HPI Health Policy Institute

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An ADA Health Policy Institute Analysis for the North Carolina Department of Health and Human Services, Division of Health Benefits

This research report was developed by the American Dental Association's Health Policy Institute.
211 E. Chicago Avenue
Chicago, Illinois 60611
312.440.2928
HPI@ADA.org

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The American Dental Association's Health Policy Institute is a thought leader and trusted source for data and research on critical issues affecting the U.S. dental care system. Their research agenda includes, but is not limited to, dental practice economies, health care reform, dental education, and oral health outcomes. Their work is led by health economists, statisticians and policy researchers and uses data collected in-house as well as data from private and public institutions. HPI has been cited by CNN, *The New York Times*, *The Washington Post*, *The Wall Street Journal*, Fox News, NOVA, and *The Atlantic*. To learn more about HPI, visit **ADA.org/HPI**.

Table of Contents

Background on Dental Care Reform in North Carolina

An introduction by Mark W. Casey, DDS, MPH, NC Medicaid Dental Officer

The North Carolina Department of Health and Human Services (NC DHHS) Division of Health Benefits (DHB) and its partner, the North Carolina Dental Society (NCDS), wish to thank the American Dental Association Health Policy Institute (HPI) for its thorough examination and insightful analysis of claims, beneficiary enrollment, provider participation and dental workforce data in the following report: "An ADA Health Policy Institute Analysis for the North Carolina Department of Health and Human Services, Division of Health Benefits."

DHB would also like to thank HPI for the opportunity to present additional background information about the NC Medicaid and Health Choice (CHIP) dental programs. We hope that the additional information will provide context to the detailed analysis that HPI has generated from evaluation of calendar year 2018 claims and eligibility data provided to them by DHB. The in-depth report that follows this introduction demonstrates the prodigious analytical skills of the HPI team. HPI is the preeminent authority on dental health care policy in the U.S. and is renowned for its comprehensive analysis and innovative presentation of Medicaid/CHIP data, which tell the story of the oral health care delivery system at the state and national levels.

The best place to start in telling the story of the NC Medicaid and NC Health Choice dental programs over the last two decades is the groundbreaking 1998 North Carolina Institute of Medicine "Task Force on Dental Access."[1] This convening of private and public stakeholders developed a list of recommendations that has been used as a blueprint to make improvements in the delivery of oral health services to disadvantaged publicly insured children and adults in North Carolina. Utilization data from the Health Care Financing Administration (HCFA) Early and Periodic Screening, Diagnosis and Treatment Participation Report (416 Report) showed that in federal fiscal year (FFY) 1999, approximately 23% of children ages 1-20 who were eligible at least one month during the reporting period received at least one dental service.[2] Coverage of pediatric dental services is mandated under Title XIX of the Social Security Act, whereas adult dental services coverage is optional for states. Thus, the tracking of pediatric dental measures is critical to the oversight provided by NC Medicaid's federal partners at the Centers for Medicare and Medicaid Services (HFCA became CMS in 2001). With less than one-quarter of NC Medicaid-enrolled children receiving a dental service each year, it became clear to all stakeholders on the NCIOM

[1] North Carolina Institute of Medicine. Task force on dental access: report to the North Carolina General Assembly and to the Secretary of the North Carolina Department of Health and Human Services. 1999. Available from: https://nciom.org/task-force-on-dental-care-access/. Accessed November 17, 2020.

[2] Centers for Medicare and Medicaid Services. CMS 416 Annual EPSDT participation report. 1999. Available from: https://www.medicaid.gov/medicaid/benefits/early-and-periodic-screening-diagnostic-and-treatment/index.html. Accessed November 17, 2020.

task force that the NC Medicaid and Health Choice (CHIP) dental programs were far from successful and needed major changes.

In 2000, in *Antrican v. Bruton*, a lawsuit was filed on behalf of North Carolina Medicaid beneficiaries against NC DHHS challenging the adequacy of Medicaid dental reimbursement rates and the state's efforts to ensure access to dental care. The plaintiffs alleged that only 16% of North Carolina dentists participated in the state's Medicaid program. The lawsuit was settled in 2003. To meet the obligations detailed in the settlement, the Division of Medical Assistance (now known as the Division of Health Benefits) increased reimbursement rates for a selected list of dental procedures commonly provided to children. This set of procedures was negotiated based on the initial recommendations of the plaintiffs, utilization of the services, expected cost of the rate increases, and the amount of state funding made available by the NC General Assembly. Effective April 1, 2003, reimbursement rates for 36 dental procedures were raised to 73% of the UNC School of Dentistry Dental Faculty Practice rates. While the procedures chosen for rate increases were selected primarily for their impact on children, more than two-thirds of the procedures were services also utilized by adult beneficiaries.[3]

In 2001, NC Medicaid implemented statewide coverage for the groundbreaking Physician Fluoride Varnish Services program known as Into the Mouth of Babes (IMB). The North Carolina model for improving the delivery of important preventive oral health services was based on a successful pilot project, which trained medical professionals to apply topical fluoride as part of well-child visits beginning at the eruption of the first primary tooth. IMB proved that early intervention through counseling parents/caregivers, applying fluoride varnish, and encouraging dental referrals paid dividends in significant reductions in tooth decay.[4] Evaluation of IMB by the UNC-CH Gillings School of Global Public Health produced many noteworthy evidence-based studies that were published in peer-reviewed journals. The findings of these studies indicated substantial gains in access to preventive oral health services in all counties of the state, reduction in the need for caries-related treatment and hospital-based care for the target preschool population, and proven cost effectiveness of the pioneering preventive oral health program.[5] More than 45 other state Medicaid programs have imitated the IMB NC medical model across the country. In September 2008, the NC Medicaid Dental Director testified about the success of IMB to the U.S. House of Representatives Committee on Oversight and Government Reform, Domestic Policy Subcommittee.[6] The testimony was part of a

[3] North Carolina Institute of Medicine. Update task force on dental care access report to the North Carolina General Assembly and to the Secretary of the North Carolina Department of Health and Human Services. 2003. Available from: https://nciom.org/wp-content/uploads/2017/08/dentalupdate03.pdf. Accessed November 17, 2020.

[4] Casey M. Necessary reforms to pediatric dental care under Medicaid. Written testimony. U.S. House of Representatives Committee on Oversight and Government Reform/Domestic Policy Subcommittee Hearing. September 23, 2008. Available upon request.

[5] Division of Public Health. Into the mouths of babes. North Carolina Department of Health and Human Services. 2020. Available from: https://publichealth.nc.gov/oralhealth/partners/IMB.htm. Accessed November 17, 2020.

[6] Casey M. Necessary reforms to pediatric dental care under Medicaid. Written testimony. U.S. House of

panel presentation by Medicaid dental policy experts who were asked to report on Medicaid/CHIP pediatric oral health program reforms. These hearings were held in the wake of the unfortunate death of Maryland Medicaid beneficiary, Deamonte Driver, in 2002. This young man died from an infection of dental origin which could have been prevented if he had been able to access timely dental care. In 2019, the National Academy of Medicine featured IMB as an example of strategies that have successfully integrated medicine and dentistry in the U.S.[7]

While improvements were made in access to care and in oral health outcomes for preschool-age NC Medicaid beneficiaries due to IMB, the Medicaid/CHIP dental provider network was also registering impressive gains in utilization of services. By 2005, the mandatory children's dental benefit program saw utilization rates for children ages 1-20 increased to 40%.[8] Over this same period, the state Medicaid agency and its fiscal agency instituted reforms to the processing of provider enrollment applications, prior authorization requests, claims for dental services and direct payments that attracted more providers to participate in the program. Further, program staff stepped up recruitment efforts by attending and presenting to state and local professional membership organization meetings as well as annually presenting to predoctoral and postdoctoral students. By 2008, the program reported over 1,900 unduplicated billing providers in its network, a gain of almost 20% since 2001.[9]

More and more NC licensed dentists committed to treating the underserved in the state. According to Division of Medical Assistance internal reports derived from the agency's own administrative claims database, almost 50% of active licensed dentists in the state participated in the program by 2011.[10] NC Medicaid implemented three separate reimbursement rate increases from 2006 to 2008. Total NC Medicaid dental expenditures increases from approximately $58 million in 2000 to $362 million in 2011.[11] Many observers heralded this comeback as solely due to the outcome of the *Antrican v. Bruton* lawsuit. This conclusion ignores the efforts of NC DHHS Division of Medical Assistance staff to implement meaningful reform to

Representatives Committee on Oversight and Government Reform/Domestic Policy Subcommittee Hearing. September 23, 2008. Available upon request.

[7] National Academy of Medicine. Integrating oral and general health through health literacy practices: proceedings of a workshop. 2019. Available from: https://www.nap.edu/catalog/25468/integrating-oral-and-general-health-through-health-literacy-practices-proceedings. Accessed November 17, 2020.

[8] Centers for Medicare and Medicaid Services. CMS 416 Annual EPSDT Participation Report. 2005. Available from: https://www.medicaid.gov/medicaid/benefits/early-and-periodic-screening-diagnostic-and-treatment/index.html. Accessed November 17, 2020.

[9] Casey M. North Carolina Institute of Medicine: task force on children's preventive oral health services. The State of Medicaid and CHIP Dental Services in North Carolina. December 12, 2012. Available from: https://nciom.org/task-force-on-childrens-preventive-oral-health-services/ or upon request. Accessed November 17, 2020.

[10] Centers for Medicare and Medicaid Services. CMS 416 Annual EPSDT Participation Report. 2005. Available from: https://www.medicaid.gov/medicaid/benefits/early-and-periodic-screening-diagnostic-and-treatment/index.html. Accessed November 17, 2020.

[11] Steinmetz E, et al. Children's use of dental care in Medicaid federal fiscal years 2000-2012. The George Washington University Milken Institute of Public Health. October 2014. Available from: https://www.medicaid.gov/sites/default/files/2019-12/dental-trends-2000-to-2012.pdf. Accessed November 17, 2020.

the NC Medicaid and Health Choice dental programs.

At the beginning of the 2010 decade, the NC Medicaid dental program had completed a remarkable turnaround in beneficiary utilization as well as provider participation metrics. The former is typically measured by pediatric utilization rates calculated from the CMS 416 ESPDT participation report. In a little over ten years, NC Medicaid went from the bottom 25% of states in terms of dental utilization rates for children ages 1-20 to the top 25% of states by 2012.[12] The about face was so transformative that in 2010, CMS recognized North Carolina's Medicaid dental program as one of eight state Medicaid agency dental programs with high pediatric dental utilization rates and/or innovative practices that improved the delivery of oral health services. NC Medicaid qualified for this distinction based on both high children's dental utilization rates and the seminal IBM/Physician Fluoride Varnish Service Program.[13]

By late 2008, during the Great Recession, state revenues began to decline in North Carolina. During this period, many state Medicaid agencies spent the next several years reducing dental reimbursement rates and modifying covered services to stave off even more dramatic cuts to services for the publicly insured. Throughout a lengthy period of economic austerity and declining revenues, the Division of Medical Assistance reduced dental reimbursement rates three times, and the Medicaid pediatric utilization rates as calculated from the CMS 416 report never decreased in North Carolina throughout the whole decade.[14] This was remarkable in that other states did experience declining children's utilization rates as fees paid to providers fell further and further behind market-based benchmarks. The gradual increase in utilization rates from 2010-2019 is characteristic of the NC Medicaid/CHIP dental programs having a core group of enrolled providers who remained active participants even as the average rates paid for the services that dentists render to children was not in the upper echelon of reimbursement rates paid by state Medicaid dental programs. The program did lose some providers from its network with the participation rate falling below 45% of active licensed dentists in the state throughout most of the decade.[15] However, the fact that pediatric utilization gradually increased, albeit not as impressively as it had increased from 2005-2010, was a sign that other more actively participating providers were able to meet the demand for services previously met by providers who chose not to participate during the economic downturn and recovery.

[12] Centers for Medicare and Medicaid Services. CMS 416 Annual EPSDT Participation Report. Federal fiscal years 1999 and 2012. Available from: https://www.medicaid.gov/medicaid/benefits/early-and-periodic-screening-diagnostic-and-treatment/index.html. Accessed November 17, 2020.

[13] Centers for Medicare and Medicaid Services. 2010 individual state reports. October 2010. Available from: https://www.medicaid.gov/medicaid/benefits/dental-care/index.html. Accessed November 17, 2020.

[14] Division of Health Benefits. Wellness visits and diagnostic and treatment Services. Federal fiscal year 2010–2020. NC Department of Health and Human Services. Available from: https://medicaid.ncdhhs.gov/providers/programs-and-services/medical/wellness-visits-and-diagnostic-and-treatment-services. Accessed November 17, 2020.

[15] Division of Health Benefits. Internal Report: DR 2018-5984. NC Department of Health and Human Services. March 6, 2018. Available by request.

During tough fiscal times, state Medicaid agencies are often directed to propose cutting optional services like adult dental benefits. From 2008 and into the first half of the next decade, many states implemented cuts to adult dental services. The primary form of reduction is to limit coverage to emergency dental services in an effort to balance state budgets.[16] A reduction in coverage for adult beneficiaries was formally proposed as a cost-cutting measure at least twice during the economic crisis and the lengthy recovery. However, thanks to support from key stakeholders like the North Carolina Dental Society, the Executive Branch of State government and the North Carolina General Assembly decided to forgo proposed significant reductions in the NC Medicaid adult dental benefit. Discussion of cuts to the adult dental benefit mobilized an influential alliance of stakeholders representing both beneficiaries and dental providers to voice opposition to the proposed reductions.

At the beginning of the decade, the CMS Medicaid Central Office Dental staff announced an ambitious National Oral Health Initiative that sought significant improvement on a performance measure targeting preventive dental services, known as PDENT by CMS. The measure numerator and denominator data are reported on the CMS 416 report. The measure is calculated by dividing line 12b by line 1b. CMS asked states to strive to increase utilization rates by 10 percentage points over a five-year span of time. The baseline year selected by CMS for the PDENT metric was FFY 2011.[17] Most likely due to the lagging economic recovery in states over much of the decade, the objective was only reached by a handful of states. North Carolina was not among the states that were able to achieve the goal of a 10 percentage point increase in five years, achieving instead. However, by FFY 2019, North Carolina was able to achieve a 7 percentage point gain and did not move backwards in any of the years since 2011 as did the Medicaid dental programs in the neighboring states of Tennessee and South Carolina. In FFY 2019, North Carolina Medicaid ranked 13 in the nation at 52.1% for the PDENT measure, approximately 4 percentage points above the national mean and in the top third of states.[18]

NC Medicaid measures provider participation by using administrative claims data to calculate a numerator of individual dentists who had been the attending or rendering provider on at least one paid claim. This numerator is divided by a denominator of the number of active licensed dentists in North Carolina, which is reported to DHB by the NC State Board of Dental Examiners. In calendar year 2018, the year examined by HPI, using the same

[16] McGinn-Shapiro M. Medicaid coverage of adult dental services. National Academy for State Health Policy. State Health Policy Monitor. October 2008. Available from: https://www.nashp.org/wp-content/uploads/sites/default/files/Adult%20Dental%20Monitor.pdf. Accessed November 17, 2020.

[17] Centers for Medicare and Medicaid Services. Improving access to and utilization of oral health services for children in Medicaid and CHIP programs CMS Oral Health Strategy. Available from: https://www.medicaid.gov/medicaid/quality-of-care/downloads/cms-oral-health-strategy.pdf. Accessed November 17, 2020.

[18] Centers for Medicare and Medicaid Services. Children's health quality measures: core set: performance on the child core set measures, FFY 2019. September 2020. Available from: https://www.medicaid.gov/medicaid/quality-of-care/performance-measurement/adult-and-child-health-care-quality-measures/childrens-health-care-quality-measures/index.html. Accessed November 17, 2020.

methodology described above, DHB calculated the percentage of active licensed dentists in North Carolina that participate in NC Medicaid at 42%. DHB has found that somewhere between 40-45% of licensed dentists in North Carolina have been active in our program since 2015. It is important to note that HPI has reported a significantly lower percentage of active dentists participating in the NC Medicaid program over the last few years in their previous infographics on state Medicaid dental programs. HPI does not use administrative claims data to calculate state Medicaid provider participation rates since obtaining that data for all 50 states would be virtually impossible to do in a timely manner. HPI's provider participation rate for NC Medicaid has varied from 29% to 35% over the course of the last few years.

NC Medicaid and its partner, the North Carolina Dental Society, agree that there is much work left to do to fulfill the promise of better oral health for the disadvantaged in our state. However, it is also important to take note of the progress that has been made over the last 20 years from a time when the vast majority of publicly insured children were not receiving an annual dental visit. North Carolina has been a state that has prided itself on a progressive approach to delivering health care and its leadership in the dental public health arena. The first state dental public health agency in the U.S. was founded in North Carolina in 1918. The NC DHHS, in close collaboration with the North Carolina Dental Society, looks forward to improving the delivery of oral health services to NC Medicaid and Health Choice beneficiaries to meet the challenges which HPI report describes in detail. This report is our new roadmap to success in an ongoing quest, which will not end until all disadvantaged North Carolinians achieve optimal oral health.

Mark W. Casey DDS, MPH
Dental Officer
NC Medicaid
Division of Health Benefits
NC Department of Health and Human Services

Key Findings of the HPI Analysis

In this report, the ADA Health Policy Institute provides an in-depth custom analysis specific to North Carolina in regards to geographic access to Medicaid dentists, meaningful participation in Medicaid among dentists, and the projected supply of dentists. Full results and in-depth descriptions of our data and methods are available in the succeeding sections.

