

Nurse Practitioner Full Practice Authority and Access to Primary Care in North Carolina

***Conor Norris¹, Shishir Shakya^{1,2}, Edward Timmons¹, Edgar
Orozco¹***

Knee Regulatory Research Center

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Introduction

Primary care that is convenient and readily accessible for patients is essential to maintain their health. It is the most common way that patients interact with the healthcare system, helping patients manage chronic conditions and diagnosing new ailments. However, the US continues to face a shortage of primary care physicians that is projected to grow. A shortage of primary care physicians makes accessing healthcare more difficult, leading to longer wait times and forcing patients travel farther for care. North Carolina is not immune from a lack of adequate primary care physicians. Today, 2.25 million residents live in Healthcare Provider Shortage Areas (HPSAs), where the primary care physician to population ratio falls below a minimum threshold to ensure adequate access.²

Both rural and urban areas in North Carolina are classified as HPSAs. An inadequate number of primary care physicians in rural areas have different causes than in urban areas. No single, simple solution exists for policymakers to immediately solve both the rural and urban shortages of primary care physicians. With a shortage of primary care physicians in North Carolina and nationwide, encouraging physicians to relocate to shortage areas will not be effective. A more practical solution is to increase the number of mid-level professionals able to offer primary care, by removing unnecessary oversight of the physicians, as physicians are already unable to fulfill all of the patients' needs. So far, 28 states have already adopted a similar reform.

Given our shortage of primary care physicians, skilled mid-level professionals, like Advanced Practice Registered Nurses (APRNs), can be used to augment the supply of primary care. Nurse Practitioners (NPs) are a type of APRN who commonly perform primary care. They can offer primary care in places where physicians choose not to locate, making primary care more

1. The authors would like to acknowledge support from the John William Pope Foundation for this research.

2. Health Workforce Health Resources and Services Administration (HRSA), "Third Quarter of Fiscal Year 2024 Designated HPSA Quarterly Summary," U.S. Department of Health and Human Services (HHS), June 30, 2024, <https://data.hrsa.gov/Default/GenerateHPSAQuarterlyReport>.

convenient and easily accessible for patients. However, state laws that require NPs to practice with oversight by physicians often prevent them from offering primary care where patients most need them. This is currently the case in North Carolina, where any NP that wants to provide primary care must sign a collaborative practice agreement with a physician to provide oversight of their practice.

A policy change to full practice authority would allow NPs to practice without collaborative practice agreements and allow greater choice in where they locate. This reform would not change the tasks that NPs perform. It also would not put patients' health at risk; the vast majority of evidence finds evidence that NPs provide primary care at the same level as physicians.³ Currently, 28 states allow NPs to have full practice authority.⁴ In addition to expanding the practice locations of NPs, full practice authority can attract NPs into the state and even encourage more to enter the profession. This translates to the same quality of care being provided for more patients.

In this report, we summarize the evidence of the effects of full practice authority on a number of outcomes and provide an analysis of North Carolina, using a 2018 change to full practice authority in neighboring Virginia. Our outcome variables include the number of NPs, self-reported poor health, and social determinants of health. We estimate that allowing full practice authority for NPs in Virginia attracted NPs to begin practicing in the state, drawing them from interior North Carolina counties. Relative to bordering counties in Virginia, North Carolina interior counties experienced a 20% decline in the number of NPs per 100,000 residents. We observe no such difference when we compare interior North Carolina counties to bordering counties in Georgia, South Carolina, and Tennessee. For North Carolina residents, fewer NPs resulted in a slightly higher percentage of residents in poor health and small increases in the number of days of poor health and poor mental health.

Our findings suggest that NPs prefer to practice in locations where they have full practice authority. After Virginia passed full practice authority, the number of NPs in the interior North Carolina counties fell, as they began practicing in Virginia. Reducing access to care had real consequences for patients. This resulted in worse health outcomes, measured by the percentage of the population in poor health, the number of poor physical health days, and the number of poor mental health days. Access to high quality, convenient primary care is important for patient health. Moving to full practice authority would result in more NPs available to offer care and allow them to provide primary care, increasing access in shortage areas.

3. See Kihwan Bae, Conor Norris, Shishir Shakya, and Edward Timmons. "Maryland's Health Care Lesson for Pennsylvania: How Full Practice Authority can Increase Access and Improve Outcomes." The Commonwealth Foundation. 2022.

