

**A RETROSPECTIVE ANALYSIS OF DENTAL PROVIDER DISTRIBUTION AND  
EMERGENCY DEPARTMENT USE FOR DENTAL CARE IN NORTH CAROLINA**

By

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## Background

Emergency department (ED) use for dental conditions has increased across the country.<sup>1,2</sup> In 2012, there were an estimated 2.18 million visits to EDs for dental problems, nationally.<sup>3</sup> EDs are often not the most appropriate setting for dental problems since many are ill-equipped to treat the underlying issue.<sup>4,5</sup> The most common problems that bring patients to the ED are infectious in nature: dental caries<sup>6-9</sup> or infection of the pulpal and/or periapical tissues.<sup>6,8,10</sup> Although a small percentage of these patients have problems serious enough to require hospitalization,<sup>11</sup> almost 95% of patients are routinely discharged from the ED with antibiotic and/or analgesic prescriptions, and in limited cases, a referral to a dentist.<sup>4-7,9,11-13</sup> Several state-based reports indicated that patients return to the ED because the underlying problem was not treated and/or they were unable to find dental care.<sup>5,11</sup>

Treating these dental problems in the ED is costly; in 2012, the cost to treat discharged patients in the ED was \$1.6 billion.<sup>3</sup> The majority of patients presenting at the ED with dental problems are Medicaid recipients or are uninsured.<sup>1,6-8,11,12,14</sup> All states are required to provide dental benefits for children enrolled in Medicaid or Children's Health Insurance Program (CHIP), but they are not required to provide any dental benefits for adults.<sup>15</sup> North Carolina does cover some procedures for Medicaid beneficiaries over the age of 21, but there is a dearth of data regarding adult Medicaid beneficiaries' utilization and access to dental care. While oral health advocacy organizations in North Carolina acknowledge the barriers facing adults, most of the efforts to improve Medicaid beneficiaries' access to dental care have focused on children.<sup>16</sup>

Aside from having dental insurance through Medicaid, beneficiaries may have difficulty being able to use their insurance. Relatively few dentists participate in the Medicaid program,<sup>17</sup> and many of those that do may not be active participants. Dentists cite low reimbursement rates,<sup>17-19</sup> administrative challenges,<sup>18,19</sup> and uncooperative patient behavior<sup>18,19</sup> as barriers to participation in Medicaid. Reimbursement rates are so low that many dentists report a net loss for treating Medicaid patients and cannot afford to see more than a handful each year.<sup>18,19</sup> At the same time, shifts in the economy have caused many

adults to replace private dental insurance with Medicaid or go without any dental insurance, which has led to a decline in utilization of preventive dental care.<sup>20</sup>

Even with costs or insurance driving ED utilization, other trends provide context for the problem. Most patients are between the ages of 18 and 50<sup>1,4-5,8,10</sup> and present at the ED during the week at times that coincide with dentist's office hours,<sup>5,8,9,21</sup> indicating that there are barriers to access other than inconvenient office hours. Utilization trends by race are unknown, but area median income below \$39,000, residency in the American South, and rural residency were positively associated with ED use for dental care.<sup>22</sup>

Preventive dental care may also affect ED rates. A long-term study of ED utilization trends among non-elderly adults demonstrated an inverse relationship between trends in utilization of conventional dental services and ED dental utilization.<sup>2</sup> In addition, even when controlling for socioeconomic status and health conditions, whites tend to utilize preventive dental services at higher rates than blacks<sup>21</sup> and Hispanics (of all races);<sup>23</sup> and women followed the recommended dental preventive schedule better than men.<sup>24</sup> However, the differences in ED utilization by gender are mixed.<sup>7,22</sup>

The use of EDs for dental conditions is particularly concerning in North Carolina, where rates are among the highest in the country. In 2013, there were 90 visits per 10,000 people, compared to the national average rate of 40 visits per 10,000 people.<sup>25</sup> Residents in Health Professional Shortage Areas (HPSA) is associated with worse health status and lower access to care.<sup>26</sup> HPSAs (or D-HPSAs for dental care) are designated by the Health Resources and Services Administration (HRSA) to define inadequate workforce for geographic areas, facilities, or specific population groups.<sup>27</sup> Although the Health Resources and Services Administration projects the dental workforce shortage to get worse over the next ten years,<sup>28</sup> Spero and colleagues argued that the true issue in North Carolina is the uneven distribution of the workforce.<sup>25</sup> Dentists are concentrated in urban areas and several counties have no dental providers.<sup>17,25,29</sup> Patients must travel to neighboring counties, which can often take an hour or more, or rely on mobile dental vans for their children's care.<sup>17</sup>

ED use for dental care is costly and inappropriate, and generally symptomatic of a lack of access to preventive care. To date, there has not been an analysis of the effects of dentist location on utilization or outcomes in North Carolina. The purpose of this study is twofold: to establish the burden of ED use for dental care in North Carolina and to determine if dentist location is associated with ED use for dental conditions.