In summary, our analysis has determined that supply of meaningful Medicaid providers and utilization vary geographically for children ages 1-20 and adults ages 21-64. State-wide, North Carolina Medicaid-enrolled children have a higher dental care utilization rate (58.9 percent with a dental visit in the past year) than the national average (51.7 percent). However, utilization among children falls below 25 percent in some counties. Among Medicaid-enrolled adults in North Carolina, dental care utilization is 18.7 percent, below the national average for publicly insured adults (23.2 percent). Utilization among Medicaid-enrolled adults is especially low in the mountain west portion of the state and along the Atlantic coast in northeastern North Carolina. Meaningful Medicaid dental providers (i.e., those meeting a threshold for reimbursement or patient volume) tend to be clustered around major metropolitan areas. For adults and children, we found that areas with both low Medicaid dental care utilization and an insufficient supply of Medicaid dental providers are also associated with low supply of meaningful Medicaid providers.

To further measure access to dental care in North Carolina, we examined how dental insurance type and other patient demographics impact ability to secure a dental appointment. Based on results of a mystery shopper survey, Medicaid-insured callers are less likely to secure a dental appointment than privately insured individuals. Even in areas with a sufficient supply of meaningful Medicaid providers according to the minimum thresholds we used, Medicaid-insured callers are less likely to secure an appointment compared to privately insured callers. This suggests that our definition of “meaningful” provider may not be pertinent from the patient perspective. Callers from rural areas are less likely to secure a dental appointment, and African American callers have longer appointment wait times than white callers, although there was not much variation by race. Callers most often cited that the dental office was not accepting any new patients as the reason why they cannot secure an appointment.

The supply of dentists in North Carolina, on a per capita basis, is projected to increase through 2039. The state is expected to consistently gain more dentists (e.g., new graduates, in-migration) than it loses (e.g., retirement, out-migration) and the expected net gain is larger than the expected increase in the population. In particular, the female share of the workforce is projected to increase from about one-third in 2019 to nearly half in 2039. This

could have important implications for practice patterns and access to care as female dentists, all else equal, are more likely to practice in DSOs, less likely to be practice owners, and more likely to be Medicaid providers.[19]

There are important policy implications to our analysis. There are several areas in North Carolina where there appears to be a sufficient number of meaningful Medicaid providers, yet dental care utilization is lower than the state average. In such areas, it may be that there is a lack of knowledge among Medicaid enrollees about how to contact dentists that participate in the program. Additional patient outreach in these areas may be necessary to inform enrollees of the locations of meaningful providers or, more broadly, to raise oral health literacy. In areas where utilization is below the state average and there is an insufficient supply of meaningful providers, the North Carolina Medicaid program may want to devise strategies to entice more dentists to treat Medicaid patients. These strategies include raising reimbursement rates to providers, streamlining administrative processes, and initiating targeted outreach to select providers and patients.[20]

There are several non-traditional models of care that may improve dental care access in underserved areas of North Carolina. These include providing basic dental services through school-based programs, mobile clinics and Federally Qualified Health Centers (FQHCs), and matching dentists with physicians and pediatricians in areas where Medicaid enrollees reside but there are not a sufficient number of dental offices. The North Carolina Medicaid program may consider such strategies to increase dental care utilization.

[19] Nasseh K, Vujicic M. The relationship between education debt and career choices in professional programs. *JADA*. 2017;148(11): 825-833.

[20] Nasseh K, Vujicic M. The impact of Medicaid reform on children's dental care utilization in Connecticut, Maryland, and Texas. *Health Services Research*. 2014;50(4): 1236-1249.

Geographic Access to Dental Care in North Carolina

In May 2017, HPI released state-specific analyses comparing where Medicaid/CHIP-insured children reside and where Medicaid/CHIP-participating dentists practice, providing states with detailed illustrations of their public dental care accessibility. HPI found that 90 percent of Medicaid/CHIP-insured children in North Carolina resided within 15 minutes of a Medicaid/CHIP-participating dentist.[21] While this analysis provided some idea of the North Carolina Medicaid dental network, it was limited in that it did not demonstrate dental care utilization levels in relation to Medicaid/CHIP-participating dentists, nor did it include a measure of how active dentists were in the Medicaid/CHIP program. The following analysis provides more nuanced detail to support policy proposals geared toward improving dental care utilization among North Carolina's Medicaid population.

Data and Methods

In March 2020, the North Carolina Medicaid program provided a file detailing dental care utilization among Medicaid-enrolled children and adults in North Carolina by census tract. It also provided a list of Medicaid-participating dentists. All files reflect calendar year (CY) 2018 data. In our analysis, we excluded dentists and offices located outside the state of North Carolina.

The beneficiary file provided by the North Carolina Medicaid program was based on 2018 claims data and included the total number of Medicaid-enrolled children ages 1-20 and adults ages 21-64 by census tract. Enrollees are defined as those enrolled in Medicaid or Health Choice for at least 180 continuous days in CY2018. The file breaks down the total number of enrollees by those that had an office-based dental visit in the past 12 months and those that did not.

Out of 2,285 dentists listed in the pediatric provider file provided by North Carolina Medicaid program, there were 1,522 meaningful providers.[22] In the adult Medicaid provider file, out of 2,160 dentists listed, 988 were meaningful providers. Dentists are considered meaningful Medicaid providers if they were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018. HPI solicited feedback from several subject matter experts and these criteria were cited by several as "rules of thumb" when defining a meaningful Medicaid provider. HPI also used this definition of a meaningful provider in a similar analysis conducted for the Virginia Medicaid program.

[21] American Dental Association. Geographic Access to Dental Care: North Carolina. Health Policy Institute Infographic. May 2017. Available from: https://www.ada.org/~/media/ADA/Science%20and%20Research/HPI/AccesstoDentalCare-StateFacts/North-Carolina-Access-To-Dental-Care.pdf. Accessed June 18, 2020.

[22] The number of dental providers in North Carolina used in this report vary from previously published HPI sources, likely due to discrepancies between Insure Kids Now data and North Carolina DHHS Medicaid administrative data.

Overall, the adult provider file included 1,365 unique office locations of which 704 had a meaningful provider. The child provider file included 1,437 office locations of which 992 had a meaningful provider. For mapping purposes, we mapped office locations with meaningful providers.

We analyzed dental care utilization rates among Medicaid enrollees and compared this to the supply of meaningful Medicaid providers. We conducted separate analysis for child enrollees and providers and adult enrollees and providers. For each census tract, we calculated the dental care utilization rate defined as the number of enrollees that used dental services at least once during CY2018 rendered by or under the supervision of a dentist in a non-emergency department setting divided by the number of individuals enrolled in Medicaid or Health Choice for at least 180 continuous days in CY2018. We limited our analysis to those census tracks with at least 100 unique Medicaid enrollees.

To calculate the supply of meaningful dental providers at the census tract level, we used the 2-stage floating area catchment method (2SFCA) using a 15-minute travel time threshold.[23] Travel times were calculated using the ArcGIS network analyst toolbox in ArcMAP 10.8. Using the 2SFCA method, we calculated the ratio of adult Medicaid enrollees to meaningful adult Medicaid providers and the ratio of child Medicaid enrollees to meaningful pediatric Medicaid providers. These ratios measure the supply of meaningful Medicaid providers for children and adults.

We created maps to illustrate supply of meaningful Medicaid providers and dental care utilization. There are two categories of supply of meaningful Medicaid providers: low and sufficient. Low supply of meaningful Medicaid providers indicated there was no Medicaid office within a 15-minute travel time or where the ratio of Medicaid enrollees to meaningful Medicaid dentists was over 2000 to 1. Sufficient supply of meaningful Medicaid dentists indicated there was a Medicaid office within a 15-minute travel time and the ratio of Medicaid enrollees to meaningful Medicaid dentists was below 2000 to 1. These cutoffs were chosen based on HPI's methodology to assess geographic access to care. Separate maps were created for children and adults.

We analyzed utilization using the state's average adult and child utilization rate for 2018 (58.9 percent for children, 18.7 percent for adults).

The census tracts are broken into three categories: red, purple and green. Red represents census tracts where the Medicaid utilization rate is below the state average (58.9 percent for children, 18.7 percent for adults) and there is an insufficient supply of meaningful Medicaid providers. Purple represents census tracts where the Medicaid utilization rate is below the state average and there is a sufficient supply of meaningful Medicaid providers. Green represents census tracts where the utilization rate is above the state average regardless of the supply of meaningful Medicaid providers.

[23] Nasseh K, Eisenberg Y, Vujicic M. Geographic access to dental care varies in Missouri and Wisconsin. *J Pub Health Dent*. 2017;77(3):197-206.

Limitations

This analysis is limited to claims data. We were unable to ascertain whether dentists, regardless of whether they met the meaningful provider definition, had open chair time during which they could have accommodated additional Medicaid enrollees. Additionally, we could only attribute Medicaid spending to office locations. We could not account for services rendered by mobile units or other types of community-based practices. Finally, we were unable to measure other barriers to care experienced by Medicaid enrollees. We hope to address some of these limitations in future research.

Results

Based on 2015 data, 90 percent of Medicaid/CHIP-insured children in North Carolina reside within 15 minutes of a Medicaid/CHIP-participating dentist (Table 1).[24] Dental care utilization among Medicaid-enrolled children in North Carolina is higher than the national utilization rate among Medicaid/CHIP-enrolled children. In much of the central part of the state, dental care use among Medicaid-enrolled children is above the state average (Figure 1). Among Medicaid-enrolled adults in North Carolina, dental care utilization is at 18.7 percent, below the national average for publicly insured adults (23.2 percent).[25] Utilization among adults is very low in the mountain-west portion of the state and along the eastern Atlantic coast (Figure 2).

Table 1: Distribution of Population According to Population per Dentist Ratio and 15-Minute Travel Time

Medicaid or CHIP-Insured Children per Medicaid or CHIP-Participating Dentist		Population per Dentist	
<500	33%	<2,500	42%
500-2,000	50%	2,500-5,000	29%
>2,000	7%	>5,000	23%
No Medicaid dentist within 15-minute travel time	10%	No dentist within 15-minute travel time	6%

Source: ADA Health Policy Institute. Geographic Access to Dental Care: North Carolina. May 2017 Infographic. Available from: https://www.ada.org/~/media/ADA/Science%20and%20Research/HPI/AccesstoDentalCare-StateFacts/North-Carolina-Access-To-Dental-Care.pdf. Accessed June 18, 2020.

For children and adults, meaningful providers are clustered in the major metropolitan areas (Charlotte, Raleigh-Durham, Winston-Salem and Wilmington). There are fewer meaningful provider locations in the mountain-west region, south-central region, and in the eastern Atlantic coast (Figures 3 and 4). About one-fifth of Medicaid-

[24] American Dental Association. Geographic Access to Dental Care: North Carolina. Health Policy Institute Infographic. May 2017. Available from: https://www.ada.org/~/media/ADA/Science%20and%20Research/HPI/AccesstoDentalCare-StateFacts/North-Carolina-Access-To-Dental-Care.pdf. Accessed June 18, 2020.

[25] Medical Expenditure Panel Survey. MEPS HC-201: 2017 Full Year Consolidated Data File. 2019. Available from: https://www.meps.ahrq.gov/mepsweb/data_stats/download_data_files_detail.jsp?cboPufNumber=HC-201. Accessed June 18, 2020.

enrolled children and one-fifth of Medicaid-enrolled adults live in areas where the enrollee-to-meaningful provider ratio within a 15-minute travel time is less than 500 to 1 (i.e., there is a sufficient supply of Medicaid providers). About one in ten Medicaid-enrolled children and one in ten Medicaid-enrolled adults live in areas where there are no meaningful Medicaid providers at all practicing within a 15-minute travel time (Tables 2 and 3).

There are several areas of North Carolina where there are no dentists participating in the Medicaid program within a 15-minute travel time of enrollees (Figures 5 and 6). Some of these areas may not have any dentists at all. Several studies have shown that travelling to a dentist's office can present major challenges for families, particularly low-income families.[26,27] In fact, inconvenient office location and trouble finding a dentist are listed as significant reasons cited by low-income North Carolinians for not visiting the dentist more often.[28]

In terms of utilization versus meaningful Medicaid provider supply by census tract (mapped in Figures 7 and 8), 57.4 percent of Medicaid-enrolled children reside in areas where utilization is above the state average (58.9 percent) while 10.6 percent live in census tracts where utilization is below the state average and there is an insufficient supply of meaningful dental providers (Table 4). Adult dental care use is above the state average (18.7 percent) in the central part of the state and the I-95 corridor. About 54.2 percent of Medicaid-enrolled adults reside in areas where utilization is above the state average while 11.2 percent of Medicaid-enrolled adults live in census tracts where utilization is below the state average and there is an insufficient supply of meaningful adult dental providers (Table 5).

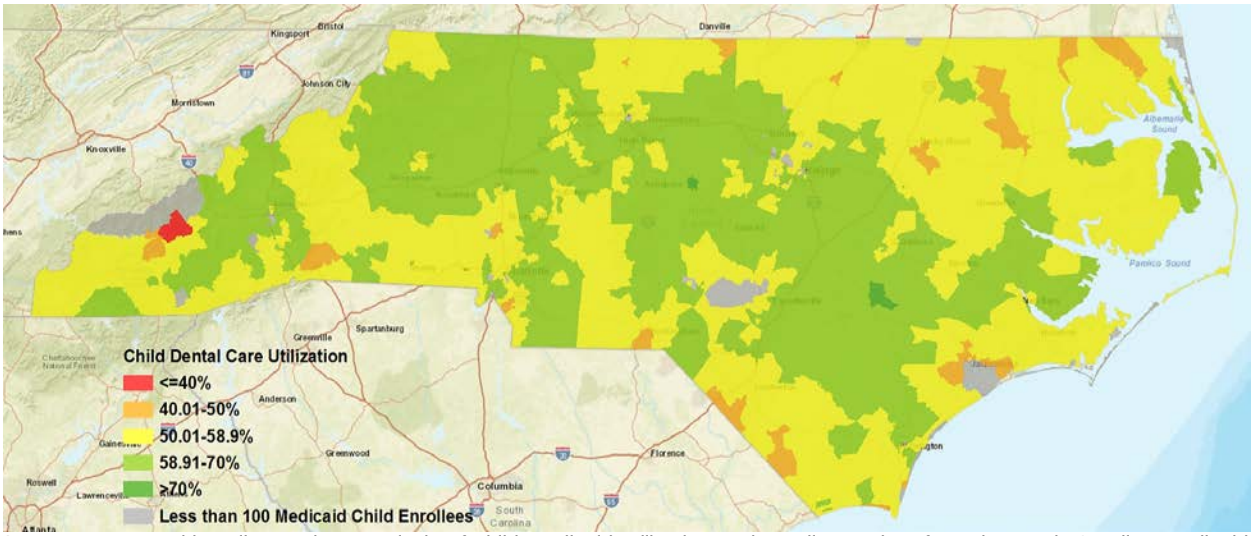
The percentage of meaningful dental providers drops off significantly in areas where Medicaid dental care utilization among children is below the state average and there is an insufficient supply of Medicaid dental providers. In areas where Medicaid dental care utilization is below the state average and there is an insufficient supply of Medicaid dental providers for children, only 13.7 percent of dentists are meaningful Medicaid providers (Table 6). The case is similar for Medicaid-enrolled adults. In areas where Medicaid dental care utilization is below the state average and there is an insufficient supply of Medicaid dental providers, only 3.5 percent of dentists are meaningful Medicaid providers (Table 7).

[26] Dodd V, Logan H, Brown C, Calderon A, Catalanotto F. Perception of oral health, preventive care, and care-seeking behaviors among rural adolescents. *J Sch Health*. 2014;84(12): 802-809.

[27] Kelly S, Binkley C, Neace W, Gale B. Barriers to care-seeking for children's oral health among low-income caregivers. *Am J Public Health*. 2005;95(8): 1345-1351.

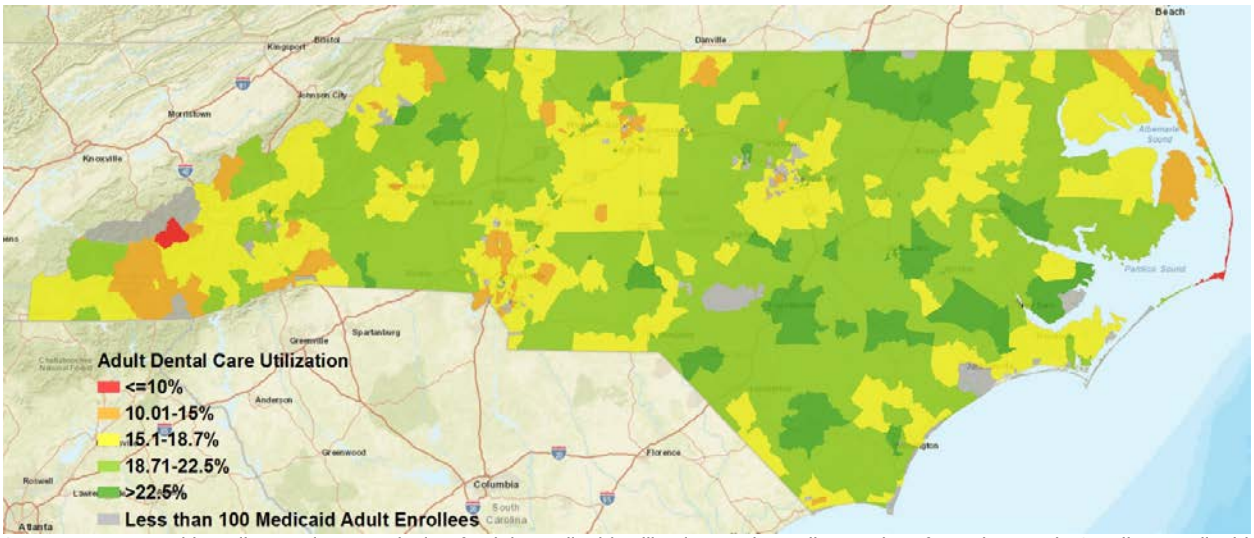
[28] Health Policy Institute. Oral health and well-being in North Carolina. Infographic. 2015. Available from: https://www.ada.org/en/science-research/health-policy-institute/oral-health-and-well-being/North-Carolina-facts. Accessed June 23, 2020.