4. American Association of Nurse Practitioners, "State Practice Environment Map." <https://www.aanp.org/advocacy/state/state-practice-environment>

Primary Care Shortages in North Carolina

The US is facing significant long-term trends that are straining our current healthcare resources. Most of the public debate of healthcare policy centers on insurance, but the issues that face patients and present the most difficulties are access to primary care. The demand for primary care continues to grow as our population ages and chronic conditions become more widespread. Meanwhile licensing requirements and residency program funding policies restrict the supply of physicians, which cannot keep up with increases in demand for those services.⁵ The high price of medical education, at both undergraduate and graduate level, encourage physicians to seek more lucrative subspecialties, worsening this problem.⁶ As a result, the American Association of Medical Colleges projects that the primary care physician shortage will grow from 20,200 to 40,400 nationwide by 2063, and given recent trends in healthcare, it could grow even faster.⁷

North Carolina faces the same issues as the nation. While 27,650 physicians practice in the state, the majority practice in higher earning specialties with just 9,211 providing primary care.⁸ Between 2025 and 2030, the shortfall of physicians required to ensure that patients have adequate access to primary care is expected to be 396.⁹ Compounding this issue, physicians are not located to optimally provide care. Many areas have no physicians practicing.

North Carolina has 22 areas that are currently designated as HPSAs for primary care, which covers 3.2 million residents.¹⁰ The U.S. Department of Health and Human Services defines an HPSA as an area, population group, or facility determined to experience a shortfall in health care available for patients. To be classified as a primary care shortage area, the supply of physicians must fall below 1 for every 3,500 residents.¹¹ It would require an additional 498 physicians, all located in HPSAs, to meet North Carolina's current needs for primary care. The map below shows the location of HPSAs for primary care in the state of North Carolina.

5. Robert Orr and Anuska Jain, "The Case for Shortening Medical Education," Niskanen Center, March 17, 2020, <https://www.niskanencenter.org/the-case-for-shortening-medical-education/>.

6. Hauer, Karen E., Steven J. Durning, Walter N. Kernan, Mark J. Fagan, Matthew Mintz, Patricia S. O'Sullivan, Michael Battistone et al. "Factors associated with medical students' career choices regarding internal medicine." *Jama* 300, no. 10 (2008): 1154-1164.

7. IHS Markit Ltd, "The Complexities of Physician Supply and Demand: Projections From 2021 to 2036," (Washington D.C.: American Association of Medical Colleges, June 2020) <https://www.aamc.org/media/75236/download?attachment>

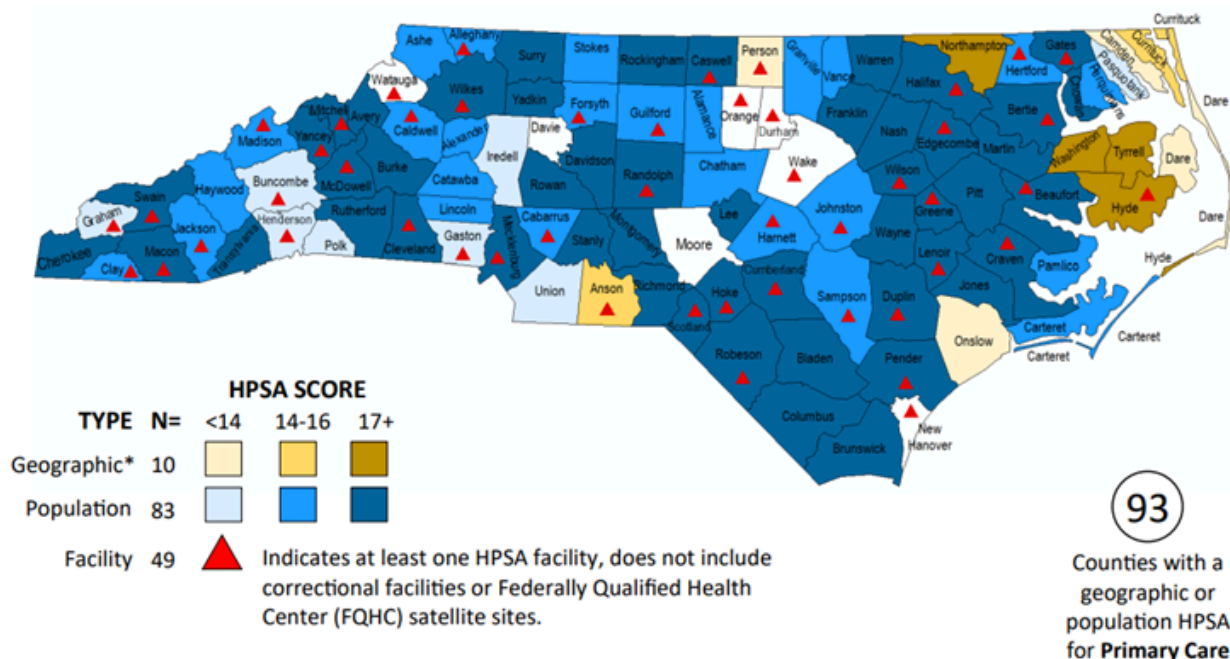
8. Association of American Medical Colleges, "North Carolina Physician Workforce Profile," 2021, <https://www.aamc.org/media/58286/download>

9. Health Workforce Health Resources and Services Administration (HRSA), "Third Quarter of Fiscal Year 2024 Designated HPSA Quarterly Summary," U.S. Department of Health and Human Services (HHS), June 30, 2024, <https://data.hrsa.gov/Default/GenerateHPSAQuarterlyReport>.

