NC increased from 2007 to 2009 (Table 1 and Figure 1). This increase in Medicaid visits occurred at the same time that the demographic characteristics of the population and overall percentage of dental emergency department visits by children remained constant. The increase in Medicaid coverage for children's dental ED visits may be explained by the economic recession in December 2007,¹⁹ an increasing trend in dental caries among American preschoolers,^{20,21} and the 2007 expiration of NC's State Children's Health Insurance Program, NC Health Choice for Children (NCHC).²²

Prior to September 2007, NCHC provided health insurance coverage, including dental benefits, for children under age 21 in families with incomes from 133% to 300% federal poverty level. Children covered by NCHC had greatly improved access to care compared to Medicaid-enrolled children.^{22,23} Following the September 2007 expiration of NCHC, children previously covered by NCHC received Medicaid benefits.²² Due to the expected increase in the number of children on Medicaid resulting from the 2007 expiration of

NCHC, we examined the effect of hospital payor-mix on the number of pediatric dental ED visits for hospitals in NC during the three-year period, 2007 to 2009. The increase in the number of children receiving Medicaid benefits depicted in the study findings, combined with potential difficulties finding Medicaid dental providers for children compared to NCHC described in the literature,^{22,23} may explain our findings. Namely, that hospitals in NC were more likely to see children for dental ED visits if their proportions of children covered by Medicaid increased in 2009 compared to 2007.

Unlike previous studies on dental ED visits, which completed analyses on an individual level, our findings assess Medicaid visits on a hospital -level. By analyzing characteristics of the hospital rather than characteristics of individuals, our study found that hospitals that serve a patient population with more Medicaid coverage were more likely to have dental ED visits. As with any observational study, it is possible that unobserved factors explain at least some of the relationship of interest. Although we control for unobserved factors that stay fixed over time (via the hospital-level fixed effects), it is likely that explanatory variables beyond payor mix change over the study period. For instance, if public transportation around a given hospital improved, we might find that both percent Medicaid and percent dental-related ED visits increase (by improving access to the ED), even though the change in one variable is not causing the change in the other in such a case.

One might assume that including fixed effects for hospitals could make the aggregated demographic controls insignificant, as sudden shifts in demographics at a hospital might be somewhat surprising. However, none of the race variables were significant (relative to White) in the complete-case analysis. Perhaps more surprisingly, this was the case even after dropping the hospital fixed effects. Only after removing the percent Medicaid and age controls does percent Black patients take on statistical significance with a positive estimate.

Additionally, dental ED visits may occur more frequently at EDs with more Medicaid payors due to characteristics of the surrounding hospital community. This would be consistent with the larger body of health services research that depicts individuals living in communities with higher poverty as being more likely to be uninsured, lack a regular source of care, more frequently go without care because of cost, and more frequently experience poor health outcomes.^{24,25} Most importantly, communities with high poverty rates tend to have lower health system performance overall.²⁴ This results in higher levels of unmet medical needs within the community, even among those who have health insurance.²⁴

Similar to medicine, the increase in dental ED use among children in communities with higher levels of Medicaid is a measure of poor oral health system performance. For example, a study in Massachusetts found that only 50% of the EDs surveyed have on-site dental coverage.²⁶ Dental care provided in EDs is more costly, more time-consuming and less likely to be definitive than care provided in traditional dental offices.²⁷ As indicated in the most common diagnosis codes for dental ED visits in Table 3, caries-related diagnoses far exceed diagnoses for traumatic dental emergencies. The ED is an especially poor oral health system if it is being used as a safety net for primary dental services, as indicated by the numerous caries-related diagnoses.

Comparison to previous studies

Our study reports that over 60% of NC children who presented to the ED with dental complaints were covered by Medicaid. This finding is similar to a longitudinal ED study in Washington State in which 61% of children diagnosed specifically with severe early childhood caries, and 43% of children with dental complaints overall, were insured by Medicaid.¹⁴

While the percentage of dental ED visits covered by Medicaid is consistent with previous studies limited to children, the number of total dental ED visits is fewer than previous reports. In NC, the annual rate of dental-related pediatric ED visits is approximately 2.5/1000 population, which is far below the national annual rate for individuals under age 20, 4.4/1000 population, described by Wall (2012).⁵ The percentage of dental-related pediatric ED visits in the present study, 0.23, is also lower than 0.7 percent, which is the result of a national analysis of the 1997–2000 National Hospital Ambulatory Medical Care Survey.¹ These values indicate that the overall number and percentage of pediatric dental ED visits in NC is lower than the national average.