Figure 1: Dental Care Utilization among Medicaid-Enrolled Children by Census Tract, 2018



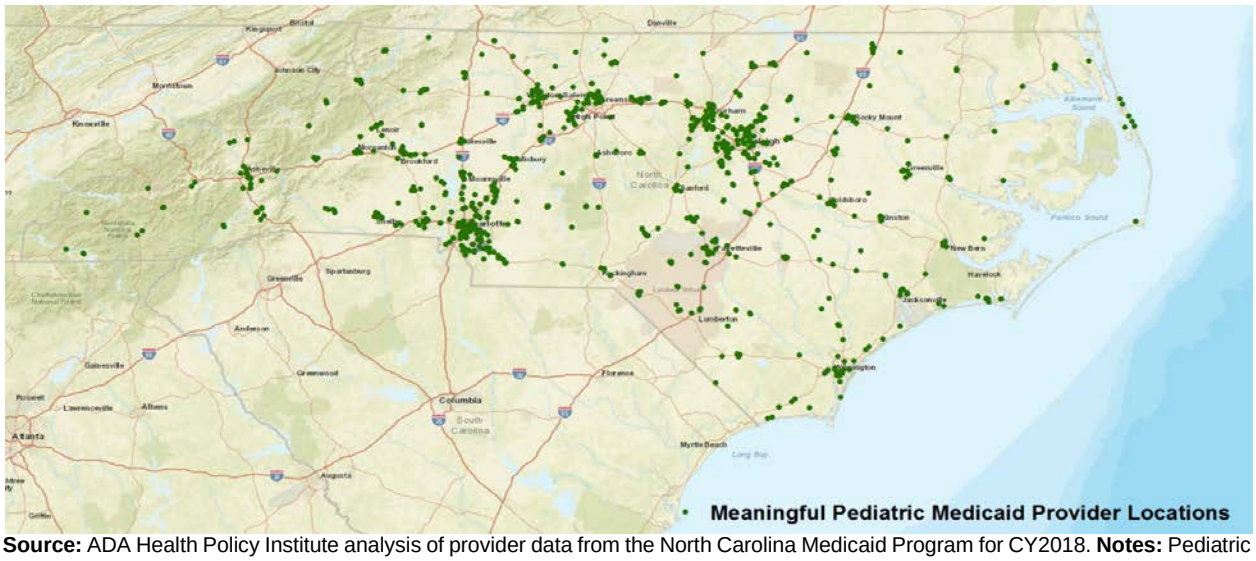
Source: ADA Health Policy Institute analysis of child Medicaid utilization and enrollment data from the North Carolina Medicaid program for CY2018. **Notes:** Census tracts with fewer than 100 Medicaid-enrolled children were not included.

Figure 2: Dental Care Utilization among Medicaid-Enrolled Adults by Census Tract, 2018



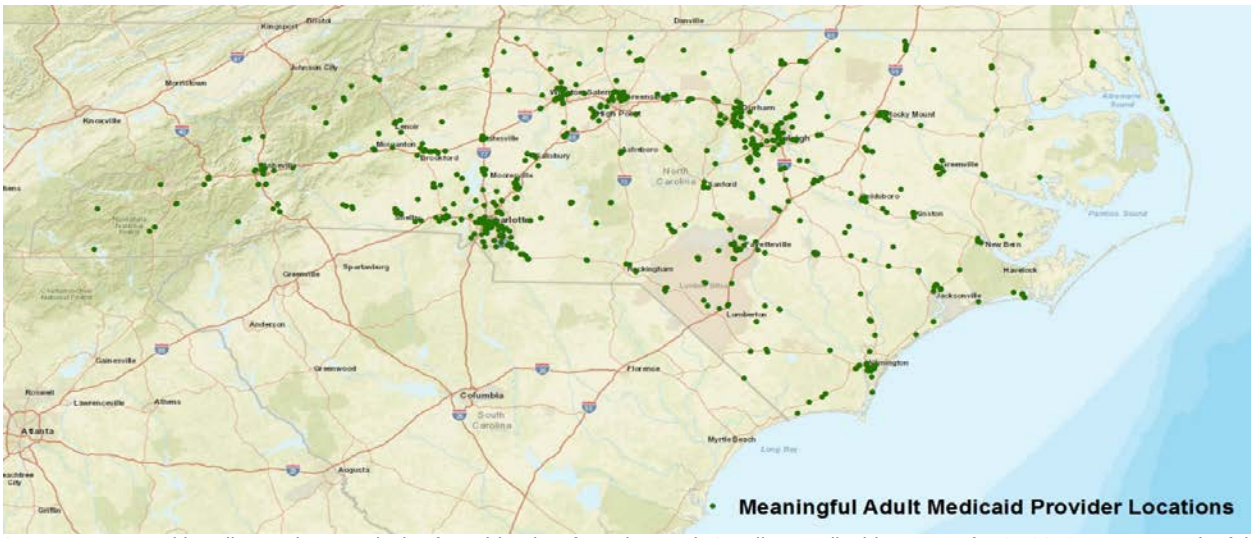
Source: ADA Health Policy Institute analysis of adult Medicaid utilization and enrollment data from the North Carolina Medicaid program for CY2018. **Notes:** Census tracts with fewer than 100 Medicaid-enrolled adults were not included.

Figure 2: Meaningful Pediatric Medicaid Dental Office Locations, 2018



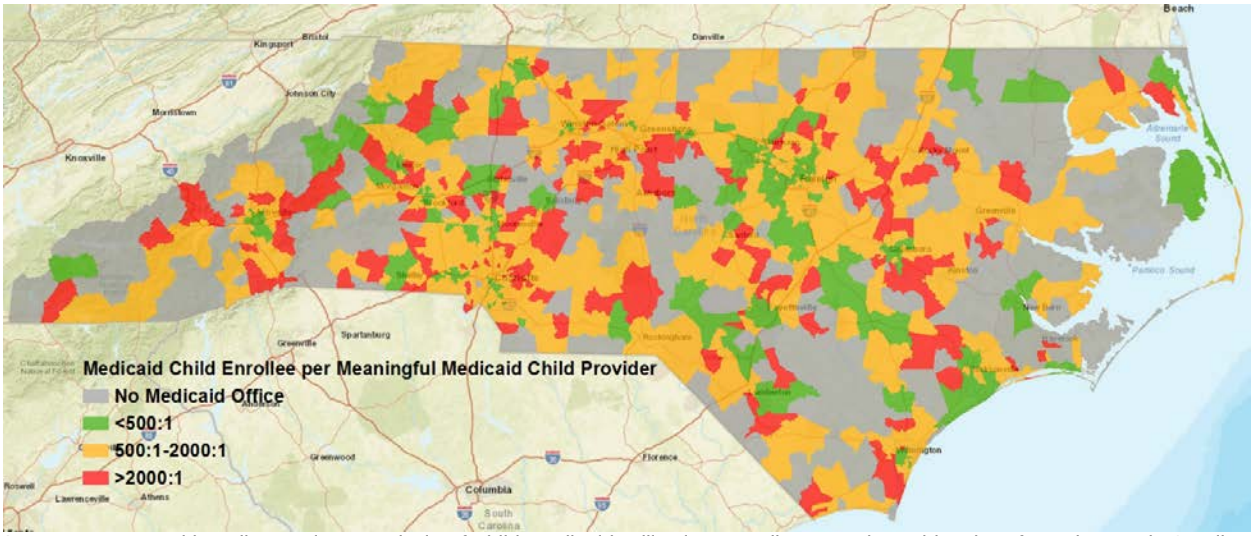
Source: ADA Health Policy Institute analysis of provider data from the North Carolina Medicaid Program for CY2018. **Notes:** Pediatric means any dental provider that treats Medicaid-enrolled children. Meaningful providers are defined as those who were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018.

Figure 4: Meaningful Adult Medicaid Dental Office Locations, 2018



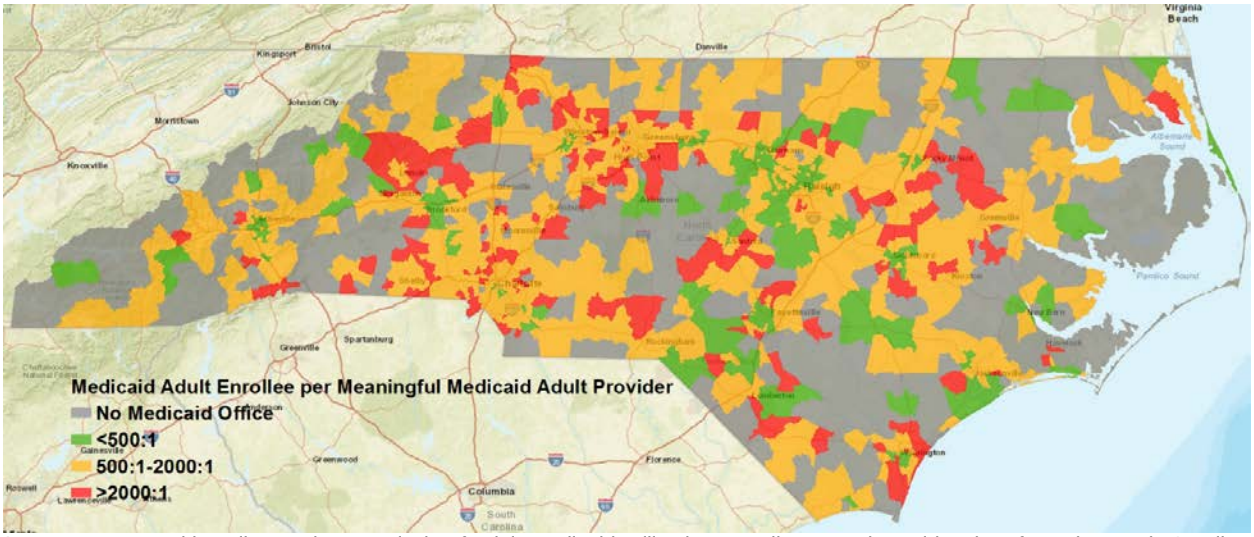
Source: ADA Health Policy Institute analysis of provider data from the North Carolina Medicaid Program for CY2018. **Note**: Meaningful providers are defined as those who were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018.

Figure 5: Medicaid-Enrolled Children per Meaningful Child Medicaid Providers within a 15-Minute Travel Time, 2018



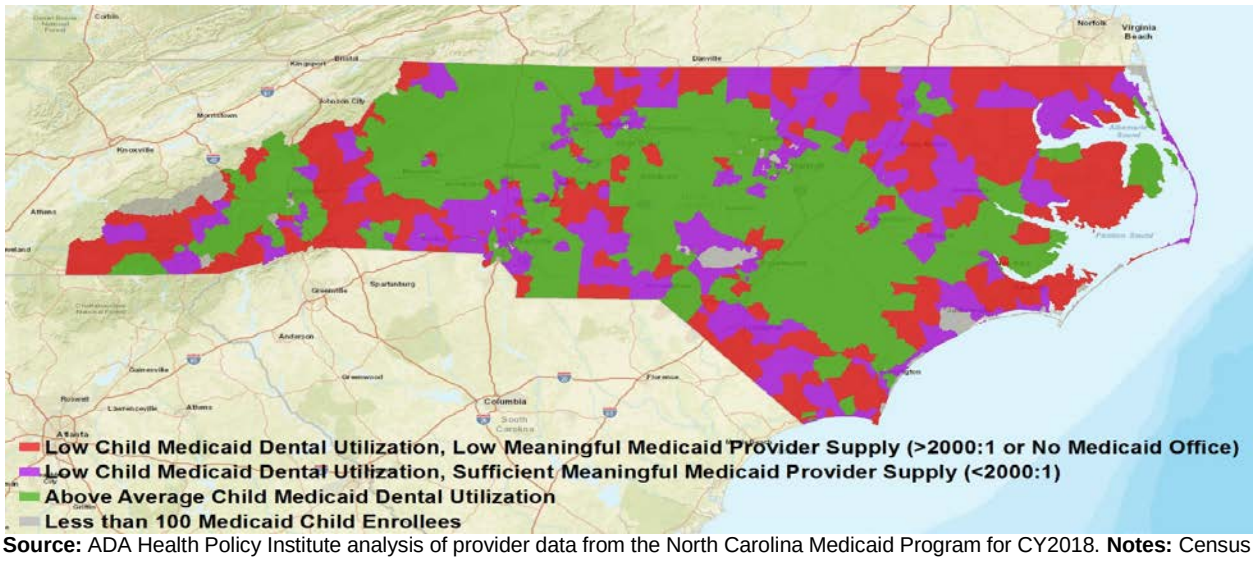
Source: ADA Health Policy Institute analysis of child Medicaid utilization, enrollment and provider data from the North Carolina Medicaid Program for CY2018. **Note**: Meaningful providers are defined as those who were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018.

Figure 6: Medicaid-Enrolled Adults per Meaningful Adult Medicaid Providers within a 15-Minute Travel Time, 2018



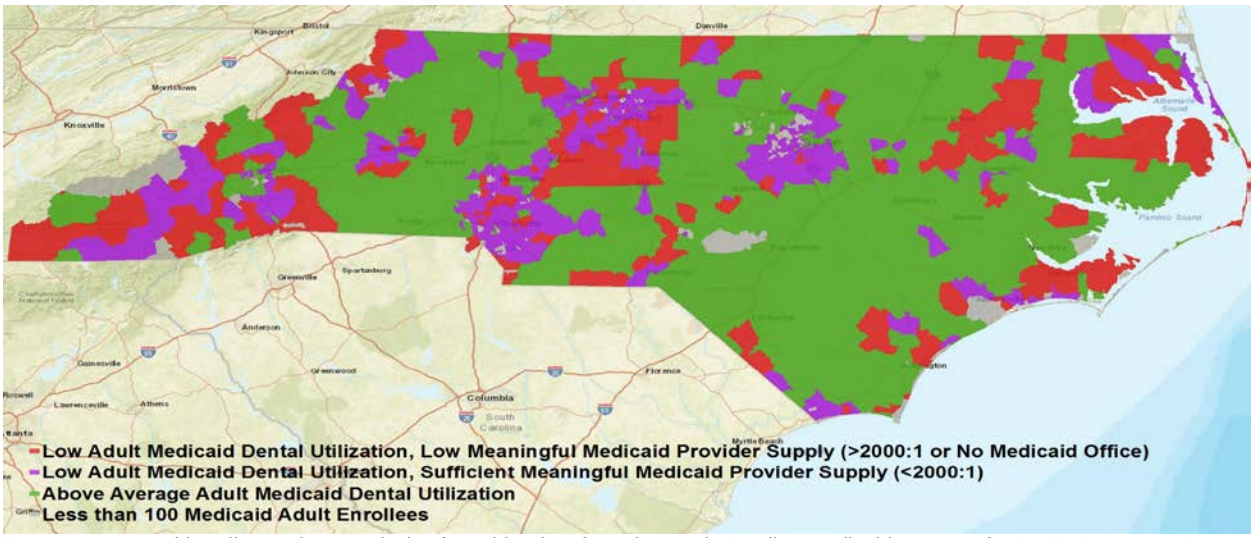
Source: ADA Health Policy Institute analysis of adult Medicaid utilization, enrollment and provider data from the North Carolina Medicaid Program for CY2018. **Note**: Meaningful providers are defined as those who were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018

Figure 7: Supply and Demand for Medicaid Dental Services for Children by Census Tract, 2018



Source: ADA Health Policy Institute analysis of provider data from the North Carolina Medicaid Program for CY2018. **Notes:** Census tracts with fewer than 100 Medicaid-enrolled children were not included. Meaningful providers are defined as those who were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018

Figure 8: Supply and Demand for Medicaid Dental Services for Adults by Census Tract, 2018



Source: ADA Health Policy Institute analysis of provider data from the North Carolina Medicaid Program for CY2018. **Notes:** Census tracts with fewer than 100 Medicaid-enrolled children were not included. Meaningful providers are defined as those who were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018

Table 2: Percent of Medicaid-Enrolled Children Residing within a 15-Minute Travel Time to a Meaningful Child Medicaid Provider, by Enrollee-to-Meaningful Provider Ratio, 2018

	Enrollee-to-Meaningful Provider Ratio	Percent
Children	<500:1	20.5%
	500:1-2000:1	57.7%
	>2000:1	12.3%
	No Meaningful Medicaid Office	9.5%

Source: ADA Health Policy Institute analysis of child Medicaid utilization, enrollment and provider data from the North Carolina Medicaid Program for CY2018 **Notes:** Percentages may not add up to 100% due to rounding. Meaningful providers are defined as those who were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018.