10. Bureau of Health Workforce Health Resources and Services Administration (HRSA) U.S. Department of Health & Human Services. "Designated Health Professional Shortage Areas Statistics." Quarterly Summary (December 31, 2022). file:///C:/Users/cn00010/Downloads/BCD_HPSA_SCR50_Qtr_Smry%20(4).pdf

11. Kaiser Family Foundation. "Primary Care Health Professional Shortage Areas." State Health Facts. (2022). <https://www.kff.org/other/state-indicator/primary-care-health-professional-shortage-areas-hpsas/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D>

Figure 1: Primary Care HPSAs in North Carolina



Source: NC Department of Health and Human Services. North Carolina Health Professional Shortage Area 2021 Profile. (March 18, 2022). <https://www.ncdhhs.gov/media/9348/open>

Difficulty accessing primary care impacts patients' health. Longer wait times and more travel time cause patients to delay care until their ailments worsen. Ultimately, this results in worse health outcomes for these patients. Research finds evidence of this relationship. Living in an HPSA results in worse disease severity, quality of life, and ultimately, lower life expectancy.¹² Children living in HPSAs have a lower 10-year survival rate after surgery, which requires repeated follow-up appointments, because of the more limited access to care.¹³ Managing chronic conditions, which requires regular visits to primary care, are much more difficult for patients in HPSAs, especially the uninsured.¹⁴

Full Practice Authority

APRNs have a different educational path than physicians. They must complete a Bachelor of Science in Nursing (BSN), practice as a Registered Nurse (RN) for a certain amount of time, then obtain a Master of Science in Nursing (MSN) or a Doctorate of Science in Nursing (DSN). APRNs must choose one of four specialties, each with their own separate education. They are Nurse Practitioners (NPs), Certified Nurse Midwives (CNMs), Clinical Nurse Specialists (CNS), and Certified Registered Nurse Anesthetists (CRNAs).

12. Norrina B. Allen, et al., "Association of Health Professional Shortage Areas and Cardiovascular Risk Factor Prevalence, Awareness, and Control in the Multi-Ethnic Study of Atherosclerosis (MESA)," *Circulation: Cardiovascular Quality and Outcomes* 4 No. 5 (September 2011) 565–72, <https://www.ahajournals.org/doi/10.1161/CIRCOUTCOMES.111.960922>; Sanjay Basu, et al., "Association of Primary Care Physician Supply with Population Mortality in the United States, 2005-2015," *JAMA Internal Medicine* 179, No. 4 (2019) 506–14, <https://doi.org/10.1001/jamainternmed.2018.7624.13>.

13. Shifman, Holly P., Erika Rasnick, Chiung-Yu Huang, Andrew F. Beck, John Bucuvalas, Jennifer C. Lai, and Sharad I. Wadhwani. "Association of primary care shortage areas with adverse outcomes after pediatric liver transplant." *The Journal of Pediatrics* 246 (2022): 103-109.

14. Raegan W. Durant, et al., "Awareness and Management of Chronic Disease, Insurance Status, and Health Professional Shortage Areas in the Reasons for Geographic And Racial Differences in Stroke (REGARDS): a Cross-Sectional Study," *BMC Health Services Research* 12, No. 1 (2012): 1–8.

This report focuses on NPs, who can practice in a variety of settings. Over 60 percent of NPs practice in a primary care setting.¹⁵ Their role in primary care focuses on taking health histories, providing physical exams, diagnosing and treating both acute and chronic illnesses, giving immunizations, prescribing medications and other therapies, ordering and interpreting lab tests and x-rays, and providing health counseling. Whether they are allowed to perform these tasks without delegation depends on the regulatory environment in the state.

The practice of APRNs is legally limited by Scope of Practice laws. Scope of practice laws are passed at the state level, dictating the range of tasks that they are allowed to perform and the level of oversight by physicians that is required. There are considerable differences between states. The American Association of Nurse Practitioners (AANP) categorizes scope of practice laws as either full practice authority, reduced practice, or restricted practice.

Full Practice Authority: Under full practice authority, NPs are able to practice independently, without physician oversight or collaborative practice agreements. For NPs, this means that they can order testing, prescribe medications, prescribe controlled substances, diagnose, and initiate and manage treatment without a physician, although they are free to collaborate with a physician when they deem necessary. Some states with full practice authority require that NPs undergo a transition period where they have physician supervision until certain experience requirements are met.