## **Methods**

The Institutional Review Board at the University of North Carolina determined this study to be exempt from continuing review.

### Dependent Variables - ED Visits

ED use data were derived from the North Carolina Hospital Discharge Database for FY 2014.<sup>30</sup> Relevant cases were those for whom North Carolina residency was established by the patient's North Carolina Federal Information Processing Standards (FIPS) code and those who had a primary or secondary diagnosis code within ICD-9 range 520.0-529.9, those pertaining to dental conditions. Cases were retained if race and ethnicity were undetermined, but cases were dropped from analysis if age or sex were undetermined. Race was coded as non-Hispanic white, non-Hispanic black, non-Hispanic other race (including Asian, American Indian, Pacific Islander, Native Hawaiian, or other race), and Hispanic of any race. In the dataset, the age of children under 2 years was coded by months, so these patients were recoded these patients into 0 years old if they were 0-11 months and 1 year old if they were 12-23 months. Patients aged 90 and older were collapsed into one category. Patient insurance was coded into self-pay, Medicaid, Medicare, private, and other.

Individual-level data was aggregated at the county level. The outcome of interest is the rate of ED visits for dental conditions per 10,000 people in each county. This was calculated by summing the number of ED visits in each county, dividing them by their respective county populations (from the Health Professions 2014 Data Book<sup>31</sup>), and multiplying the resulting fraction by 10,000. Because discharge data were not uniquely

identifiable, it is possible that not all of the visits represent a unique patient. One study estimated that repeat visits accounted for at least 20% of dental ED visits,<sup>5</sup> which may also be true for this data, but it was assumed that such visits would not negatively impact the model's predictability value.

To analyze Medicaid ED dental rates, all of the relevant observations from the dataset with Medicaid listed as the primary payer were aggregated to calculate the Medicaid population's ED dental cases. Annual Report Tables for fiscal years 2014<sup>32</sup> and 2015,<sup>33</sup> published by the NC Division of Medical Assistance, were used to estimate the population of Medicaid-eligible beneficiaries. The number of cases was divided by the estimated population, then multiplied by 10,000 to calculate the rate of ED visits per 10,000 eligible persons.

#### Independent variables - Dentists

The independent variable of interest is the rate of dentists per 10,000 people in each county, obtained from the Health Professions 2014 Data Book.<sup>31</sup>

For the Medicaid analysis, the number of significant Medicaid providers was estimated from two fiscal years of data, provided by the NC Division of Medical Assistance. Significant providers are those who billed Medicaid for at least \$10,000 annually. These particular providers were selected because they were presumed to be more representative of the workforce most accessible to Medicaid-enrolled patients. Since many of these dentists work for group offices and may bill under a single provider National Provider Identification (NPI) number, the service provider's NPI was used to identify the dentist providing services and the county in which they worked. Some providers worked in more than one county, so they were included in the provider distribution in each county they provided services. The rate of significant providers was also calculated per 10,000 eligible population, using the same population estimates defined above.

## Control variables

Control variable demographic data were derived from the American Community Survey 2014 estimates. Census age data were only available in groupings, where 20- and 21-year-olds could not be separated from 22-24. Therefore, although Medicaid covers adults up to 21, ED data were aggregated to match Census designations. Demographic data for the Medicaid population were not available. County-level insurance estimates were only available for Medicaid<sup>32,33</sup> and Medicare recipients.<sup>34</sup>

## **Regression Methods**

Although a logarithmic-transformed dependent variable would maximize model fit for the right-skewed data, the variable was not transformed for interpretive reasons. Minor heteroscedasticity in the errors was controlled for in the statistical program. Residual vs. fitted value plots were well-distributed around the horizontal axis with no obvious pattern. Analysis was conducted in Stata 13 (College Station, TX).

Based on the methods of a recent analysis of dental ED use and Medicaid providers<sup>35</sup>, the analysis was further stratified by urban and rural counties. Metropolitan Statistical Area (MSA) designation was used to estimate urban and rural areas. MSA designations are based on population density and economic development characteristics. These particular designations came from the Health Professions 2014 Data Book,<sup>31</sup> where counties were designated “Metropolitan” or “Non-Metropolitan.” While there are more nuanced definitions for urban and rural counties, this is used as an estimation for the purposes of this analysis.