Table 3: Percent of Medicaid-Enrolled Adults Residing within a 15-Minute Travel Time to a Meaningful Medicaid Adult Provider, by Enrollee-to-Meaningful Provider Ratio, 2018

	Enrollee-to-Meaningful Provider Ratio	Percent
Adults	<500:1	18.4%
	500:1-2000:1	58.7%
	>2000:1	10.6%
	No Meaningful Medicaid Office	12.2%

Source: ADA Health Policy Institute analysis of child Medicaid utilization, enrollment and provider data from the North Carolina Medicaid Program for CY2018 **Notes:** Percentages may not add up to 100% due to rounding. Meaningful providers are defined as those who were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018.

Table 4: Percent of Medicaid-Enrolled Children Residing In Areas of Different Dental Demand and Meaningful Provider Supply, 2018

	Demand and Supply for Dental Services	Percent
Children	Less than 100 Medicaid Enrollees (Gray Areas)	0.2%
	Above Average Dental Care Utilization (Green Areas)	57.4%
	Utilization Below the State Average, Sufficient Provider Supply (Purple Areas)	31.8%
	Utilization Below the State Average, Insufficient Provider Supply (Red Areas)	10.6%

Source: ADA Health Policy Institute analysis of child Medicaid utilization, enrollment and provider data from the North Carolina Medicaid Program for calendar year 2018. **Notes**: Meaningful providers are defined as those who were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018

Table 5: Percent of Medicaid-Enrolled Adults Residing In Areas of Different Dental Demand and Meaningful Provider Supply, 2018

	Demand and Supply for Dental Services	Percent
Adults	Less than 100 Medicaid Enrollees (Gray Areas)	1.0%
	Above Average Dental Care Utilization (Green Areas)	54.2%
	Utilization Below the State Average, Sufficient Provider Supply (Purple Areas)	33.6%
	Utilization Below the State Average, Insufficient Provider Supply (Red Areas)	11.2%

Source: ADA Health Policy Institute analysis of child Medicaid utilization, enrollment and provider data from the North Carolina Medicaid Program for CY2018. **Notes**: Meaningful providers are defined as those who were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018.

Table 6: Distribution of Child Dental Providers by Regions with Different Levels of Demand and Supply for Medicaid Dental Services

	Demand and Supply for Dental Services	Meaningful Medicaid Dentists	Non-Meaningful Medicaid Dentists	Non-Medicaid Dentists	Total Dentists
Children	Less than 100 Medicaid Enrollees (Gray Areas)	18 (5.5%)	13 (3.9%)	299 (90.6%)	330 (100%)
	Above Average Dental Care Utilization (Green Areas)	981 (24.2%)	670 (16.5%)	2401 (59.3%)	4052 (100%)
	Utilization Below the State Average, Sufficient Provider Supply (Purple Areas)	796 (21.6%)	534 (14.5%)	2361 (64.0%)	3691 (100%)
	Utilization Below the State Average, Insufficient Provider Supply (Red Areas)	32 (13.7%)	39 (16.7%)	162 (69.5%)	233 (100%)

Source: ADA Health Policy Institute analysis of child Medicaid utilization, enrollment and provider data from the North Carolina Medicaid Program for CY2018. **Notes**: Row percentages in parentheses. A dentist is considered a meaningful Medicaid provider if they were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018. Non-meaningful Medicaid dentists are listed in the North Carolina dentist directory but do not meet the threshold of a meaningful provider. The number of non-Medicaid dentists are generated by subtracting the total number of dentists in a census tract from the 2019 ADA office database by the total number of Medicaid providers (meaningful and non-meaningful) from the North Carolina Medicaid provider directory. Because dentists may practice in multiple census tracts, the "Total Dentists" column contains some double counting of dentists.

Table 7: Distribution of Adult Dental Providers by Regions with Different Levels of Demand and Supply for Medicaid Dental Services

	Demand and Supply for Dental Services	Meaningful Medicaid Dentists	Non-Meaningful Medicaid Dentists	Non-Medicaid Dentists	Total Dentists
Adults	Less than 100 Medicaid Enrollees (Gray Areas)	26 (4.3%)	38 (6.2%)	546 (89.5%)	610 (100%)
	Above Average Dental Care Utilization (Green Areas)	697 (17.6%)	931 (23.5%)	2333 (58.9%)	3961 (100%)
	Utilization Below the State Average, Sufficient Provider Supply (Purple Areas)	360 (10.7%)	588 (17.5%)	2414 (71.8%)	3362 (100%)
	Utilization Below the State Average, Insufficient Provider Supply (Red Areas)	13 (3.5%)	54 (14.5%)	306 (82.0%)	373 (100%)

Source: ADA Health Policy Institute analysis of child Medicaid utilization, enrollment and provider data from the North Carolina Medicaid Program for CY2018. **Notes**: Row percentages in parentheses. A dentist is considered a meaningful Medicaid provider if they were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during CY2018. Non-meaningful Medicaid dentists are listed in the North Carolina dentist directory but do not meet the threshold of a meaningful provider. The number of Non-Medicaid dentists are generated by subtracting the total number of dentists in a census tract from the 2019 ADA office database by the total number of Medicaid providers (meaningful and non-meaningful) from the North Carolina Medicaid provider directory. Because dentists may practice in multiple census tracts, the "Total Dentists" column contains some double counting of dentists.

Assessing Appointment Availability for Medicaid Enrollees

To further analyze dental care accessibility in North Carolina, HPI conducted an audit of North Carolina dental offices to determine how patient dental insurance type, age, race/ethnicity, and dental practice geographic location determined whether patients could successfully secure dental appointments. These results provide insight as to what obstacles Medicaid patients may face when trying to secure an appointment with a North Carolina dentist.

Data and Methods

Mystery Shopper Survey Methodology

To analyze access to dental care among North Carolina Medicaid enrollees, we conducted a mystery shopper survey with the University of Chicago Survey Lab (SL). SL performed an audit of all dental offices in North Carolina where at least one general practitioner dentist or pediatric dentist was enrolled with the North Carolina Medicaid program. SL developed the survey script in partnership with HPI, tested the survey, screened the survey with a sample of dental offices, completed the full audit, and provided a list limited to the survey criteria.

To determine which offices to call, we obtained the most updated list of Medicaid-participating dental providers from the North Carolina Department of Health and Human Services on March 16, 2020. The list contained 2,915 participating dentist-office pairs in North Carolina. HPI limited this list by excluding every dentist-office pair that did not involve a general practitioner or pediatric dentist. We then deleted duplicate dental office addresses. The analysis was done at the office level, so we were comfortable with some offices having multiple dental providers that could see Medicaid-enrolled pediatric patients. We then checked every address and telephone number via an internet search to ensure that (a) the office was still in business, (b) the office provided preventive and diagnostic services, rather than specialty services such as orthodontia or oral surgery only, and (c) that the address and telephone number appeared to be correct.

After these exclusions, 1,138 dental offices remained on the list to be contacted for the mystery shopper survey. A total of 2,276 cases were identified for audit, one for Medicaid and one for Delta Dental insurance for each office. The full audit was completed by a diverse team of four callers, hired by SL, to play roles for a range of simulated patients along pre-selected age, race/ethnicity and gender dimensions. The callers collectively portrayed female, white, Hispanic and African American vocal features across an age range of 30-40 years. Callers asked to schedule a dental appointment for their child or for themselves and recorded whether an appointment was secured, the wait time for the appointment, reasons an appointment was not secured (if those reasons were provided by office staff), and whether a referral was given if an appointment was not available at the office contacted. Each caller was assigned an even distribution of cases by dental benefit type (Medicaid or private insurance) and portrayed patient age (child or adult) to control for any effect personal or demographic

traits might have on his or her ability to obtain an appointment. The simulated patient calls for all cases were made between July 2019 and September 2019.

Completed Cases

A case was "complete" when the caller was able to reach office staff to either schedule an appointment or be told that no appointment was available. "No successful contact" indicates the number of cases for which calls were attempted but office staff was never reached. "Ineligible" indicates cases for which someone was reached, but general dental care was not offered at the office location on file, or the case was a duplicate in our list. Once the audit was complete, SL reviewed the data for consistency and missing information, and the refined data was sent to HPI for further analysis.

Table 1: Mystery Shopper Survey Case Results

Final Status	Number	Percentage
Complete	2,040	89.6%
No Successful Contact	174	7.6%
Ineligible	62	2.7%
Total	**2,276**	**100%**

Table 2: Mystery Shopper Survey Cases Completed by Race/Ethnicity

	Adult	Child	Total
African American	220 (44.4%)	276 (55.7%)	496 (25.3%)
Hispanic	72 (39.6%)	110 (60.4%)	182 (9.3%)
White	568 (44.2%)	718 (55.8%)	1,286 (65.5%)

Callers completed two cases (one for Medicaid and one for Delta Dental PPO) for 982 of the 1,138 dental offices contacted. (For the other 156 dental offices, either no cases were completed or only one case was completed.) Analyses included only the cases from these 982 offices. Dental offices in this analysis were classified by categories of dental care utilization and supply of meaningful dental providers at the census tract level as described in the previous section. Dentists were considered meaningful Medicaid providers if they were reimbursed at least $10,000 for Medicaid dental services or treated at least 100 unique Medicaid enrollees during calendar year 2018. Utilization was measured by North Carolina's average adult and child utilization rate for 2018 (58.9 percent for children, 18.7 percent for adults). Further, each completed case was placed into one

of the classifications outlined in the previous section in terms of availability of Medicaid providers and dental care utilization.

Table 3: Completed Cases by Availability of Meaningful Medicaid Providers and Utilization Rate for Dental Care Services Classification Based on Analysis in Previous Section

	Adult	Child	Total
Green *(above average utilization, sufficient supply of providers)*	262 (47.7%)	287 (52.3%)	549 (55.9%)
Purple *(below average utilization, sufficient supply of providers)*	148 (38.4%)	237 (61.6%)	385 (39.2%)
Red *(below average utilization, low supply of providers)*	12 (30.8%)	27 (69.2%)	39 (4.0%)
Grey *(too few Medicaid enrollees to map)*	8 (88.9%)	1 (11.1%)	9 (0.9%)

Notes: Low supply of meaningful Medicaid providers indicated there was no Medicaid office within a 15-minute travel time or where the ratio of Medicaid-enrolled children to meaningful Medicaid dentists was over 2000 to 1. Sufficient supply of meaningful Medicaid dentists indicated there was a Medicaid office within a 15-minute travel time and the ratio of Medicaid-enrolled children to meaningful Medicaid dentists was below 2000 to 1.

Dental offices were further classified by rural-urban commuting area codes (RUCA).[29] RUCA codes classify U.S. census tracts using measures of population density, urbanization, and daily commuting. We have grouped them into four categories to identify urban areas, large city/town, small rural town, and isolated rural town so that we can look at the type of area in which callers from our study were better able to schedule appointments, for example. Urban areas are more densely populated which could mean more competition in terms of being able to make an appointment.

Table 4: Number of Offices by RUCA Classification

	Adult	Child	Total
Isolated Small Town	12 (42.9%)	16 (57.1%)	28 (2.9%)
Large Rural City/Town	84 (52.2%)	77 (47.8%)	161 (16.4%)
Small Rural Town	20 (35.7%)	36 (64.3%)	56 (5.7%)
Urban	314 (42.6%)	423 (57.4%)	737 (75.1%)

Notes: We defined "large rural city/town" to include RUCA codes 4.0, 5.0, and 6.0. (The majority are 4.0.) **4.0** - Micropolitan area core: primary flow within an urban cluster of 10,000 to 49,999 (large UC). Lumberton, Asheboro, Beaufort are examples of 4.0. **5.0** - Micropolitan high commuting: primary flow 30% or more to a large UC. Henderson, Wilkesboro, Pinehurst are examples of 5.0. **6.0** - Micropolitan low commuting: primary flow 10% to 30% to a large UC. Snow Hill, Robbins, Biscoe are examples of 6.0.

[29] Economic Research Service, United States Department of Agriculture. Documentation: 2010 Rural-Urban Commuting Area (RUCA) Codes. Available from: https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes/documentation/. Accessed October 15, 2019.

Analyses include the 982 offices for which both the Medicaid and private insurance cases were completed, a total of 1,964 cases. We examined two outcomes: success in making an appointment and wait time for an appointment. Analyses split each outcome by dental benefit type, portrayed age of patient, portrayed race of caller, categories for utilization and supply of meaningful Medicaid providers, and RUCA code classification which was determined using rural-urban commuting area (RUCA) codes.

Success in Making an Appointment

Hierarchical analyses were conducted to account for the fact that each office was associated with two cases.

For this analysis, we combined “regular appointment” and “hypothetical appointment” into one category and “unable to make an appointment” and “unable to get past system restrictions” into a second category to create a binary outcome variable. Regular appointments are those for which the caller was scheduled for a specific data and time. Hypothetical appointments are those for which the caller was given a date for an available appointment, but staff was not able to schedule a specific time due to system restrictions, e.g., the need for more information from the caller.

Hierarchical logistic regression analysis was conducted to examine the role of each of five variables in success making an appointment: dental benefit type, portrayed age of patient, portrayed race of caller, utilization and supply of meaningful Medicaid providers, and RUCA code classification. Pretesting indicated that utilization and supply of meaningful Medicaid providers was not correlated with the outcome variable, appointment success. It was correlated with two other variables in the model, portrayed patient age and RUCA code classification. In order to simplify the model for testing, the variable for utilization and supply of meaningful Medicaid providers was excluded from further analysis. The interaction effects of dental benefit type and portrayed age of patient with the other portrayed race of caller and RUCA code classification were also examined.

Appointment Wait Times

Hierarchical analyses were conducted to account for the fact that each office was associated with two cases.

Hierarchical linear modeling was conducted to examine wait time overall and differences in wait time based on dental benefit type, portrayed age of patient, portrayed race, census tract color classification, RUCA code classification as well as the interaction of dental benefit type and portrayed age of patient with the other three variables.

Results

Based on the results of the mystery shopper survey, Medicaid-insured callers in North Carolina were overall less likely to secure a dental appointment compared to privately insured callers, regardless of age, race/ethnicity, or geography. One in four Medicaid-insured callers did not secure an appointment compared to only one in ten privately insured callers (Table 5). While there is not much variation due to race or ethnicity, there are some

patterns for appointment availability. Among adults, compared to Medicaid-enrolled callers with a white profile, callers with a Hispanic profile secured fewer appointments (Table 6a). Among children, Medicaid-enrolled African American callers secured more appointments than Medicaid-enrolled white or Hispanic callers (Table 6b). In areas with a sufficient supply of meaningful Medicaid providers (color-coded as green and purple on the map), Medicaid-enrolled callers secured fewer appointments for adults and children compared to privately insured callers, though the majority of each were able to secure an appointment (Tables 7a and 7b).

Among adults, a similar number of Medicaid-enrolled callers were able to secure an appointment with an office in an isolated rural town and an urban area (Table 8a). More Medicaid-enrolled children secured an appointment with an office in an isolated small rural town than those who secured an appointment in a large rural city/town. (Table 8b). The number of cases in isolated rural towns was quite small, so these results should be viewed with caution.

Average wait time for an appointment for the entire sample was about 19 days. Children covered by Medicaid were quoted longer wait times on average than those covered by private insurance. There was not much difference in average wait times between child and adult Medicaid enrollees (Table 9). Among adults, Medicaid-enrolled African American callers had the longest appointment wait times while privately insured callers with a white race profile had the shortest. Among children, Medicaid-enrolled callers with African American profiles had a waiting period twice as long as privately insured callers with African American and white profiles. (Table 10). While areas with a sufficient supply of meaningful Medicaid providers (color-coded as green and purple on the map) were similar in terms of ability to secure appointments, wait times were slightly longer for dental offices in areas with lower than average utilization (color-coded as purple on the map): 15.9 days for adults and 20.2 days for children. In areas with higher than average utilization (color-coded as green on the map), wait times were 14.1 days for adults and 17.9 days for children (Table 11). Highest wait times occurred for offices in large rural cities/towns. Wait times for children were generally lower, except in isolated small rural towns (Table 12).

In 326 cases, the caller was given a reason why office staff was unable to schedule an appointment date and time. Overall, the top reason for not securing an appointment was that the office was not accepting any new patients. However, Medicaid-enrolled callers were primarily told that the office was not taking any Medicaid patients, new or established (Table 13). Of the 326 cases for which the caller was given a reason that office staff was unable to schedule a specific date and time, the front office staff referred them to a different provider in 67 (20.4 percent) cases. Although Medicaid-enrolled callers had more difficulty securing appointments compared to privately insured callers, Medicaid-enrolled callers were given more referrals for adult patients compared to privately insured callers.