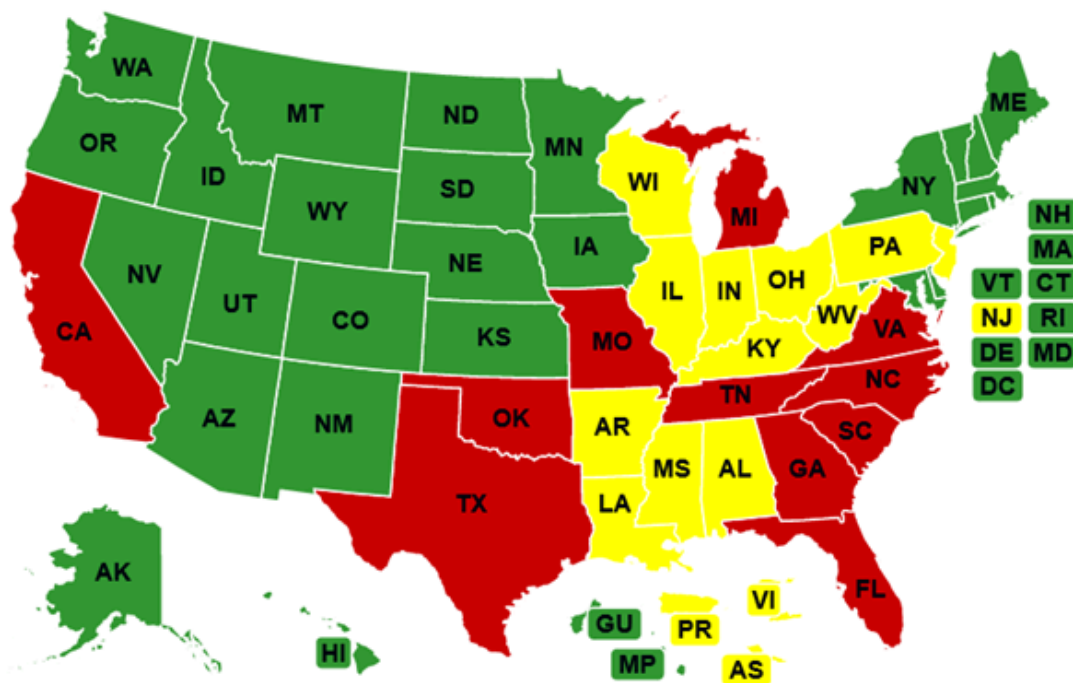
Reduced Practice Authority: In this category, NPs are limited in their ability to perform at least one element of their practice and must sign a collaborative practice agreement with a physician. The most common limitations relate to operating their own practices or prescribing certain types of medications. The collaborating physician provides direction and oversight of the APRN's practice and must be available for consultation or referral, although they do not have to be in the same physical location in every state.

Restricted Practice Authority: This is the most restrictive level of practice, requiring the greatest amount of physician oversight of NPs. These states require APRNs to be supervised by an on-site physician or receive regular oversight visits from a physician. Supervising physicians must be consulted to order, prescribe medications, or decide on treatment, slowing care.

Figure 2 below provides a map of the AANP classifications for NP practice authority. The AANP classifies North Carolina as a Restricted Practice state. In North Carolina, an NP must sign a collaborative practice agreement with a physician, detailing the medication that they are allowed to prescribe and how the continuous availability of the supervising physician will be provided.

15. American Association of Nurse Practitioners, "NP Fact Sheet," Perma.cc record October 17, 2020, <https://perma.cc/Y2YV-42XJ>

They must include predetermined plans for emergency situations and procedures for diagnosing or treating patients. The supervising physician must provide ongoing supervision, consultation, collaboration, referral, and evaluation of care provided by the Nurse Practitioner. The collaborative practice agreement must be reviewed and signed by the NP and the supervising physician annually. Requiring that the NP and supervising physician are continuously available to each other limits the NP's ability to provide primary care and can restrict them from practicing in an area with limited physician presence.



Legend

Full Practice
Reduced Practice
Restricted Practice

Source: American Association of Nurse Practitioners, "State Practice Environment Map."

<https://www.aanp.org/advocacy/state/state-practice-environment>

Full Practice Authority

Full practice authority allows NPs to provide primary care without physician supervision. Allowing them to practice independently can remove bureaucratic delays and unnecessary interference with the provision of care created by the required oversight. As a result, they can practice as

primary care providers in rural and impoverished rural areas, where patients are more easily able to afford NP wage rates compared to physician wage rates. NPs show a greater willingness than physicians to practice in rural areas, even in states that restrict their practice authority.¹⁶ Additionally, the number of NPs is projected to double between 2019 and 2034, representing a rapidly growing stock of primary care providers that can support primary care physicians.¹⁷