Comprehensive demographic data about the Medicaid population was unavailable, so no regression analysis or comparison to state averages was conducted. However, the ED rates and provider patterns for this population are described in the results section.

## **Results**

### State-Level Patient Characteristics – General Population

Dental visits accounted for 108,625 visits, or about 2.5% of all visits to North Carolina EDs. Black North Carolinians disproportionately use the ED for dental reasons, as well as persons aged 20-39. More than 75% of ED dental users were self-pay (51.97%) or Medicaid (24.51%). Slightly more women than men presented at the ED, although there was little difference between patients' characteristics and representation in NC. Rates of ED use were higher in rural counties than in urban. State-level characteristics are described in Table 1.

### State-Level Patient Characteristics – Medicaid Population

The majority of Medicaid beneficiaries who used the ED were aged 20-39, and the second-highest group was those aged 0-19, including many infants. More Medicaid-enrolled women than men used the ED for dental reasons. Rural counties saw higher rates of ED use than urban counties. Medicaid population characteristics are described in Table 2.

### County-Level Characteristics

#### *ED Visits*

The average rate was 109.13 visits per 10,000 population. Rates vary widely across counties. The lowest rate was in Ashe with 32.42 visits per 10,000 people, and the highest was in Hertford, with 436.16 visits per 10,000 people. The majority of counties had rates under 200 (Figure 1).

There was also a broad range in rates for patients who were Medicaid recipients: the lowest rate was in Ashe with 29.14 visits per 10,000 eligibles and the highest was in McDowell with 387.67 visits per 10,000 eligibles. The majority of counties again had rates under 200 visits per 10,000 eligible people, although there were more counties with rates above 200 visits per 10,000 than there were with the overall population (Figure 2).

## *Dentists*

Three counties had no registered dentists and the mean rate of dentists was 4.7 per 10,000 people. Medicaid-accepting dentists were limited to those who billed for at least \$10,000, so it is possible that there are active dentists who are not represented, but dentists with these characteristics were chosen for reasons described above. The average rate of significant Medicaid providers is 8.24 dentists per 10,000 eligible population.

## Regression Results

Regression results are detailed in Table 3.

Provider distribution is not linearly associated with ED use (coefficient: 1.34,  $p = 0.666$ ). However, specific characteristics were significant. In the overall model, a 1% increase in county population that is Hispanic is associated with a 4.29-ED dental visit decrease ( $p = 0.004$ ). In this same model, Medicaid eligibility was marginally associated with an increase in ED dental visits (coefficient: 2.73,  $p = 0.057$ ). No factors were significant in the urban model. In the rural model, a one percent increase in persons aged 0-19 was associated with an expected 13.18-visit increase in ED visits ( $p = 0.015$ ), while the same change in percent Hispanic was associated with a 7.56-visit expected decrease ( $p = 0.005$ ).

Regression results for Medicaid patients relative to significant providers is inconclusive due to lack of covariate information. Preliminary results with only the dental provider rate and urban/rural designation and stratification show a slight negative, marginally significant, association.

## **Discussion**

This cross-sectional examination of ED dental utilization and the influence of dental provider distribution demonstrated slightly higher ED dental utilization in North Carolina compared to previous estimates. Nationally, reports estimate dental visits to comprise between 1% and 2% of total ED visits.<sup>2,7</sup> The results from this study are not surprising, considering North Carolina's significantly higher ED dental utilization rate relative to other



states.<sup>25</sup> However, in terms of patient characteristics, the insurance status and age utilization rates in the present study are consistent with current literature.<sup>1,4-8,10-12,14</sup>

This study confirmed that young adults are using the ED for dental care at disproportionately high rates. More than 60% of these patients were self-pay. Among the privately insured, non-Marketplace insurance plans are not required to include dental insurance, so there could be even more patients without adequate dental insurance coverage.

Regression analysis failed to demonstrate a linear association between the number of dentists in a county and the subsequent preventable ED dental use. Therefore, the solution to this particular access barrier is also not linear. While many counties would probably benefit from having more (or any) providers, there are other access barriers that are not addressed by introducing more dentists. Cost and fear are two significant barriers, and adding more dentists will not help the people who cannot afford care or are afraid to seek care. This is not to say that efforts to bring dentists to underserved areas are misguided, merely that developing the dental workforce in underserved areas is only one piece of creating access to convenient, affordable care.