In 206 cases, the caller was given a reason that a specific appointment time was not available or not possible due to system restrictions. Of these, 83 were Medicaid cases and 123 were privately insured cases. The top reason among both Medicaid and Delta Dental PPO callers was the need for more information. In some cases, dental office staff might ask for Medicaid ID or other insurance policy number. In these cases, callers explained

that they were new enrollees to Medicaid and did not yet have their card or that they were calling from work and did not have their insurance policy number on hand. In cases where office staff asked for patient name, the caller offered a name that had assigned to that particular case.[30] The need for more information was given more often to callers requesting appointments for adults versus children. Among children, compared to those covered under private insurance, those covered under Medicaid were more often told that their case or file needed to be evaluated before an appointment could be scheduled. For Medicaid, "other" reasons included the requirement that the parent be an established patient or be seen before the child, or office staff suggesting that the caller check with Medicaid providers first (Table 15).

Table 5: Appointment Success by Dental Benefit Type and Patient Age

	Medicaid N (%)		Delta Dental PPO N (%)	
	Adult	Child	Adult	Child
Regular appointment	286 (66.5%)	377 (68.3%)	331 (77.0%)	437 (79.2%)
Hypothetical appointment	25 (5.8%)	27 (4.9%)	42 (9.8%)	46 (8.3%)
Unable to make appointment	109 (25.4%)	127 (23.0%)	41 (9.5%)	50 (9.1%)
Unable to get past appointment system restrictions	10 (2.3%)	21 (3.8%)	16 (3.7%)	19 (3.4%)

Table 6a: Appointment Success by Dental Benefit Type and Patient Race/Ethnicity – Adult

	African American		Hispanic		White	
	Medicaid N (%)	Delta Dental N (%)	Medicaid N (%)	Delta Dental N (%)	Medicaid N (%)	Delta Dental N (%)
Regular appointment	82 (73.2%)	93 (86.1%)	20 (60.6%)	30 (76.9%)	184 (64.6%)	208 (73.5%)
Hypothetical appointment	4 (3.6%)	3 (2.8%)	0 (0.0%)	0 (0.0%)	21 (7.4%)	39 (13.8%)
Unable to make appointment	25 (22.3%)	10 (9.3%)	9 (27.3%)	5 (12.8%)	75 (26.3%)	26 (9.2%)
Unable to get past appointment system restrictions	1 (0.9%)	2 (1.9%)	4 (12.1%)	4 (10.3%)	5 (1.8%)	10 (3.5%)

[30] According to methodology of University of Chicago Survey Lab.

Table 6b: Appointment Success by Dental Benefit Type and Patient Race/Ethnicity – Child

	African American		Hispanic		White	
	Medicaid N (%)	Delta Dental N (%)	Medicaid N (%)	Delta Dental N (%)	Medicaid N (%)	Delta Dental N (%)
Regular appointment	105 (76.1%)	121 (87.7%)	31 (62.0%)	49 (81.7%)	241 (66.2%)	267 (75.4%)
Hypothetical appointment	3 (2.2%)	0 (0.0%)	1 (2.0%)	1 (1.7%)	23 (6.3%)	45 (12.7%)
Unable to make appointment	26 (18.8%)	11 (8.0%)	13 (26.0%)	1 (1.7%)	88 (24.2%)	38 (10.7%)
Unable to get past appointment system restrictions	4 (2.9%)	6 (4.4%)	5 (10.0%)	9 (15.0%)	12 (3.3%)	4 (1.1%)

Table 7a: Appointment Success by Census Tract Classification and Dental Benefit Type – Adult

	Green *(above average utilization, sufficient supply of providers)*		Purple *(below average utilization, sufficient supply of providers)*		Red *(below average utilization, low supply of providers)*		Grey *(too few Medicaid enrollees to map)*	
	Medicaid N (%)	Delta Dental PPO N (%)	Medicaid N (%)	Delta Dental PPO N (%)	Medicaid N (%)	Delta Dental PPO N (%)	Medicaid N (%)	Delta Dental PPO N (%)
Regular appointment	169 (64.5%)	204 (77.9%)	102 (68.9%)	110 (74.3%)	9 (75.0%)	10 (83.3%)	6 (75.0%)	7 (87.5%)
Hypothetical appointment	16 (6.1%)	25 (9.5%)	8 (5.4%)	17 (11.5%)	1 (8.3%)	0 (0%)	0 (%)	0 (0%)
Unable to make appointment	69 (26.3%)	25 (9.5%)	36 (24.3%)	15 (10.1%)	2 (16.7%)	0 (0%)	2 (25.0%)	1 (12.5%)
Unable to get past appointment system restrictions	8 (3.1%)	8 (3.0%)	2 (1.4%)	6 (4.1%)	0 (0%)	2 (16.7%)	0 (%)	0 (0%)

Notes: Low supply of meaningful Medicaid providers indicated there was no Medicaid office within a 15-minute travel time or where the ratio of Medicaid-enrolled children to meaningful Medicaid dentists was over 2000 to 1. Sufficient supply of meaningful Medicaid dentists indicated there was a Medicaid office within a 15-minute travel time and the ratio of Medicaid-enrolled children to meaningful Medicaid dentists was below 2000 to 1.

Table 7b: Appointment Success by Census Tract Classification and Dental Benefit Type – Child

	Green *(above average utilization, sufficient supply of providers)*		Purple *(below average utilization, sufficient supply of providers)*		Red *(below average utilization, low supply of providers)*		Grey *(too few Medicaid enrollees to map)*	
	Medicaid N (%)	Delta Dental PPO N (%)	Medicaid N (%)	Delta Dental PPO N (%)	Medicaid N (%)	Delta Dental PPO N (%)	Medicaid N (%)	Delta Dental PPO N (%)
Regular appointment	202 (70.4%)	231 (80.5%)	156 (65.8%)	183 (77.2%)	18 (66.7%)	22 (81.5%)	1 (100.0%)	1 (100.0%)
Hypothetical appointment	12 (4.2%)	22 (7.7%)	13 (5.5%)	23 (9.7%)	2 (7.4%)	1 (3.7%)	0 (0%)	0 (0%)
Unable to make appointment	59 (20.6%)	26 (9.1%)	61 (25.7%)	20 (8.4%)	7 (25.9%)	4 (14.8%)	0 (0%)	0 (0%)
Unable to get past appointment system restrictions	14 (4.9%)	8 (2.9%)	7 (3.0%)	11 (4.6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Notes: Low supply of meaningful Medicaid providers indicated there was no Medicaid office within a 15-minute travel time or where the ratio of Medicaid-enrolled children to meaningful Medicaid dentists was over 2000 to 1. Sufficient supply of meaningful Medicaid dentists indicated there was a Medicaid office within a 15-minute travel time and the ratio of Medicaid-enrolled children to meaningful Medicaid dentists was below 2000 to 1.

Table 8a: Appointment Success by RUCA Classification and Dental Benefit Type – Adult

	Urban		Large Rural City/Town		Small Rural Town		Isolated Small Rural Town	
	Medicaid N (%)	Delta Dental PPO N (%)	Medicaid N (%)	Delta Dental PPO N (%)	Medicaid N (%)	Delta Dental PPO N (%)	Medicaid N (%)	Delta Dental PPO N (%)
Regular appointment	218 (69.4%)	242 (77.1%)	46 (54.8%)	63 (75.0%)	14 (70.0%)	18 (90.0%)	8 (66.7%)	8 (66.7%)
Hypothetical appointment	20 (6.4%)	34 (10.8%)	3 (3.6%)	8 (9.5%)	2 (10.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Unable to make appointment	70 (22.3%)	25 (8.0%)	31 (36.9%)	12 (14.3%)	4 (20.0%)	1 (5.0%)	4 (33.3%)	3 (25.0%)
Unable to get past appointment system restrictions	6 (1.9%)	13 (4.1%)	4 (4.8%)	1 (1.2%)	0 (0.0%)	1 (5.0%)	0 (0.0%)	1 (8.3%)

Table 8b: Appointment Success by RUCA Classification and Dental Benefit Type – Child

	Urban		Large Rural City/Town		Small Rural Town		Isolated Small Rural Town	
	Medicaid N (%)	Delta Dental PPO N (%)	Medicaid N (%)	Delta Dental PPO N (%)	Medicaid N (%)	Delta Dental PPO N (%)	Medicaid N (%)	Delta Dental PPO N (%)
Regular appointment	302 (71.4%)	340 (80.4%)	42 (54.6%)	57 (74.0%)	21 (58.3%)	25 (69.4%)	12 (75.0%)	15 (93.8%)
Hypothetical appointment	23 (5.4%)	36 (8.5%)	3 (3.9%)	9 (11.7%)	1 (2.8%)	1 (2.8%)	0 (0.0%)	0 (0.0%)
Unable to make appointment	82 (19.4%)	35 (8.3%)	28 (36.4%)	7 (9.1%)	13 (36.1%)	7 (19.4%)	4 (25.0%)	1 (6.3%)
Unable to get past appointment system restrictions	16 (3.8%)	12 (2.8%)	4 (5.2%)	4 (5.2%)	1 (2.8%)	3 (8.3%)	0 (0.0%)	0 (0.0%)

Table 9: Average Appointment Wait Time in Days by Dental Benefit Type and Patient Age

Overall Mean (Standard Error)		Medicaid Mean (Standard Error)		Delta Dental PPO Mean (Standard Error)	
Adult	Child	Adult	Child	Adult	Child
19.4 (3.30	18.6 (5.23)	19.1 (3.93)	22.8 (6.04)	19.7 (3.81)	14.4(6.06)

Table 10: Average Appointment Wait Time in Days by Dental Benefit Type, Patient Age and Race/Ethnicity

	Overall Mean (Standard Error)		Medicaid Mean (Standard Error)		Delta Dental PPO Mean (Standard Error)	
	Adult	Child	Adult	Child	Adult	Child
African American	21.3 (3.45)	19.5 (5.31)	21.9 (4.19)	25.8 (6.10)	20.7 (4.18)	13.3 (6.33)
Hispanic	19.2 (4.17)	20.0 (5.62)	17.2 (5.63)	23.5 (6.85)	21.1 (5.04)	16.5 (6.65)
White	17.8 (3.25)	16,2 (5.22)	18.4 (3.77)	19.2 (6.08)	17.3 (3.81)	13.4 (5.99)

Table 11: Average Appointment Wait Time in Days by Census Tract Classification, Dental Benefit Type, and Patient Age

	Overall Mean (Standard Error)		Medicaid Mean (Standard Error)		Delta Dental PPO Mean (Standard Error)	
	Adult	Child	Adult	Child	Adult	Child
Green *(above average utilization, sufficient supply of providers)*	14.1 (2.73)	17.9 (2.32)	13.5 (3.34)	20.5 (2.72)	14.7 (3.14)	15.3 (2.72)
Purple *(below average utilization, sufficient supply of providers)*	15.9 (3.28)	20.2 (2.35)	14.6 (3.87)	24.1 (2.70)	17.2 (3.84)	16.2 (2.76)
Red *(below average utilization, low supply of providers)*	25.4 (6.95)	18.6(4.68)	27.483 (8.04)	20.7 (5.45)	23.4 (8.00)	16.5 (5.39)
Grey *(too few Medicaid enrollees to map)*	22.2 (8.05)	17.7 (19.2)	21.0 (9.33)	25.9 (22.17)	23.4 (9.30)	9.5 (22.16)

Notes: Green = utilization higher than state Medicaid average, Red = low utilization and low supply, Purple = low utilization but "high" supply. Grey = census tracts had too few Medicaid enrollees to map. Dental Offices Outside VA = office census tracts outside of VA, so we didn't map them originally.

Table 12: Average Appointment Wait Time in Days by RUCA Classification, Dental Benefit Type, and Patient Age

	Overall Mean (Standard Error)		Medicaid Mean (Standard Error)		Delta Dental Mean (Standard Error)	
	Adult	Child	Adult	Child	Adult	Child
Urban	19.9 (2.91)	12.9 (5.01)	19.9 (3.45)	16.0 (5.81)	19.9 (3.38)	9.9 (5.79)
Large Rural City/Town	24.4 (4.09)	16.8 (5.72)	25.1 (4.79)	19.7 (6.61)	23.7 (4.70)	13.9 (6.59)
Small Rural Town	21.3 (5.62)	12.3 (6.69)	21.4 (6.52)	15.7 (7.7)	21.2 (6.48)	8.9 (7.75)
Isolated Small Rural Town	12.1 (7.95)	32.4 (7.33)	10.2 (9.24)	39.9 (8.43)	14.0 (9.16)	24.8 (8.47)

Table 13: Main Reason for Not Securing an Appointment by Dental Benefit Type and Patient Age

	Overall N (%)		Medicaid N (%)		Delta Dental PPO N (%)	
	Adult	Child	Adult	Child	Adult	Child
Not accepting any new patients	54 (36.2%)	50 (28.3%)	30 (27.5%)	22 (17.3%)	24 (60.0%)	28 (56.0%)
Not accepting any new pediatric patients	N/A	2 (1.1%)	N/A	1 (0.8%)	N/A	1 (2.0%)
This location does not see children	N/A	9 (5.1%)	N/A	4 (3.2%)	N/A	5 (10.0%)
This location only sees children	18 (12.1%)	N/A	10 (9.2%)	N/A	8 (20.0%)	N/A
Patient age restrictions (only accepts patients under or over certain age)	3 (2.0%)	24 (13.6%)	1 (0.9%)	15 (11.8%)	2 (5.0%)	9 (18.0%)
Not accepting any Medicaid patients	35 (23.5%)	37 (20.9%)	34 (31.2%)	37 (29.1%)	N/A	N/A
Not accepting any new Medicaid patients	27 (18.1%)	43 (24.3%)	27 (24.8%)	43 (33.9%)	N/A	N/A
Only accepting Medicaid for children, or for children under certain age	6 (4.0%)	3 (1.7%)	6 (5.5%)	3 (2.4%)	N/A	N/A
Not accepting any private dental benefits patients	3 (2.0%)	3 (1.7%)	N/A	N/A	3 (7.5%)	3 (6.0%)
Other	4 (2.7%)	6 (3.4%)	1 (0.9%)	2 (1.6%)	3 (7.5%)	4 (8.0%)

Table 14: Referrals by Dental Benefit Type and Patient Age

	Overall N (%)		Medicaid N (%)		Delta Dental PPO N (%)	
	Adult	Child	Adult	Child	Adult	Child
Yes	29 (19.3%)	38 (21.5%)	28 (25.7%)	31 (24.4%)	1 (2.4%)	7 (14.0%)
No	121 (80.7%)	139 (78.5%)	81 (74.3%)	96 (75.6%)	40 (97.6%)	43 (86.0%)

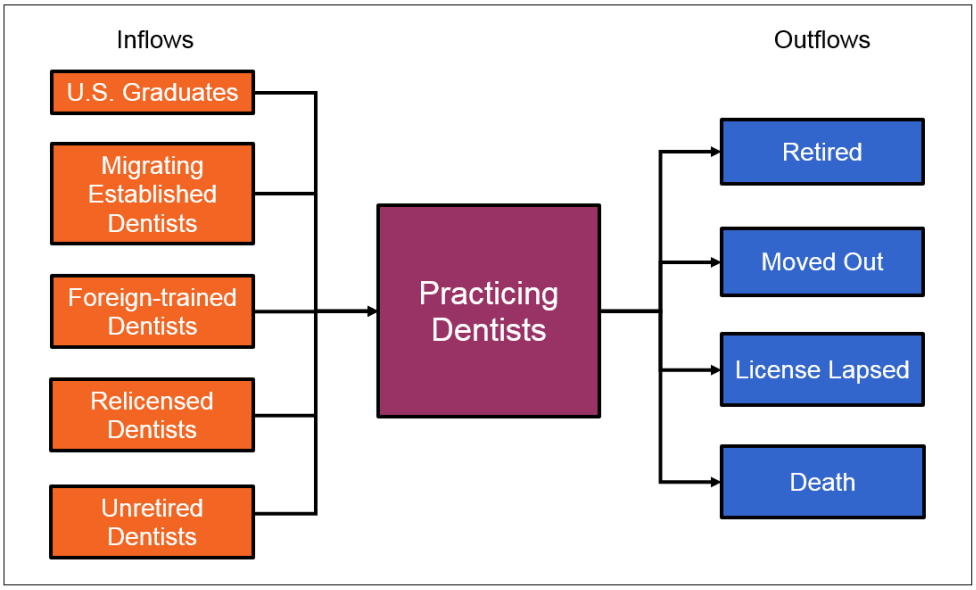
Table 15: Main Reasons Why Securing an Appointment was Uncertain or Impossible

	Overall N (%)		Medicaid (Medicaid) N (%)		Delta Dental PPO N (%)	
	Adult	Child	Adult	Child	Adult	Child
They can't progress in the appointment system without more information	83 (89.3%)	86 (76.1%)	33 (94.3%)	35 (72.9%)	50 (86.2%)	51 (78.5%)
Paperwork required	8 (8.6%)	18 (15.9%)	4 (11.4%)	7 (14.6%)	4 (6.9%)	11 (16.9%)
Case or file needs to be evaluated	17 (18.3%)	15 (13.3%)	6 (17.1%)	10 (20.8%)	11 (19.0%)	5 (7.7%)
Receptionist doesn't know if they accept your insurance	5 (5.4%)	4 (3.5%)	1 (2.9%)	1 (2.1%)	4 (6.9%)	3 (4.6%)
Other	4 (4.3%)	10 (8.9%)	1 (2.9%)	7 (14.6%)	3 (5.2%)	3 (4.6%)

Projected Supply of Dentists

HPI has developed a methodology to project the future supply of dentists for select states. We updated this analysis for North Carolina through 2039 using assumptions based on historical trends for dentists joining the North Carolina dentist workforce and dentists leaving the workforce (Figure 1). The results reflect overall future supply of dentists in North Carolina, broken down by hours worked, appointments seen, and how the female share of the workforce will increase.