Granting NPs full practice authority increases the likelihood of routine check-ups, access to a regular care provider, timely appointments, and fewer emergency room visits.¹⁸ Full practice authority reduces the probability that a county contains an HPSA and states with full practice authority have a lower likelihood of patients located more than 30 miles from a primary care provider.¹⁹

Research on the effect of full practice authority on wait times for patients is more limited. A meta-analysis of APRNs included fourteen studies that examined wait times, nine of them finding that full practice authority reduces wait times.²⁰ However, none of those nine were performed in the US. The evidence in the US is mixed, with one study finding evidence of a reduction in wait times in Veteran's Affairs facilities with full practice authority for new patients, while another found no evidence of an effect for Medicaid patients.²¹

Despite the concerns shared by physicians, studies consistently find that NPs provide high quality care, comparable to physicians in all but the rarest cases.²² Stronger NP regulations that limit full practice authority do not have a positive impact on the quality of care, which we would expect to see if NPs provided lower quality care or needed physician oversight. They do, however, increase costs for medical visits.²³ Allowing NPs to provide primary care independently can improve the quality of healthcare in some cases. For instance, it is associated with decreased unnecessary hospitalizations and better health outcomes.²⁴

16. Barnes H, Richards MR, McHugh MD, Martsolf G. (2018). "Rural and non-rural primary care physician practices increasingly rely on nurse practitioners." *Health Affairs* 37(6): 908-914.

17. Auerbach D, Staiger D, Buerhaus P. (2018). "Growing ranks of advanced practice clinicians—Implications for the physician workforce." *New England Journal of Medicine*. 378(25): 2358–2360.

18. Traczynski, Jeffrey, and Victoria Udalova. (2018). "Nurse Practitioner Independence, Health Care Utilization, and Health Outcomes." *Journal of Health Economics* 58: 90–109.

19. McMichael, Benjamin. (2017). "Beyond Physicians: The Effect of Licensing and Liability Laws on the Supply of Nurse Practitioners and Physician Assistants." Mercatus Center Working Paper.; Jeongyoung Park, Xinxin Han, and Patricia Pittman, "Does Expanded State Scope of Practice for Nurse Practitioners and Physician Assistants Increase Primary Care Utilization in Community Health Centers?" *Journal of the American Association of Nurse Practitioners* 32, No. 6 (June 2020) 447–58, <https://doi.org/10.1097/JXX.0000000000000263>

20. Jennings, Natasha, Stuart Clifford, Amanda R. Fox, Jane O'Connell, and Glenn Gardner. "The impact of nurse practitioner services on cost, quality of care, satisfaction and waiting times in the emergency department: a systematic review." *International journal of nursing studies* 52, no. 1 (2015): 421-435.

21. Crowder-Martin, T., P. Richard, and R. Hirsch. "The Influence of Veterans Affairs' Full Practice Authority Policy Change on Access to Primary Health care." *Health Services Research* 55 (2020): 73-74; Cross, Summer, and Patricia Kelly. "Access to care based on state nurse practitioner practice regulation: Secondary data analysis results in the Medicare population." *Journal of the American Association of Nurse Practitioners* 27, no. 1 (2015): 21-30.

22. Buerhaus, Peter. (2018). "Nurse practitioners: A solution to America's primary care crisis." *American Enterprise Institute*: 1-30; Adams, Kathleen, and Sara Markowitz. (2018). "Improving efficiency in the health-care system: Removing anticompetitive barriers for advanced practice registered nurses and physician assistants." *Policy Proposal* 8: 9-13.

23. Kleiner, Morris. (2016). "Battling over jobs: Occupational licensing in health care." *American Economic Review*, 106(5):165-170.

24. Michael Mileski, et al., "The Impact of Nurse Practitioners on Hospitalizations and Discharges from Long-Term Nursing Facilities: A Systematic Review," *In Healthcare* 8, No. 2 (April 2020) 114, <https://doi.org/10.3390/healthcare8020114>

In general, the research finds that full practice authority for APRNs can lower health care costs, with some evidence of an increase in overall spending or unnecessary tests.²⁵ States with NP full practice authority have lower spending on Medicare and Medicaid.²⁶ More recent work with larger sample sizes find evidence that full practice authority for NPs decreases healthcare spending. In general, the estimated cost savings are relatively modest; however, it is important to remember that they occur alongside an increase in utilization.