The majority of patients who presented at the ED with dental complaints were self-pay and likely uninsured. The uninsured are a heterogeneous group.<sup>36</sup> North Carolina did not expand Medicaid, so adults without dependent children whose incomes are below 100% of the federal poverty line (FPL) do not qualify for Medicaid and cannot afford private plans. There are also full-time workers who earn income above 400% FPL but do not have employer-sponsored insurance and may have declined ACA marketplace plans. Solving dental care access issues for these individuals is difficult, and future efforts should focus on access barriers for the uninsured, regardless of income level.

In contrast to the overall population, the second-largest group of patients in the ED with Medicaid were those aged 0-19. In addition, out of all patients aged 0-19, more than 70% were Medicaid recipients. Medicaid coverage for children is more comprehensive than for adults, so parents who are unable to find a dentist for their child may choose to take her

to the hospital, knowing that she is guaranteed to see a physician and that the visit will be covered. In addition, low socioeconomic status is associated with low health literacy,<sup>37,38</sup> which contributes to poor oral health in young children.<sup>39</sup> Parents with low oral health literacy may not know to take their child to the dentist at first tooth eruption or by one year of age and may wait until there is a problem to seek dental care for their child.

## **Limitations**

There were several limitations of this study. This analysis used data that is unique to North Carolina and should not be considered generalizable to other states. One limitation that may have affected ED use rate data was the necessary exclusion of cases for which NC residency could not be established. Patients whose FIPS codes did not match NC counties were excluded, as well as those for whom there was not a FIPS code, which could have been patients from underserved NC counties. There were 11,440 visits for whom county information was missing and the patient's primary or secondary diagnosis was for a dental condition (0.3%).

ED visit rates were based on the patient's county of residence, not the county in which they sought services. In addition, the rates of providers were limited to those registered in North Carolina and did not capture those in Virginia, Tennessee, or South Carolina, who likely treat patients residing in neighboring counties, so their contribution to care is not known.

## **Future Directions**

This study highlights the significant number of ED dental visits in North Carolina. The analysis demonstrated a non-linear problem, so non-linear solutions are warranted. Increasing affordable access to care for the uninsured is a challenging task because of the diversity of this population. Future research should maximize mixed-methods approaches to hone in on the challenges facing the young adults, particularly those without insurance. For example, since few hospitals in North Carolina have dentists on staff, further research could

analyze whether patients seek care in hospitals in which they know a dentist is present, and whether outcomes are better for patients who seek care in these hospitals.

## Tables and Figures

*Table 1. State-level patient and population statistics*

<b>Characteristic</b>	<b>% of Dental ED visits</b>	<b>State %</b>
<b>Race/Ethnicity</b>		
White, non-Hispanic	54.15	64.55
Black, non-Hispanic	37.12	21.15
Other race, non-Hispanic	3.14	5.58
Hispanic, any race	3.36	8.73
Unknown	2.23	--
<b>Age</b>		
0 – 19	9.89	25.72
20 – 39	62.00	26.51
40 – 64	25.57	33.06
65+	2.54	14.72
<b>Payer</b>		
Self-pay	51.97	--
Medicaid	24.51	21.52
Medicare	6.23	17.27
Private	15.69	--
Other	1.59	--
<b>Sex</b>		
Male	47.53	48.72
Female	52.47	51.18
<b>MSA Designation</b>		
Metro	98.25 / 10K	---
Non-Metro	140.71 / 10K	---
<b>State Average Rate</b>		
	109.13 / 10K	---

Table 2. State-level Medicaid patient statistics

Characteristic	% of ED Dental Visits
<b>Race/Ethnicity</b>	
White, non-Hispanic	51.09
Black, non-Hispanic	37.35
Other race, non-Hispanic	3.79
Hispanic, any race	5.43
Unknown	2.28
<b>Age</b>	
0 – 19	28.43
20 – 39	57.13
40 – 64	14.42
65+	0.03
<b>Sex</b>	
Male	31.83
Female	68.17
<b>MSA Designation</b>	
Metro	113.96 / 10K
Non-Metro	147.30 / 10K
<b>State Average Rate</b>	
	124.30 / 10K