Figure 1: Conceptual Model of State-Level Dentist Workforce Projections



Data and Methods

We used several data sources in our analysis. The American Dental Association (ADA) masterfile is a database that contains the most up-to-date information on dentists, practicing and non-practicing, in the United States. It is updated through a variety of methods including reconciliation with state licensure databases, death records, and various surveys and censuses of dentists carried out by the ADA. We used the masterfile's annual archived datasets from 2002 through 2019 to gather historical information on the dentist population profile, including dentists' ages, dental school graduation years, licensure statuses, practice locations, retirement dates, and deceased dates. This provided us with a "snapshot" for each of our study years. In addition, through various unique identifiers, we were able to track critical information for each dentist over time (e.g., location, whether they have retired). To calculate historical measures of dentists per 100,000 population in North Carolina, we

used ADA masterfile archives and counts from the U.S. Census Bureau.[31,32] To calculate future estimates of dentists per 100,000 population, we combined our future dentist supply modeling results with population projections from the North Carolina Office of State Budget and Management.[33]

We relied on the ADA's Survey of Dental Education for historical data on the number of graduates and current enrollment of U.S. dental schools.[34]

We adjusted our projection of the future supply of dentists for annual hours worked and number of patients seen per week, yielding an estimate of full-time equivalent dentists. We based this on historical data on annual hours worked and the number of patients seen per week for different age groups of male and female dentists separately. These data were drawn from the ADA's Survey of Dental Practice results from 2009 through 2018.[35]

We used the "U.S. Business Cycle Expansions and Contractions" table from the National Bureau of Economic Research for information on the 2008 recession and the average duration of business cycles.

The model counts professionally active, licensed dentists with these occupation codes in the ADA masterfile: private practice (full or part-time), dental school faculty/staff, armed forces, other federal services (i.e., Veterans Affairs, Public Health Service, Federally Qualified Health Centers), state or local government employee, hospital staff, graduate student/intern/resident, or other health/dental organization staff member.

The state workforce projection model uses historical trends of inflows of dentists to and outflows of dentists from the state's workforce to inform various assumptions about future inflows and outflows. We defined four types of outflows of dentists: (1) those who retired, (2) those who moved out of state, (3) those whose license expired, and (4) those who died before retirement.

We defined five types of inflows of dentists: (1) new U.S. dental school graduates who became licensed to practice in the state, (2) established dentists who moved into the state from another state, (3) foreign-trained dentists who became licensed to practice in the state, (4) dentists who reactivated an expired license, and (5) dentists who returned from retirement to the workforce.

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[31] U.S. Census Bureau. National Intercensal Estimates (2000-2010). U.S. Department of Commerce. Available from: https://www.census.gov/data/tables/time-series/demo/popest/intercensal-2000-2010-national.html. Accessed February 4, 2020.

[32] U.S. Census Bureau. Population and Housing Unit Estimates Datasets. U.S. Department of Commerce. Available from: https://www.census.gov/programs-surveys/popest/data/data-sets.2019.html. Accessed February 4, 2020.

[33] North Carolina Office of State Budget and Management. County/State Population Projections. Available from: https://www.osbm.nc.gov/demog/county-projections. Accessed February 4, 2020.

[34] American Dental Association. 2018-19 Survey of Dental Education; Report 1 – Academic Programs, Enrollment and Graduates. Health Policy Institute. Available from: http://www.ada.org/en/science-research/health-policy-institute/data-center/dental-education. Accessed February 4, 2020.

[35] For more information on Survey of Dental Practice methodology, see the Methodology section in the most recent releases, available from: http://www.ada.org/en/science-research/health-policy-institute/data-center/dental-practice.

We analyzed historical inflows and outflows for seven age groups of dentists separately to capture important differences in behaviors across the life cycle (e.g., propensity to graduate or retire). The age groups are: under 35, 35 to 44, 45 to 54, 55 to 64, 65 to 74, 75 to 84, and 85 and older.

Outflow History and the Business Cycle

We updated the outflows part of the model by assuming a relationship between outflows and business cycles, meaning a dentist's decision to retire may be influenced by the presence or absence of a typical economic downturn.

We calculated outflows as the proportion of dentists per age group who left the workforce over a five-year period. For example, for dentists in the workforce who were aged 55 to 64 in 2014, we calculated the proportion who were retired in 2019. This provided a retirement rate for the 55 to 64 age group for the period 2014-2019. We also calculated the proportions who moved out of state, were deceased, or whose license was expired in 2019.

We computed total outflow rates as the combined shares of dentists who had retired, who moved out of state, whose license had lapsed, or who were deceased. Table 1 and Figures 2 and 3 display North Carolina's total five-year outflow rates per age group for years ending 2009-2019.

When examining historical outflow trends, we focused on dentists aged 55 and older; they account for the majority of dentists who leave the workforce in a five-year period. As seen in Table 1 and Figure 3, outflow rates for North Carolina dentists aged 65 and older declined from 46.2 percent to 30.7 percent (2007-2012) and have increased to 45.4 percent since then. Outflow rates for ages 55 to 64 fluctuated similarly within a narrower range.

The low outflow rates in 2012 occurred after an economic downturn. The National Bureau of Economic Research determined that an 18-month recession ended in June 2009.[36] The stock market had declined from its 2007 high, reached a trough in 2009, and was still below its peak in 2012, despite recovery.[37] The gross domestic product per capita (inflation-adjusted) had declined from its 2007 high, reached a trough in 2009, and in 2012 had not yet regained the level of its previous peak.

[36] National Bureau of Economic Research. U.S. Business Cycle Expansions and Contractions. Available from: http://www.nber.org/cycles.html. Accessed February 4, 2020.

[37] MacroTrends LLC. S&P 500 Index - 90 Year Historical Chart. Available from: http://www.macrotrends.net/2324/sp-500-historical-chart-data. Accessed February 4, 2020.

Table 1: Outflow Rates, North Carolina

	2002-2007	2003-2008	2004-2009	2005-2010	2006-2011	2007-2012	2008-2013	2009-2014	2010-2015	2011-2016	2012-2017	2013-2018	2014-2019	Hypo-theti-cal*
Age under 35	16.4%	16.9%	16.7%	15.9%	16.4%	16.2%	16.9%	16.1%	16.9%	17.5%	20.1%	19.7%	20.9%	20.9%
Age 35 - 44	7.9%	8.3%	6.3%	5.9%	5.9%	6.1%	6.3%	6.3%	4.9%	6.0%	5.9%	6.2%	7.0%	7.0%
Age 45 - 54	6.9%	7.5%	7.3%	8.2%	6.7%	6.2%	7.6%	8.2%	5.7%	7.6%	7.0%	6.7%	6.4%	6.4%
Age 55 - 64	17.8%	16.9%	16.3%	13.6%	12.6%	12.0%	15.4%	18.3%	17.1%	17.1%	19.9%	19.5%	24.1%	28.3%
Age 65 - 74	42.0%	40.9%	35.9%	36.6%	29.6%	26.1%	27.5%	33.8%	33.0%	36.0%	40.0%	41.7%	41.9%	43.7%
Age 75 - 84	63.6%	48.7%	51.9%	52.8%	50.0%	49.1%	54.8%	61.4%	52.1%	57.3%	58.2%	69.0%	67.5%	76.8%
Age 85 and older	80.0%	75.0%	75.0%	75.0%	100.0%	80.0%	66.7%	75.0%	75.0%	72.7%	77.8%	75.0%	85.7%	93.7%
All ages 65 and older	46.2%	42.5%	39.5%	40.1%	34.2%	30.7%	32.3%	39.3%	37.2%	40.1%	43.3%	45.9%	45.4%	N.A.

Source: ADA Health Policy Institute analysis of ADA masterfile. **Note**: Outflow rates denote the percentage of dentists who had retired, who moved out of state, whose license had lapsed, or who were deceased. *The hypothetical outflow rate is extrapolated for ages 55 and older based on the change from 2017 to 2019. N.A. = Not available.

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Figure 2: Historical Outflow Rates (Five Years Ending), Dentists Aged 55 and Under, North Carolina

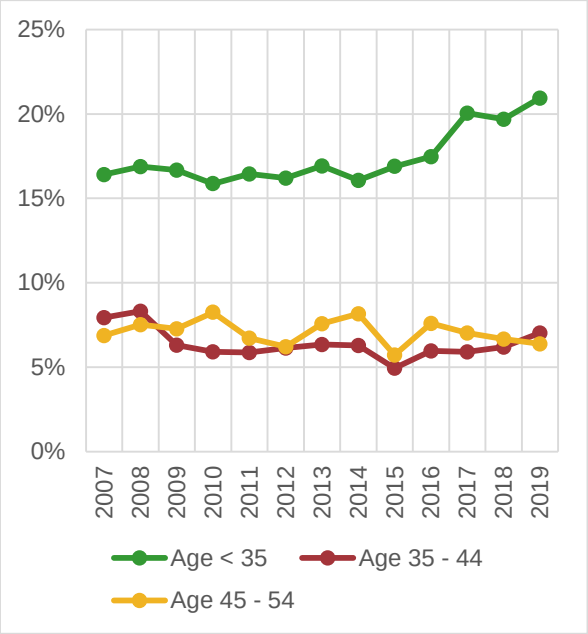
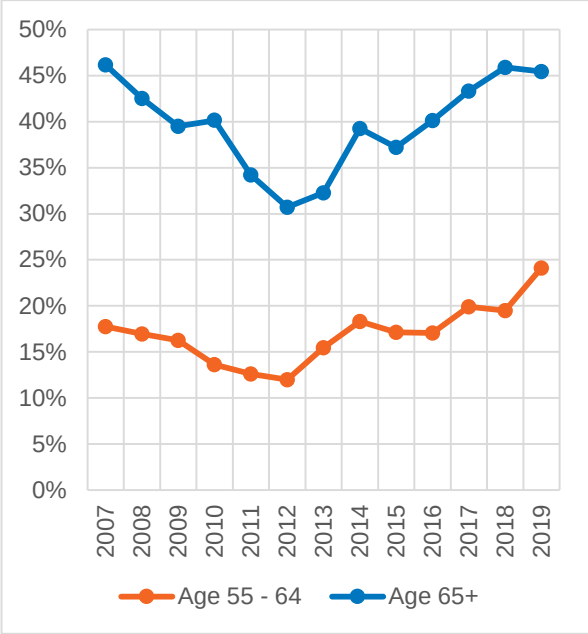


Figure 3: Historical Outflow Rates (Five Years Ending), Dentists Aged 55 and Older, North Carolina



Source: ADA Health Policy Institute analysis of ADA masterfile. **Note**: Total outflow rates denote the percentage of dentists who had retired, who moved out of state, whose license had lapsed, or who were deceased.

Why were fewer older dentists leaving the profession in 2012 after the downturn? It is reasonable to assume that some postponed retirement. Retirement funds may have decreased in value and average general dentist income (inflation-adjusted) was declining from a 2005 peak.[38]

Calculation of Outflows, Step 1: 2019-2024

Given the variance of dentists' likelihood to retire before, during and after the 2008 recession, the size of the dentist workforce in 2024 could also vary, depending on how dentists respond to the disruption of the coronavirus pandemic in 2020.

We designed one assumption of outflow percentages to simulate the effects of a typical economic downturn (either a recession or a substantial decline in the stock market) before end-of-year 2024. For this, we selected outflow percentages as the average of those from 2011 and 2012, yielding decreased outflows but not as low as those solely from 2012. This represents a lower-than-average number of retirements.

We designed a second assumption of outflow percentages to represent the higher number of retirements expected if there was no typical economic downturn before end-of-year 2024. For this we calculated a hypothetical outflow rate, extrapolated for ages 55 and older based on the change from 2017 to 2019, estimated to be likely continuations of the trends shown in Table 1 and graphed in Figures 2 and 3.

Calculation of Outflows, Step 2: 2024-2039

We used a different approach to estimate long-term outflow percentages for the 15 years after 2024. First, to understand how prevalent recessions are over the long term, we consulted the "U.S. Business Cycle Expansions and Contractions" table released by the National Bureau of Economic Research,[6] excerpted in Table 2.

Table 2: U.S. Business Cycle Expansions and Contractions

Years	Number of Cycles	Duration of Average Contraction	Duration of Average Expansion	Duration of Average Cycle
1945-2009	11	11.1 months	58.4 months	69.5 months

Source: National Bureau of Economic Research.

[38] Munson B, Vujicic M. Dentist earnings were stable in 2015. Health Policy Institute Research Brief. American Dental Association. December 2016. Available from http://www.ada.org/~/media/ADA/Science%20and%20Research/HPI/Files/HPIBrief_1216_1.pdf. Accessed February 5, 2020.

The table states that from 1945 to 2009, there were 11 business cycles, each with a period of expansion and contraction. The average business cycle lasted 69.5 months and included an economic contraction (recession) of 11.1 months average duration, or 16 percent of the business cycle.

We therefore assumed that for the years 2024-2039, 16 percent of the period will be affected by a recession (specific years unknown). We calculated outflow percentages for this period, by dentist age group, weighted 16 percent by historical outflow percentages influenced by the 2008 recession and weighted 84 percent by historical outflow percentages that occurred outside of the 2008 recession. We described these as the "average retirement rate" outflow percentages.

Calculation of Outflows, Step 3: Baseline Assumption, 2019-2039

As described earlier, we created two outflow assumptions for the period 2019-2024 to represent the presence or absence of a typical economic downturn by end-of-year 2024. But for purposes of our baseline (or most likely) assumption, we applied the "average retirement rate" outflow percentages to 2019-2024.

We choose this assumption as a compromise – a mix of behavior from both recessionary and non-recessionary periods – because we lack certainty about how the pandemic will affect dentist retirement rates. During this time, older dentists may be more likely to leave the workforce to avoid contracting an illness or (if they're practice owners) to avoid the expense of updating infection control. On the other hand, this time is also the start of an economic downturn which normally compels older dentists to postpone retirement and remain in the workforce. (In our department's tracking poll on the economic effect of COVID-19, only about 1% of U.S. dentists did not expect their practices to reopen, as of the week of June 1.)

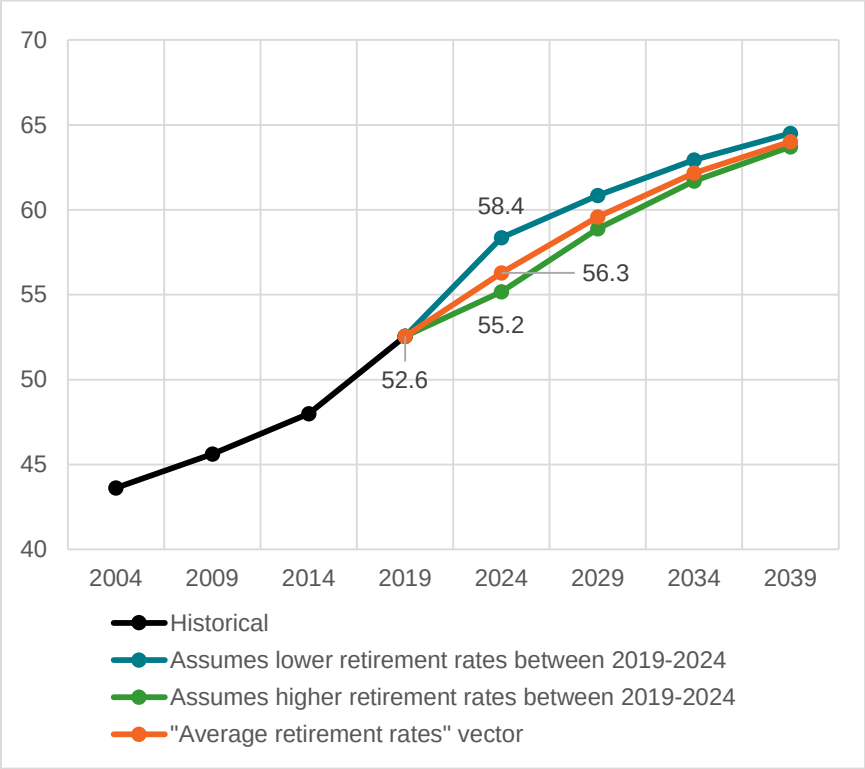
Table 3: Three Outflow Assumptions, North Carolina

	Lower retirement rates by end-of-year 2024		Average retirement rates (baseline scenario)		Higher retirement rates by end-of-year 2024	
	2019-2024	2024-2039	2019-2024	2024-2039	2019-2024	2024-2039
Age under 35	16.3%	18.3%	18.3%	18.3%	20.9%	18.3%
Age 35 - 44	6.0%	7.2%	7.2%	7.2%	7.0%	7.2%
Age 45 - 54	6.5%	6.6%	6.6%	6.6%	6.4%	6.6%
Age 55 - 64	12.3%	21.3%	21.3%	21.3%	28.3%	21.3%
Age 65 - 74	27.9%	40.5%	40.5%	40.5%	43.7%	40.5%
Age 75 - 84	49.6%	66.9%	66.9%	66.9%	76.8%	66.9%
Age 85 and older	90.0%	87.3%	87.3%	87.3%	93.7%	87.3%

Source: ADA Health Policy Institute analysis of ADA masterfile. **Notes**: The three assumptions differ only in their percentages for the years 2019-2024. All three use the "average retirement rate" percentages for the years 2024-2039. Total outflow rates denote the percentage of dentists who had retired, who moved out of state, whose license had lapsed, or who were deceased.