Not only does full practice authority allow for a better use of existing healthcare resources, but it can also increase the supply of APRNs, further improving access to care. Less stringent regulations and a simpler practice environment that respects the skills of providers should increase the number of workers willing to enter into the profession. Collaborative practice agreements can be a significant financial burden for nurse practitioners and research confirms this fact. States with full practice authority for NPs have a greater number of NPs practicing.²⁷ The NPs also tend to practice where they are needed most. Counties within states with full practice authority are less likely to be HPSAs than similar counties in states without full practice authority. In states with full practice authority, rural counties experience an increase in the number of NPs.²⁸ Once a state implements full practice authority, NPs are more likely to move to that state, and less likely to leave a state with full practice authority for a state without full practice authority.²⁹

Data and Analysis

For our analysis of the effect of full practice authority on the supply of NPs, we used data from the American Community Survey and the National Plan and Provider Enumeration System (NPPES) to compare the number of NPs in North Carolina interior counties and Virginia border counties. We focus our attention on interior North Carolina counties for two reasons. First, we want to focus our attention on NPs working in North Carolina. NPs working in border North Carolina counties may commute to and work in Virginia. Second, we want to utilize the same control group for our primary and placebo analysis. We obtain counts of NPs in Georgia, South Carolina, and Tennessee bordering counties for an additional robustness check for our analysis. We anticipate observing changes when comparing interior North Carolina counties to bordering Virginia counties, but do not expect to observe similar changes when using counties from other bordering states.

25. Most of the research that we cite is for NPs specifically, but in a few instances, we include studies including all four specialties of APRNs, because NPs are the most common specialty of APRN. We make sure to note when a study's results are for APRNs in general.

26. Timmons, Edward. (2017). "The effects of expanded nurse practitioner and physician assistant scope of practice on the cost of medicaid patient care." *Health Policy*, 121(2): 189-196; Poghosyan, L, Edward Timmons, Abraham, C. M., & Grant Martsolf. (2019). "The economic impact of the expansion of nurse practitioner scope of practice for Medicaid." *Journal of Nursing Regulation*, 10(1), 1-6.

27. McMichael, Benjamin. (2017). "Beyond Physicians: The Effect of Licensing and Liability Laws on the Supply of Nurse Practitioners and Physician Assistants." Mercatus Center Working Paper.

28. Xue, Ying, Viji Kannan, Elizabeth Greener, Joyce A. Smith, Judith Brasch, Brent A. Johnson, and Joanne Spetz. 2018. "Full Scope-of-Practice Regulation Is Associated with Higher Supply of Nurse Practitioners in Rural and Primary Care Health Professional Shortage Counties." *Journal of Nursing Regulation* 8(4): 5-13.

29. Shakya, Shishir, and Alicia Plemmons. (2020). "Does scope of practice affect mobility of nurse practitioners serving medicare beneficiaries?" *Journal of Labor Research* 41(4): 421-434.

We retrieved the National Plan and Provider Enumeration System (NPPES) public use file from 2016 to 2023 from the Centers for Medicare & Medicaid Services (CMS), which contains a unique identifying number, the National Provider Identifier (NPI), for all licensed healthcare professionals.³⁰ When a healthcare provider obtains an active license and begins practicing, they must register for an NPI, which identifies them specifically. We retrieve the complete set of NPs based on the relevant taxonomy codes. Using these taxonomies, we track their NPI. From this, we identify their personal information, which includes their first, middle, and last name and gender, along with their practicing location for each year from 2016 to 2023 and whether they are an individual or organization. Finally, we gathered data on the county-level population from the American Community Survey from 2016 to 2021 and implemented an autoregressive integrated moving average (ARIMA) imputation for years 2022 and 2023. We use the county population to calculate the number of NPs per 100,000 residents.

We also consider several measures of health outcomes, which we obtain from Robert Wood Johnson Foundation County health ranking data. County health ranking data provides a snapshot of the overall health of a county relative to other counties in the United States. This data is compiled from various sources and includes metrics on health outcomes, health behaviors, and social determinants of health. We include the percentage of population with fair or poor health, average numbers of physically unhealthy days, average numbers of mentally unhealthy days, preventable hospital rate, percentage of annual mammogram, and percentage of people vaccinated.

In 2018, Virginia implemented a reform that granted NPs independent practice authority. Our study aims to investigate the effect of this sudden shift in incentives for nurse practitioners in North Carolina interior counties to potentially seek employment in contiguous Virginia counties, where they can practice with greater autonomy. Because the regulatory environment impacts NPs' location decisions,³¹ we test to see if this policy change leads to NPs from North Carolina leaving the state to practice in Virginia, and the changes in health outcomes this causes.

We employ a standard difference-in-differences framework to compare North Carolina interior counties to bordering Virginia before and after the reform. To make sure that our results are not spurious, we perform additional estimations comparing North Carolina interior counties to bordering counties in Georgia, South Carolina, and Tennessee. We anticipate observing no differences in these estimations—helping to confirm that the effects of the policy change in Virginia that we observe are legitimate.

30. https://download.cms.gov/nppes/NPI_Files.html

31. Shakya, Shishir, and Alicia Plemmons. (2020). "Does scope of practice affect mobility of nurse practitioners serving medicare beneficiaries?." *Journal of Labor Research* 41(4): 421-434.