An explanation for why NC has a low annual rate of dental-related pediatric ED visits compared to the country may be that NC has fewer EDs per capita than other states. Another explanation for the low percentage of dental ED visits is that dental public health professionals have implemented significant dental health service efforts for young children throughout NC.²⁹ These efforts include screening and referral for oral disease, fluoride varnish application, and oral health education by primary care providers.²⁹ Despite the multitude of programs targeting children's oral health in NC and the low rate of overall dental ED visits compared to the national average, dental care in hospital EDs remains a significant problem.

Policy Implications

NC hospitals with a higher proportion of Medicaid payors have a greater proportion of pediatric dental-related ED visits ($P<0.01$). The association between hospital payor-mix and pediatric dental-related ED visits has implications for resource allocation to improve access to dental care. Public health resources should prioritize communities that are served by hospitals with a high proportion of Medicaid payors.

These results of this study are particularly significant in light of the cost of ED use for dental care. In the Minneapolis/St. Paul metropolitan region alone, there were over 10,000 dental emergency room visits at a cost of nearly \$5 million over a single year.³⁰ In New York state, dental ED visit charges rose from \$204,874 in 2004 to \$531,426 in 2008 for a total of \$2,016,367 during the 4-year period.¹⁵ Pettinato and colleagues (2000) analyzed ER discharge claims from a children's hospital in Texas from 1996–1998 and concluded that Medicaid expenditures for dental ED visits was ten times greater than the anticipated amount for preventive care when dental patients were admitted as an inpatient to the hospital.³¹ The potential cost implications of the increasing dental ED visits also supports the notion that resources should be targeted at oral health services for Medicaid children in order to reduce the rising cost of pediatric dental-related ED visits.

Limitations and Strengths

The results of this analysis should be taken in light of the study's limitations. Firstly, the study findings are limited to the state of NC and can not be generalized to other areas and populations in the US or the country as a whole. Secondly, our analytic model may have omitted variable bias. The NC Emergency Discharge Database did not have information on several important demographic variables, such as the education, income, and health status of the hospital communities. Our fixed effect model assumes that such factors stay fixed over the study period; violations of this assumption may have had an important impact on the number of ED visits for dental complaints at each hospital. Thirdly, our study may have misclassification bias since the hospital-reported data had dental diagnoses coded by physicians. As described in Table 3, the most common discharge diagnosis code was “Unspecified disorder of the teeth and supporting structures.” Lastly, it is not possible to determine causality between the elimination of Medicaid benefits and increased dental ED visits, even with our longitudinal dataset. Other temporal factors, such as the economic depression and increased dental disease may have contributed to the temporal effect.

Despite these limitations, the increase in dental ED visits covered by Medicaid is consistent with the decreased access to dental services that would be expected to result from eliminating children's Medicaid benefits. We believe that the findings of our study are significant enough to create awareness among health professionals and policymakers regarding the burden of dental ED visits on hospital systems. Although this is not the first study to document the association between Medicaid payor and dental ED visits, it is the first to conduct this analysis at the hospital-level.

Additionally, this study was conducted using a comprehensive, state-wide and longitudinal dataset. To our knowledge, there is only one published longitudinal study on dental ED visits, and it is based on a sample population for one city.²⁸ The present study included dental ED visits across entire state of NC. Reporting the magnitude and trends in pediatric ED utilization for dental conditions in NC is important public health data, especially when presented in a longitudinal manner.