Figure 1

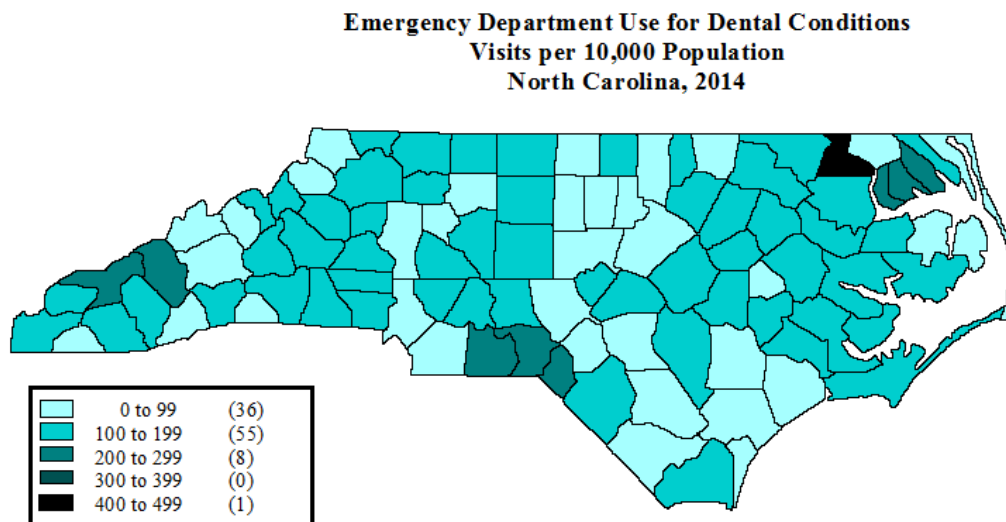


Figure 2

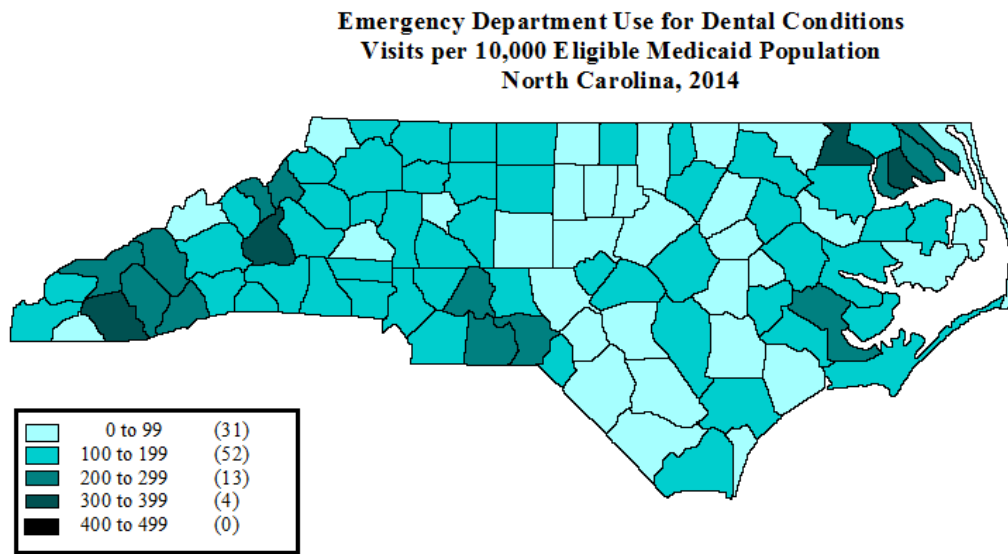


Table 3. Regression results for general population

Variable	All		Urban		Rural	
	Coefficient (SE)	P-value	Coefficient (SE)	P-value	Coefficient (SE)	P-value
Dentist rate	1.34	0.666	-0.31	0.903	6.83	0.339
Rural/urban designation	-15.62	0.169	---	---	---	---
Age						
0-19 years	2.69	0.231	-2.95	0.212	<b>13.18</b>	<b>0.015*</b>
20-39 years	-2.81	0.333	-1.16	0.710	-8.61	0.190
40-64 years	-3.57	0.291	-3.07	0.546	-8.28	0.278
65+ years	Reference	---	---	---	---	---
Sex						
Female	-3.16	0.439	1.09	0.814	-15.86	0.117
Male	Reference	---	---	---	---	---
Race/Ethnicity						
Black, non-Hispanic	0.20	0.794	-0.08	0.925	0.46	0.673
Other, non-Hispanic	-0.10	0.949	-2.22	0.335	-1.05	0.574
Hispanic, any race	<b>-4.29</b>	<b>0.004**</b>	-1.08	0.662	<b>-7.56</b>	<b>0.005**</b>
White, non-Hispanic	Reference	---	---	---	---	---
Medicaid eligible	<b>2.73</b>	<b>0.057<sup>†</sup></b>	3.12	0.190	2.28	0.197

\* =  $p < 0.05$

\*\* =  $p < 0.01$

<sup>†</sup> = marginal p-value

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