Our three outflow assumptions for 2019-2039 (Table 3) all applied "average retirement rate" outflow percentages to the years 2024-2039. Up until 2024, one assumption is that there will be lower retirement rates, a second assumption is that there will be higher retirement rates, and the third assumption applies the "average retirement rate" percentages to the period 2019-2024. This third assumption is our baseline scenario.

Figure 4: Historical and Projected Dentists per 100,000 Population (Unadjusted), 3 Scenarios for Retirement Rates for 2019 – 2024, North Carolina



Sources: ADA Health Policy Institute analysis of ADA masterfile; ADA Survey of Dental Practice; ADA Survey of Dental Education; U.S. Census Bureau, Intercensal Estimates and National Population Projections. **Notes**: Data for 2004-2019 are based on the ADA masterfile. Results after 2019 are projected. Assumes the annual number of U.S. dental school graduates will increase through 2024 and then remain constant.

Figure 4 compares the effects of our three outflow assumptions while holding our inflow assumption constant. The "lower retirement rates" option, 2019-2024, assumes that older dentists will be more likely to stay in the workforce because some "can't afford to retire," thus boosting the number of active dentists per capita. When we assume higher retirement rates occurring by 2024, this would reduce the growth rate of dentists per capita in the short term. Our third, or baseline, assumption used the "average retirement rate" outflows applied to 2019-2024 as well as beyond 2024 and generated a trend line falling between the first two assumptions.

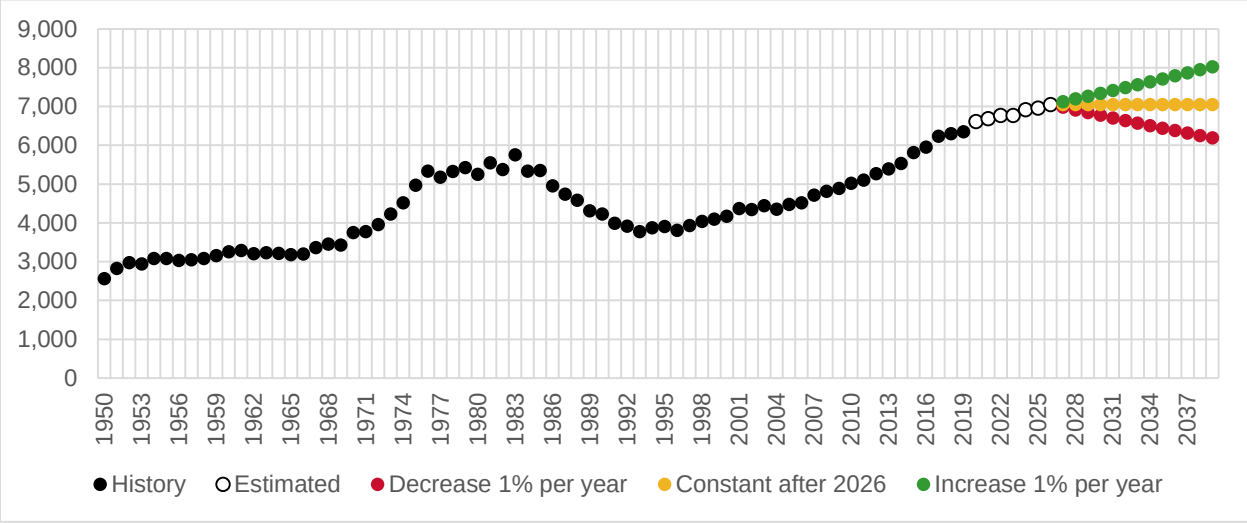
Calculation of Inflows, Step 1: Dental School Graduates

We updated the inflows analysis part of the model by recognizing that, on average, 2.2 percent of new U.S. dental school graduates do not achieve "professionally active" status long enough to be counted in the model. This group includes dentists who work in U.S. territories or the armed forces overseas, those who move to other countries, those who find U.S. employment that does not require a dentist license, and those who retire early or die.

We used a two-step process to calculate inflows of dentists into a state's workforce. The first step was to estimate the number of future dental school graduates who will practice in the state from 2019 to 2039.

We first estimated the number of U.S. dental school graduates from 2020 through 2026 based on existing enrollment and expected attrition of dental school students. The estimates also assumed the opening of new dental schools in El Paso, Texas and Joplin, Missouri and indicated increasing numbers every year through 2026. We then created three scenarios for the annual number of dental school graduates after 2026: that the number of graduates will remain constant, that the number will increase by 1 percent per year, and that the number will decrease by 1 percent per year. [39] (See Figure 5.)

Figure 5: U.S. Dental School Graduates per Year, Historical, Estimated, and Three Inflow Assumptions



Sources: ADA Health Policy Institute Survey of Dental Education, ADA Health Policy Institute estimates and assumptions. **Notes:** Data for years 1950-2019 are historical. Estimates for 2020-2026 assume that all dental schools in operation in 2020 will maintain current or expected levels of graduates per year until 2026 and that two proposed dental schools will open in 2021 and 2022. Data points after 2026 are assumptions about future numbers of U.S. dental school graduates.

[39] Health Policy Institute. National dentist workforce projection 2020. Unpublished data. American Dental Association.

For state-level projections, we assumed that the annual number of graduates will remain constant after 2026, because while we could reasonably estimate the number of graduates through 2026, uncertainty increases thereafter.

We recognize that the future number of dental school graduates is subject to intense debate and speculation. On one hand, there are dental schools that have recently opened. On the other hand, the flattening of dentist earnings in recent years[40] combined with increases in dental educational debt and reduced demand for restorative dental care could place downward pressure on the number of dental school applicants, as suggested in previous research.[41,42,43]

After establishing the scenario for future U.S. dental school graduates, we estimated the percentage of those graduates who will start practicing in a particular state. We based the percentage for each state on historical data between 2009 and 2019. We applied those percentages to the projected number of future U.S. dental school graduates to estimate the number of new dental school graduates locating in a particular state. For example, 3.5 percent of recent U.S. dental school graduates were practicing in North Carolina in 2019.

For some states, historical data are not sufficient to project where future dental school graduates locate. Some dental schools have opened so recently that they had little or no presence in the historical inflows of graduates we analyzed. For states where these dental schools are located, we took additional steps to account for the new schools' effects on the future supply of dentists. We estimated these schools' future numbers of graduates based on either their first graduating classes or by estimating the share of enrollees expected to graduate (based on national historical percentages). We then estimated the share of that school's graduates expected to practice in the state by using the percentage of enrollees who resided in the state at the time of matriculation. Given these numbers, we increased the estimated percentage of U.S. dental school graduates expected to locate in the state accordingly.

Calculation of Inflows, Step 2: Established and Foreign-Trained Dentists

In recent years, about two-thirds of inflows into the dentist workforce in larger states consisted of new U.S. dental school graduates. The remainder came from established dentists who moved into the state, dentists who reactivated an expired license, foreign-trained dentists entering the state, or dentists who came out of retirement. In order to project the inflow of dentists due to in-migration, license reactivation, and foreign-trained dentists entering the state, we relied on historical inflow rates observed from 2009 to 2019.

[40] American Dental Association. 2018 Income, Gross Billings, and Expenses. Health Policy Institute. Available from: http://www.ada.org/en/science-research/health-policy-institute/data-center/dental-practice. Accessed February 5, 2020.

[41] Eklund SA, Bailit HL. Estimating the number of dentists needed in 2040. *J Dent Educ*. 2017;81(8 Suppl): eS146–152.

[42] Meyerhoefer C, Panovska I, Manski R. Projections of dental care use through 2026: preventive care to increase while treatment will decline. *Health Affairs*. 2016;35(12): 2183-2189.

[43] Asch D, Nicholson S, Vujicic M. Are we in a medical education bubble market? *N Engl J Med*. 2013;369: 1973-1975.

Table 4 summarizes the modeling assumptions for inflows used in the North Carolina analysis based on historical data. The analysis assumes inflow patterns will remain constant for North Carolina, including the settlement of new U.S. dental school graduates in the state, in-migration of practicing dentists from other states, license reactivation rates, and entry of foreign-trained dentists in the state.

Table 4: Assumptions of Inflow Rates into the Dentist Workforce in North Carolina

	Share of New U.S. Dental School Graduates Who Locate in North Carolina	Share of Dentists from Other Sources Who Locate in North Carolina
Age under 35	3.5%	1.0%
Age 35 - 44	3.1%	0.5%
Age 45 - 54	3.1%	0.2%
Age 55 - 64	0.0%	0.2%
Age 65 - 74	0.0%	0.1%
Age 75 - 84	0.0%	0.1%
Age 85 and older	0.0%	0.0%

Source: ADA Health Policy Institute analysis of ADA masterfile. **Notes**: "Share of New U.S. Dental School Graduates Who Locate in North Carolina" percentages represent the share of U.S. dental school graduates (per graduate age group) who located in North Carolina between 2009 and 2019. "Share of Dentists from Other Sources Who Locate in North Carolina" percentages represent the average share of "Other Dentists" (per age group) who were not practicing in North Carolina five years ago but who started practicing in the state by the end of the "current year." (We calculated this statistic for "current years" equal to 2014 and 2019.) "Dentists from Other Sources" are established dentists from out of state, foreign-trained dentists, relicensed dentists, or dentists returning to the workforce from retirement (i.e., not new U.S. dental school graduates).

Combining Outflows and Inflows in the Model for Estimated Dentist "Head Count"

The model started with the state's 2019 active licensed dentist workforce broken out into seven age groups. We applied various assumptions for outflows per age group to calculate the number of these dentists still working in 2024. To yield an updated age distribution for 2024, we applied aging logic based on masterfile historical patterns of how these seven age groups move from younger to older groups in a five-year period. To this total, we add the estimated inflows of new dental school graduates, established and foreign-trained dentists moving in state, relicensed dentists, and unretired dentists by age group.

Table 5 summarizes the basic working of the model and shows results for our scenario of the projected North Carolina dentist workforce head count in 2024. The modeling projects that there will be 6,255 practicing dentists in the state in 2024 compared to 5,512 in 2019. We reiterated the process to calculate projections for 2029, 2034 and 2039.

Table 5: Example of Workforce Model Projection, North Carolina, 2019-2024, for Baseline Scenario

	Column A	Column B	Column C	Column D	Column E	Column F	Sum of Columns D, E, F
	Active licensed dentists, 2019	Assumed five-year outflow rate	Apply five-year outflow rate	Apply aging logic to Column C to yield 2024 age distribution	Inflow of new U.S. grads	Inflow of established, foreign-trained, relicensed, & unretired dentists	Active licensed dentists, 2024
Age under 35	1,144	18.3%	935	262	960	95	1,317
Age 35 - 44	1,383	7.2%	1,283	1,314	152	253	1,720
Age 45 - 54	1,250	6.6%	1,168	1,190	12	99	1,301
Age 55 - 64	936	21.3%	736	1,039	0	77	1,115
Age 65 - 74	691	40.5%	411	617	0	38	655
Age 75 - 84	97	66.9%	32	136	0	3	139
Age 85 and older	11	87.3%	1	8	0	0	8
Total	5,512	17.2%	4,566	4,566	1,124	565	6,255

Source: ADA Health Policy Institute analysis of ADA masterfile. **Notes**: Data for 2019 are based on the ADA masterfile. Results after 2019 are projected. Totals in the projection may not appear to match the sum of age groups due to the rounding of fractional numbers produced by the model. Assumes (1) retirement rates over the next 20 years correspond to historical averages and (2) the annual number of U.S. dental school graduates will increase through 2026 and then remain constant. "Outflow rate" in Column B is the percentage of dentists leaving the workforce after combining assumed percentages for dentists who are retired, moved out of state, deceased, or who have expired licenses.

Female Share of the Dentist Workforce

We examined the historical trends of females as a share of dental school graduates and the dentist workforce. From 1972 to 2018, the female share of U.S. dental school graduates grew dramatically from 1.0 percent to 49.7 percent.[44,45]

The increase in female dental school graduates since the 1970s affects the dentist workforce today. Among active dentists under age 35, the female share grew from 36.8 percent (2004) to 49.9 percent (2019). For active dentists aged 55 to 64, the female share grew from 4.9 percent (2004) to 24.3 percent (2019).

[44] American Dental Association. Annual Report on Dental Education, 1972/73. Division of Educational Measurements, Council on Dental Education.

[45] American Dental Association. 2018-19 Survey of Dental Education; Report 1 – Academic Programs, Enrollment and Graduates. Health Policy Institute. Available from: http://www.ada.org/en/science-research/health-policy-institute/data-center/dental-education. Accessed February 4, 2020.

After analyzing the historical growth of females in all dentist age cohorts, we projected the future female share of each age cohort using North Carolina as an example (Table 6). These projections assumed that the female share will level off at 52.0 percent of the workforce within each age cohort. (This is the 2018-19 female share of first-year enrollment in North Carolina dental schools.) We applied these projected percentages of female dentists in the state's workforce to our state workforce projection, yielding projections of the dentist workforce by gender and age group.

Table 6: Historical and Projected Female Share of North Carolina Dentist Workforce

	2004	2009	2014	2019	2024	2029	2034	2039
Age under 35	35.4%	39.7%	45.4%	48.6%	52.0%	52.0%	52.0%	52.0%
Age 35 – 44	29.4%	36.0%	37.8%	41.5%	45.4%	48.6%	52.0%	52.0%
Age 45 – 54	15.7%	22.4%	30.2%	35.1%	37.8%	41.5%	45.4%	48.6%
Age 55 – 64	3.0%	9.4%	15.5%	22.8%	30.2%	35.1%	37.8%	41.5%
Age 65 – 74	0.5%	2.7%	3.3%	10.3%	15.5%	22.8%	30.2%	35.1%
Age 75 and older	0.0%	0.0%	1.1%	1.9%	3.3%	10.3%	15.5%	22.8%
All ages	18.6%	23.5%	27.5%	33.6%	38.4%	42.0%	45.1%	46.9%

Source: ADA Health Policy Institute analysis of ADA masterfile. **Notes**: Data for 2004-2019 are historical. Results after 2019 are projected and assume that the female share will level off at 52.0% for each age cohort.

Full-Time Equivalent Adjustments

We adjusted the simple head count measure of the supply of dentists to full-time equivalent dentists based on hours worked and patients seen. We calculated the national average annual hours worked for each dentist gender and age group. We then calculated an index of hours worked that compares every gender and age group to male dentists under age 35, the group we used as the reference group. For example, the "hours worked" index for females under age 35 is 0.875 because their average annual hours worked is 87.5 percent of the average for males under age 35 (Table 7). We applied these indices for each gender and age group to the head count projection of the dentist workforce for each gender and age group. Thus, we calculated the full-time equivalent supply of dentists per 100,000 population adjusted for hours worked.

Similarly, to adjust the supply of dentists by patient visits, we first calculated the national average number of weekly patient visits for each dentist gender and age group. We then calculated an index of patient visits that compares every dentist gender and age group to male dentists under age 35, the group we again used as the reference group. For example, the "patient visits" index for male dentists aged 55 to 64 is 0.921 because their average number of weekly patient visits is 92.1 percent of the average for male dentists under age 35 (Table 8). We applied these indices for each gender and age group to the head count projection of the dentist workforce

for each gender and age group. Thus, we calculated the full-time equivalent supply of dentists per 100,000 population adjusted for patient visits.

Table 7: Dentist Hours Worked by Dentist Gender and Age Group

	Average Annual Hours Worked		Indexed to Male, Age under 35	
	Male	Female	Male	Female
Age under 35	1,814.8	1,587.9	1.000	0.875
Age 35 - 44	1,836.7	1,565.2	1.012	0.862
Age 45 - 54	1,774.0	1,611.8	0.978	0.888
Age 55 - 64	1,698.7	1,559.7	0.936	0.859
Age 65 - 74	1,461.0	1,460.2	0.805	0.805
Age 75 and older	1,197.4	914.4	0.660	0.504

Source: ADA Health Policy Institute, 2009-2018 results from the Survey of Dental Practice.