We perform this analysis for the number of NPs per 100,000 residents and for health outcomes, which include the percentage of population with fair or poor health, average numbers of physically unhealthy days, average numbers of mentally unhealthy days, preventable hospital rate, percentage of annual mammogram, and percentage of vaccinated.

Provider Density

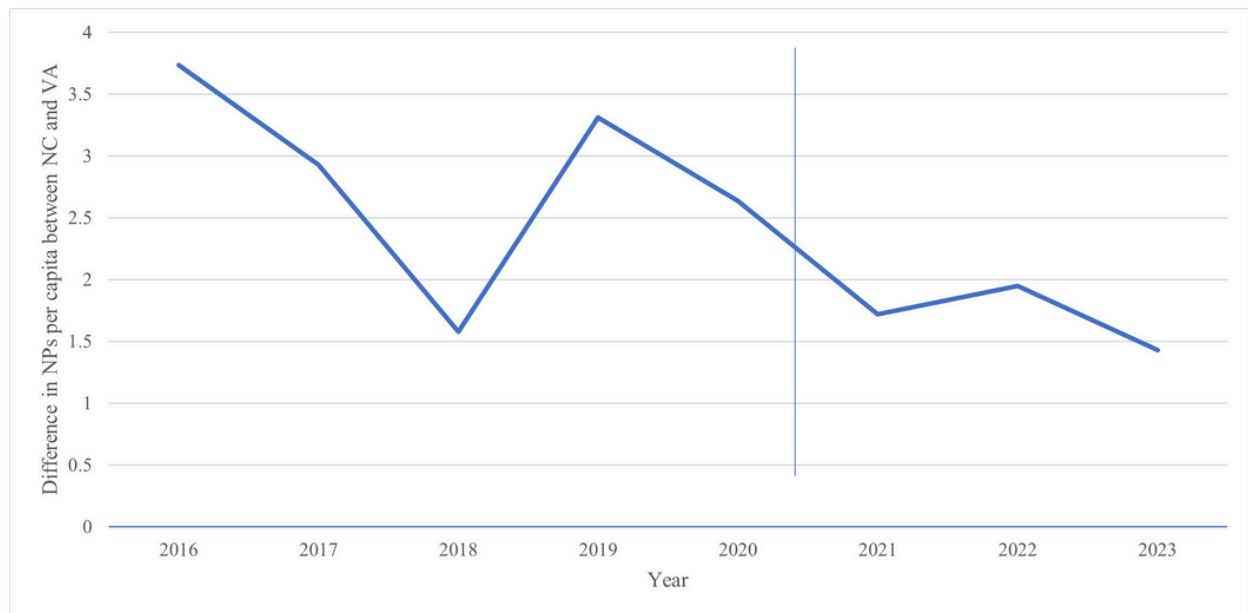
Table 1 below compares the density of healthcare providers in North Carolina and Virginia. To provide a complete picture, we provide both the total number of NPs and the number of NPs per 100,000 residents. Although North Carolina has more total NPs and NPs per capita throughout the sample period, after the passage of full practice authority in 2018, the difference between the two states falls. Figure 2 shows the trends visually, where the difference in NPs per capita fell by half between North Carolina and Virginia from 2016 to 2023. Figure 3 shows the number of NPs and the number of NPs per 100,000 residents in each county in 2023. These trends provide some initial evidence of a positive effect of independent practice authority on access to care.

Table 1: The Number of NPs in Virginia and North Carolina by Year

Year	North Carolina	Virginia	NC per 100,000	VA per 100,000
2016	6107	4795	61.43	57.70
2017	6704	5334	66.69	63.76
2018	7395	5994	72.82	71.24
2019	8273	6534	80.60	77.28
2020	9191	7306	88.49	85.86
2021	10008	8010	95.25	93.53
2022	11004	8756	103.54	101.59
2023	11004	8756	102.37	100.94