REFERENCES

1. Lewis C, Lynch H, Johnston B. Dental complaints in emergency departments: A national perspective. *Ann Emerg Med.* 2003; 42(1):93–99. [PubMed: 12827128]
2. Zeng Y, Sheller B, Milgrom P. Epidemiology of dental emergency visits to an urban children's hospital. *Pediatr Dent.* 1994; 16(6):419–423. [PubMed: 7854948]
3. Ladrillo TE, Hobdell MH, Caviness AC. Increasing prevalence of emergency department visits for pediatric dental care, 1997–2001. *J Am Dent Assoc.* 2006; 137(3):379–385. [PubMed: 16570472]
4. Lee HH, Lewis CW, Saltzman B, Starks H. Visiting the emergency department for dental problems: trends in utilization, 2001 to 2008. *Am J Public Health.* 2012; 102(11):e77–e83. [PubMed: 22994252]
5. Wall T. Recent trends in dental emergency department visits in the United States: 1997/1998 to 2007/2008. *J Public Health Dent.* 2012; 72(3):216–220. [PubMed: 22536892]
6. Adekoya N. Reasons for visits to emergency departments for Medicaid and State Children's Health Insurance Program patients: United States, 2004. *N C Med J.* 2010; 71(2):123–130. [PubMed: 20552761]

7. Sheller B, Williams BJ, Lombardi SM. Diagnosis and treatment of dental caries-related emergencies in a children's hospital. *Pediatr Dent*. 1997; 19(8):470–475. [PubMed: 9442540]
8. Cohen LA, Bonito AJ, Eicheldinger C, Manski RJ, Macek MD, Edwards RR, Khanna N. Comparison of patient visits to emergency departments, physician offices, and dental offices for dental problems and injuries. *J Public Health Dent*. 2011; 71(1):13–22. [PubMed: 20726944]
9. Seu, K.; Hall, KK.; Moy, E. Emergency Department Visits for Dental-Related Conditions, 2009. Healthcare Cost and Utilization Project Statistical Brief #143. Agency for Healthcare Research and Quality; Rockville, MD: Nov. 2012 URL: <http://www.hcupus.ahrq.gov/reports/statbriefs/sb143.pdf> [December 15, 2012]
10. Casamassimo PS, Thikkurissy S, Edelstein BL, Maiorini E. Beyond the dmft: The human and economic cost of early childhood caries. *J Am Dent Assoc*. 2009; 140(6):650–657. [PubMed: 19491160]
11. Medical Expenditure Panel Survey, 2009. National Institute of Dental and Craniofacial Research and Centers for Disease Control and Prevention Dental, Oral and Craniofacial Data Resource Center; Web site: Data Query System. <http://drc.hhs.gov/dqs.htm> [March 2, 2013]
12. Cohen LA, Bonito AJ, Akin DR, Manski RJ, Macek MD, Edwards RR, Cornelius LJ. Toothache pain: A comparison of visits to physicians, emergency departments and dentists. *J Am Dent Assoc*. 2008; 139(9):1205–1216. [PubMed: 18762631]
13. Hocker MB, Villani JJ, Borawski JB, Evans CS, Nelson SM, Gerardo CJ, Limkakeng AT. Dental visits to a North Carolina emergency department: a painful problem. *N C Med J*. 2012; 73(5):346–351. [PubMed: 23189415]
14. Rowley ST, Sheller B, Williams BJ, Mancl L. Utilization of a hospital for treatment of pediatric dental emergencies. *Pediatr Dent*. 2006; 28(1):10–17. [PubMed: 16615370]
15. Nagarkar SR, Kumar JV, Moss ME. Early childhood caries-related visits to emergency departments and ambulatory surgery facilities and associated charges in New York state. *J Am Dent Assoc*. 2012; 143(1):59–65. [PubMed: 22207670]
16. Andersen RM. Revisiting the behavioral model and access to medical care: Does it matter? *J Health Soc Behav*. 1995; 36(1):1–10. [PubMed: 7738325]
17. Su YS, Gelman A, Hill J, Yajima M. Multiple imputation with diagnostics (mi) in R: opening windows into the black box. *J Stat Softw*. 2009; 20(1):1–27.
18. North Carolina Office of State Budget and Management, State Demographics Branch. [December 15, 2012] Child Population by Age Group: Under 18. Jul. 2012 URL: <http://www.osbm.state.nc.us>
19. Holahan J. The 2007–09 recession and health insurance coverage. *Health Aff (Millwood)*. 2011; 30(1):145–152. [PubMed: 21134911]
20. Dye BA, Tan S, Smith V, Lewis BG, Barker LK, Thornton-Evans G, et al. Trends in oral health status: United States, 1988–1994 and 1999–2004. *Vital Health Stat*. 2007; 11(248):1–92.
21. Tomar SL, Reeves AF. Changes in the oral health of US children and adolescents and dental public health infrastructure since the release of the healthy people 2010 objectives. *Acad Pediatr*. 2009; 9(6):388–395. [PubMed: 19945073]
22. Shulman, S.; Kell, M.; Rosenbach, M. SCHIP takes a bite out of the dental access gap for low-income children. Mathematica Policy Research, Inc.; Cambridge, MA: Nov. 2004 URL: <http://www.mathematica-mpr.com/publications/pdfs/schipdental.pdf> [December 15, 2012]
23. Mofidi M, Slifkin R, Freeman V, Silberman P. The impact of a State Children's Health Insurance Program on access to dental care. *J Am Dent Assoc*. 2002; 133(6):707–714. [PubMed: 12083646]
24. Institute of Medicine. America's Uninsured Crisis, Consequences for Health and Health Care. National Academies Press; Washington, DC: 2009.
25. Ayanian JZ, Weissman JS, Schneider EC, Ginsburg JA, Zaslavsky AM. Unmet health needs of uninsured adults in the united states. *JAMA*. 2000; 284(16):2061–2069. [PubMed: 11042754]
26. Needleman HL, Stucenski K, W Forbes P, Chen Q, Stack AM. Massachusetts emergency departments' resources and physicians' knowledge of management of traumatic dental injuries. *Dent Traumatol*. 2012 [Epub ahead of print].
27. Cohen L, Manski R, Hooper F. Does the elimination of Medicaid reimbursement affect the frequency of emergency department dental visits? *J Am Dent Assoc*. 1996; 127(5):605–609. [PubMed: 8642140]