Table 8: Patient Visits per Week (Including Hygienist Visits) by Dentist Gender and Age Group

	Average Patient Visits Per Week (Excluding Hygienist Visits)		Indexed to Male, Age under 35	
	Male	Female	Male	Female
Age under 35	81.8	64.4	1.000	0.787
Age 35 - 44	86.2	67.4	1.054	0.824
Age 45 - 54	81.5	64.9	0.996	0.793
Age 55 - 64	75.3	59.0	0.921	0.721
Age 65 - 74	61.5	46.6	0.752	0.570
Age 75 and older	44.4	27.5	0.543	0.336

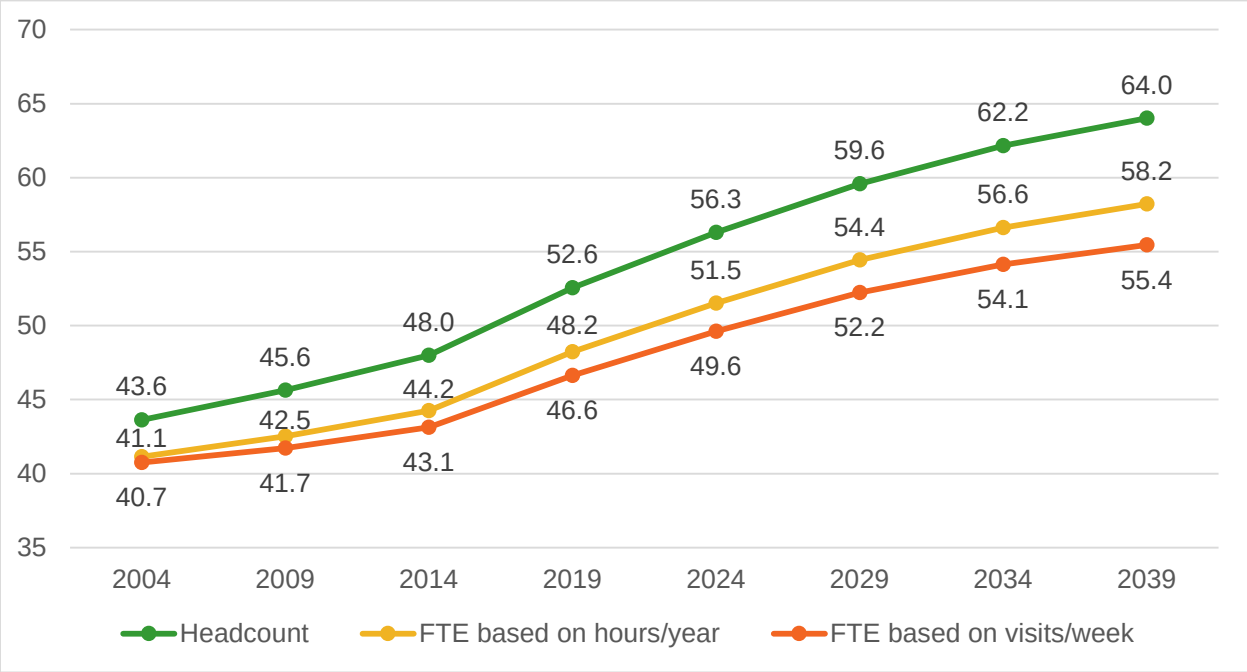
Source: ADA Health Policy Institute, 2009-2018 results from the Survey of Dental Practice.

Results

The supply of dentists in North Carolina is projected to increase through 2039, rising from 52.6 per 100,000 population in 2019 to 64.0 in 2039. Full-time equivalent hours worked per year and patients seen per week are also projected to increase through 2039. (Figure 6). The female share of the North Carolina dentist workforce will increase from 33.6 percent in 2019 to 46.9 percent in 2039 (Figure 7). The North Carolina dental workforce is expected to consistently gain more dentists (e.g., new graduates, in-migration) than it loses (e.g., retirement, out-migration) and the expected net gain is larger than the expected increase in the population (Figure 8). It is important to note that an increased supply of dentists per capita does not give insight on access to care, particularly for vulnerable populations. How the future of supply of dentists is distributed geographically, the extent to which they meaningfully participate in Medicaid and how the demand for dental care evolves among the population play are important factors to consider in assessing the adequacy of the dentist workforce. This could have important implications for practice patterns and access to care as female dentists, all else equal, are more likely to practice in DSOs, less likely to be practice owners, and more likely to be Medicaid providers.[46]

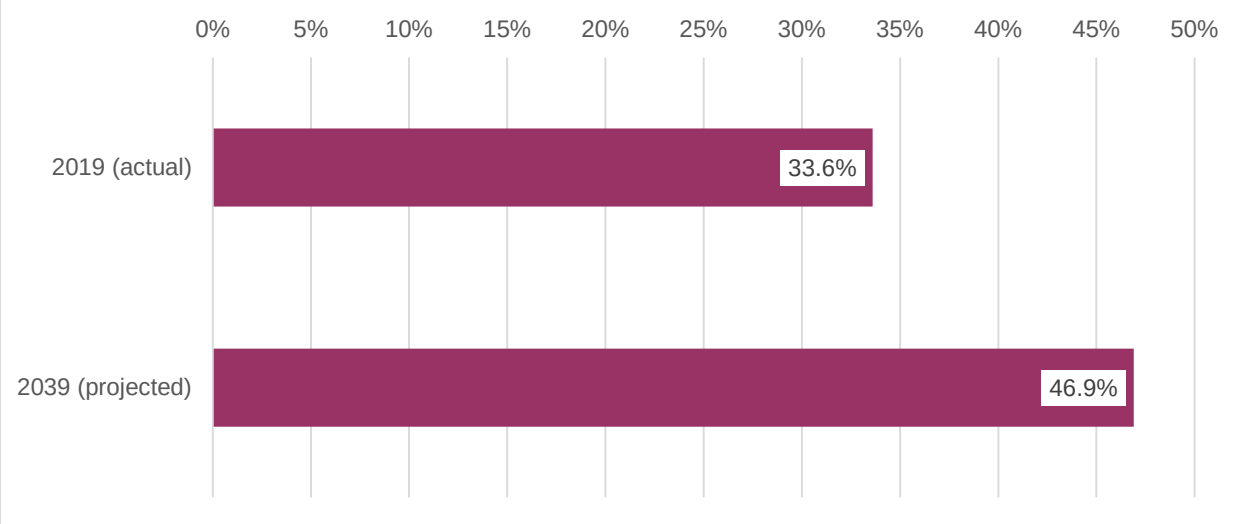
[46] Nasseh K, Vujicic M. The relationship between education debt and career choices in professional programs. *JADA*. 2017;148(11): 825-833.

Figure 6: Historical and Projected Dentists per 100,000 Population, North Carolina



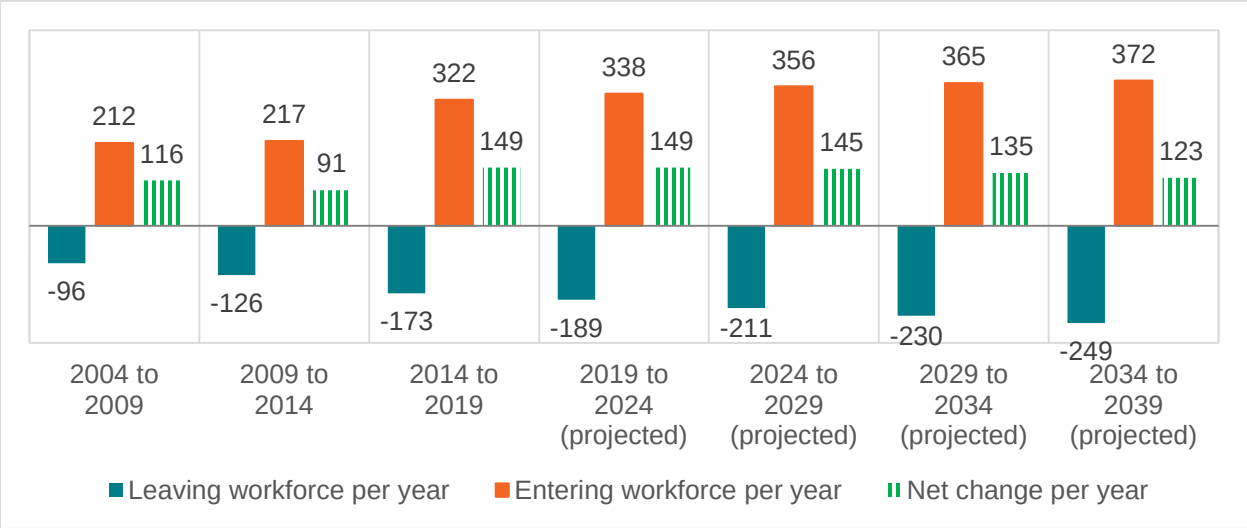
Sources: ADA Health Policy Institute analysis of ADA masterfile; ADA Survey of Dental Practice; ADA Survey of Dental Education; U.S. Census Bureau, Intercensal Estimates and National Population Projections. **Notes**: Data for 2004-2019 are based on the ADA masterfile. Results after 2019 are projected.

Figure 7: Historical and Projected Female Percentage of the Dentist Workforce, North Carolina



Sources: ADA Health Policy Institute analysis of ADA masterfile; ADA Survey of Dental Practice; ADA Survey of Dental Education.
Notes: Data for 2004-2019 are based on the ADA masterfile. Results after 2019 are projected.

Figure 8: Inflows to and Outflows from North Carolina Dentist Workforce (Average per Year), Baseline Scenario



Sources: ADA Health Policy Institute analysis of ADA masterfile; ADA Survey of Dental Practice; ADA Survey of Dental Education.
Notes: Data for 2004-2019 are based on the ADA masterfile. Results after 2019 are projected.

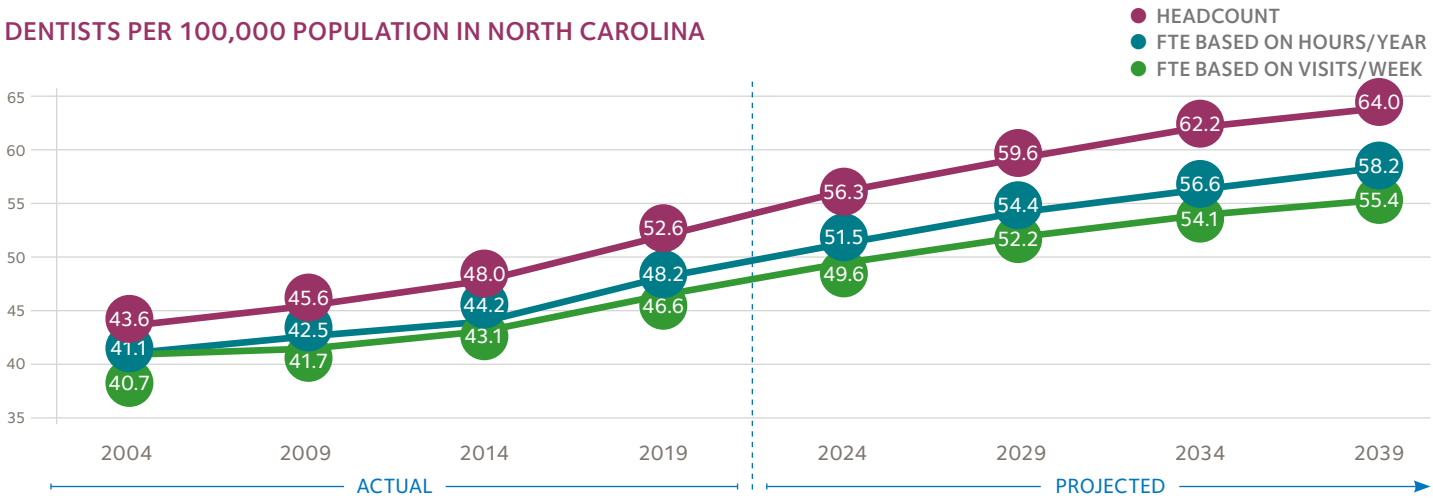
On the next page, please find a stand-alone infographic summarizing this section of the report. .

HPI Health Policy Institute

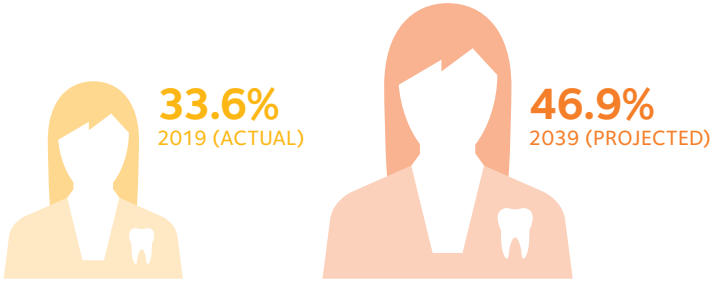
ADA American Dental Association®

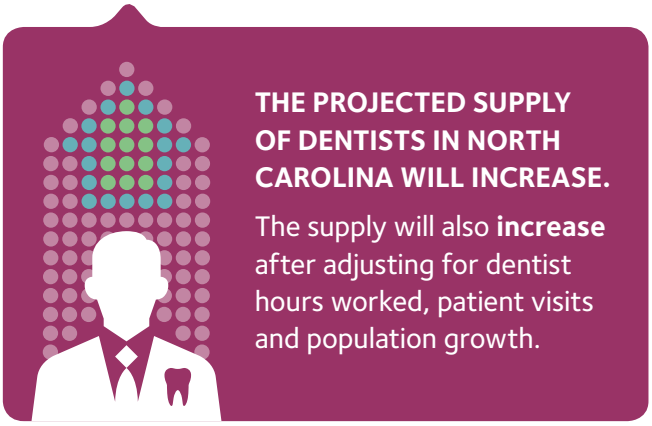
Projected Supply of Dentists: North Carolina

DENTISTS PER 100,000 POPULATION IN NORTH CAROLINA



PERCENTAGE OF NORTH CAROLINA DENTISTS THAT ARE FEMALE

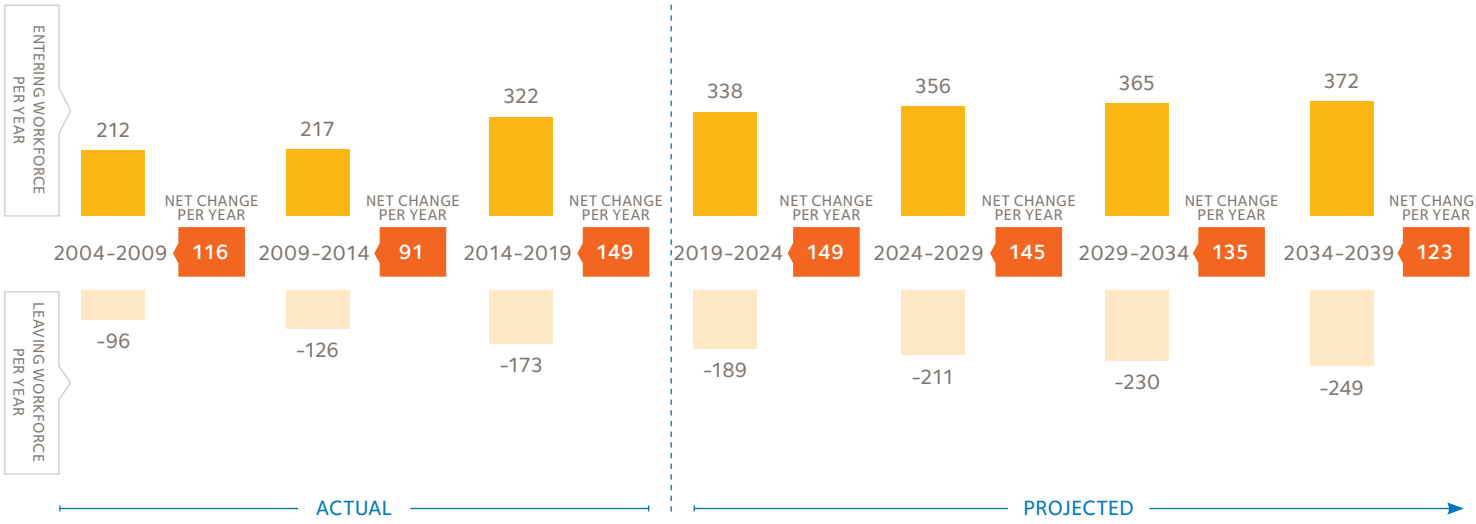




THE PROJECTED SUPPLY OF DENTISTS IN NORTH CAROLINA WILL INCREASE.

The supply will also **increase** after adjusting for dentist hours worked, patient visits and population growth.

AVERAGE ANNUAL INFLOWS TO AND OUTFLOWS FROM DENTIST WORKFORCE IN NORTH CAROLINA



Sources: ADA Health Policy Institute analysis of ADA masterfile; ADA Survey of Dental Practice; ADA Survey of Dental Education; U.S. Census Bureau, Intercensal Estimates and National Population Projections. **Notes:** Data for 2004-2019 are based on the ADA masterfile. Results after 2019 are projected.

For more information, visit **ADA.org/HPI** or contact the Health Policy Institute at **hpi@ada.org.**

Research Contributors

Marko Vujicic, PhD, oversees all of the ADA's policy research activities in his role of Chief Economist and Vice President of the Health Policy Institute. Prior to joining the ADA in 2011, he was senior economist with The World Bank in Washington D.C., where he directed the global health workforce policy program. He was also a health economist with the World Health Organization in Geneva, Switzerland. He is a visiting assistant professor at Tufts University in Boston.

Dr. Vujicic obtained his PhD in Economics from the University of British Columbia.

HPI Team

Andrew Blatz, MS, Senior Research and Data Analyst,

Chelsea Fosse, DMD, MPH, Senior Health Policy Analyst

Brittany Harrison, MA, Coordinator, Research and Editing

Adriana Menezes, Director, Operations

Matthew Mikkelsen, MA, Manager, Education Surveys

Rachel Morrissey, MPA, Research Analyst/Education

Bradley Munson, Senior Research Analyst

Kamyar Nasseh, PhD, Health Economist

Rebecca Starkel, PhD, Senior Research Analyst

Sylvia Zeno, MA, Manager of Administrative Services

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This report draws on Health Policy Institute analysis of a wide variety of data sources, including proprietary in-house datasets produced and maintained by HPI, external datasets purchased by HPI, and publicly available data. The HPI team uses the most reliable, credible and scientifically robust data available. This includes both primary data collected by the HPI team and administrative data drawn from dental insurance claims or government databases. This report draws heavily on key findings and insights from the numerous research briefs and scholarly publications produced by HPI staff.

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