28. Hong L, Ahmed A, McCunniff M, Liu Y, Cai J, Hoff G. Secular trends in hospital emergency department visits for dental care in Kansas City, Missouri, 2001-2006. *Public Health Rep.* 2011; 126(2):210–219. [PubMed: 21387951]
29. Rozier RG, Stearns SC, Pahel BT, Quinonez RB, Park J. How a North Carolina program boosted preventive oral health services for low-income children. *Health Aff (Millwood).* 2010; 29(12): 2278–2285. [PubMed: 21134930]
30. Davis EE, Deinard AS, Maïga EW. Doctor, my tooth hurts: the costs of incomplete dental care in the emergency room. *J Public Health Dent.* 2010; 70(3):205–210. [PubMed: 20337900]
31. Pettinato ES, Webb MD, Seale NS. A comparison of medicaid reimbursement for non-definitive pediatric dental treatment in the emergency room versus periodic preventive care. *Pediatr Dent.* 2000; 22(6):463–468. [PubMed: 11132504]

Figure 1. Total ED visits and Dental ED visits in North Carolina, 2007-2009. Percent of Medicaid Dental ED visits over Total Dental ED visits are labeled above each bar.

Table 1

Characteristics of North Carolina hospital emergency departments from 2007 to 2009 (N=327 hospital years)

Characteristic	Total Mean (SD) [Range]	2007 Mean (SD) [Range]	2008 Mean (SD) [Range]	2009 Mean (SD) [Range]
Total sample	327	108	109	110
Male	0.523 (0.037) [0-0.718]	0.525 (0.021) [0.484-0.652]	0.525 (0.027) [0.495-0.718]	0.517 (0.054) [0-0.698]
Age (years)	7.31 (0.74) [1.0-9.71]	7.33 (0.67) [5.48-9.71]	7.31 (0.66) [5.46-8.58]	7.28 (0.88) [1.0-8.72]
Race and Ethnicity				
White	0.54 (0.27) [0-1]	0.54 (0.25) [0-1]	0.54 (0.27) [0-1]	0.54 (0.28) [0-1]
African American	0.26 (0.22) [0-0.87]	0.26 (0.22) [0-0.78]	0.26 (0.22) [0-0.87]	0.26 (0.22) [0-0.79]
American Indian and Eskimo	0.02 (0.11) [0-1]	0.02 (0.12) [0-1]	0.02 (0.12) [0-1]	0.01 (0.07) [0-0.5]
Asian and Pacific Islander	0.01 (0.04) [0-0.35]	0.01 (0.04) [0-0.35]	0.01 (0.04) [0-0.35]	0.01 (0.04) [0-0.35]
Other Race	0.17 (0.23) [0-1]	0.18 (0.25) [0-1]	0.16 (0.22) [0-1]	0.18 (0.24) [0-1]
Average Number of Hospital ED Visits	31,639.91 (22,695.01) [280-102,396]	30,569 (21,883) [292-101,463]	31,350 (22,655) [280-102,130]	32,991 (23,747) 5-102,396]
Average Number of Hospital Medicaid ED Visits	8,202.08 (6,414.72) [95-33,866]	7,516 (5,801) [95-29,747]	8,032 (6,274) [96-30,302]	9,060 (7,069) [104-33,866]
Percent Medicaid ED Visits (Total Hospital Medicaid ED Visits / Total Hospital ED Visits)	25.88 (6.71) [4.86-51.86]	24.73 (6.77) [4.86-50.02]	25.63 (6.65) [6.67-51.41]	27.28 (6.52) [6.16-45.58]
Average Number of Dental ED Visits	51.27 (39.9) [0-255]	51.63 (39.2) [0-185]	50.12 (41.1) [0-255]	53.02 (39.7) [0-193]
Average Number of Dental Medicaid ED Visits	31.17 (23.7) [0-113]	29.56 (24.1) [0-120]	30.39 (24.2) [0-136]	33.50 (25.4) [0-115]
Percent Dental Medicaid ED Visits (Total Hospital Dental Medicaid ED Visits / Total Hospital Dental ED Visits)	0.623 (0.106) [0.342,0.860]	0.589 (0.135) [0.275,1]	0.612 (0.149) [0,1]	0.654 (0.157) [0,1]
Percent Dental ED visits (Total Hospital Dental ED Visits / Total Hospital ED Visits)	0.0023 (0.011) [0,0.2]	0.0017 (0.00076) [0,0.0057]	0.0017 (0.00081) [0,0.0058]	0.0035 (0.019) [0,0.2]

SD = standard deviation

Table 2

Ordinary Least Squares Regression on the effect of Medicaid on emergency dental visits in North Carolina from 2007 to 2009 using hospital and year fixed effects (N=327)

	Coefficient (SE)	95% CI
Variable		
% Medicaid	0.0321 ** (0.0095)	0.0134, 0.0508
Age (years)	0.010 (0.12)	-0.22, 0.24
Male	0.956 (1.67)	-2.32, 4.23
Race and Ethnicity		
American Indian and Eskimo	0.072 (0.27)	-0.48, 0.62
Asian and Pacific Islander	0.26 (1.16)	-2.07, 2.58
African American	0.12 (0.29)	-0.47, 0.71
Other race	0.06 (0.28)	-0.52, 0.65
Year		
2008	-0.064 (0.038)	-0.139, 0.001
2009	-0.088 (0.046)	-0.178, 0.002
Constant	-8.14 ** (1.28)	-10.6, -5.6

SE=standard error, CI=confidence interval

**
P<0.01

Table 3

Top ten ICD-9-CM^{*} discharge diagnosis codes and for emergency dental visits in North Carolina from 2007 to 2009

ICD-9-CM Code	Total	2007	2008	2009
Unspecified disorder of the teeth and supporting structures (525.90)	9,924	3,103	3,256	3,565
Dental Caries (521.00)	4,053	1,374	1,243	1,436
Periapical abscess without sinus (522.50)	3,527	1,252	1,156	1,119
Teething (520.7)	2,876	921	921	1,034
Chronic gingivitis, plaque induced (523.10)	1,170	396	366	408
Other specified disorders of the teeth and supporting structures (525.8)	1,022	340	342	340
Unspecified disease of the jaws (526.9)	626	196	222	208
Acute apical periodontitis of pulpal origin (522.4)	555	173	193	189
Disturbances in tooth eruption (520.6)	481	152	142	187
Other and unspecified diseases of the oral soft tissues (528.90)	396	115	115	166

Note: Multiple ICD-9-CM diagnosis codes could be listed for each emergency dental visit. ICD-9-CM Codes were aggregated from the first five diagnosis codes.

* ICD-9-CM indicates International Classification of Diseases, Ninth Edition, Clinical Modification