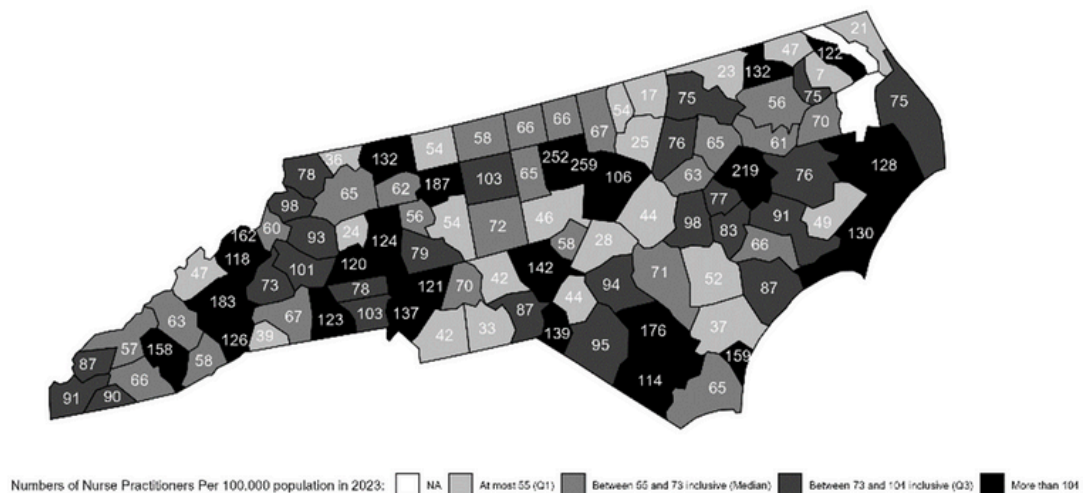
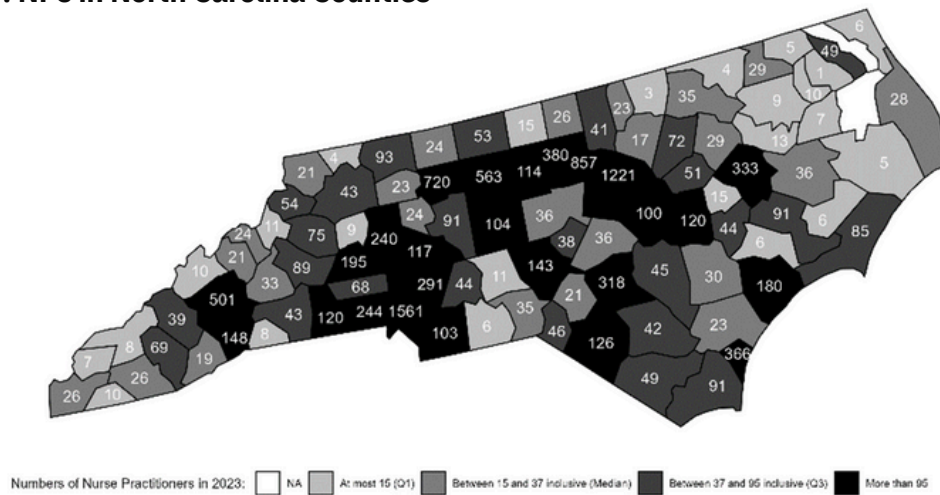
Source: American Community Survey and the National Plan and Provider Enumeration System (NPPES)

Figure 2: Difference between NPs per capita in NC and Virginia



Source: Authors' calculations

Figure 3: NPs in North Carolina Counties



Source: NPPES and author's calculations

The Impact of Virginia's Full Practice Authority on North Carolina

Table 2 provides the results for the effect of full practice authority on the density of healthcare providers. The first column, Contiguous VA vs Interior NC, compares the Virginia counties along the border with North Carolina to the interior counties of the state. It is displayed in bold. The next three columns are placebo tests, each including the interior North Carolina counties with one of the other states. We should not see an effect in the bordering counties in other states—Georgia, Tennessee, and South Carolina had no policy change.

We find that, on average, interior North Carolina counties relative to contiguous Virginia counties experienced a reduction of 10.5 NPs per 100,000 residents after Virginia allowed NPs to practice independently in 2018. Evaluated at the mean number of NPs per 100,000 residents in North Carolina (51.48), we can say that North Carolina experienced a more than 20% decline in NPs after Virginia's policy change. We do not estimate a statistically significant change for bordering counties in Georgia, South Carolina, and Tennessee. Combined, this provides strong evidence that the full practice authority reform in Virginia attracted NPs from North Carolina.

Table 2: Estimates of Differences in NP Supply in North Carolina and Bordering Counties

	Contiguous VA vs Interior NC (1)	Contiguous TN vs Interior NC (2)	Contiguous GA vs Interior NC (3)	Contiguous SC vs Interior NC (4)
NP per 100,000 residents	-10.526*** (3.950)	-5.050 (5.218)	1.021 (3.356)	4.565 (4.045)
NC Mean	51.48	51.48	51.48	51.48
Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Cluster FE	Yes	Yes	Yes	Yes
Observations	592	552	504	600
R2	0.093	0.064	0.065	0.076
Adjusted R2	0.089	0.059	0.065	0.071

*Note: Data from NPPES and the American Community Survey. Standard Errors in parentheses. Significance: *:0.1, **: 0.05, ***: 0.01*

We also find evidence that the reduction in supply of NPs negatively impacts some measures of population-level health outcomes, which we report in Table 3. Column (1), which displays the estimates of the bordering counties with Virginia, are in bold. Each of these estimations were performed separately, we are including them in one table for ease of comparison. We include the placebo tests in columns (2) through (4). We estimate that the migration of NPs to Virginia from North Carolina counties resulted in an increase in the percentage of the population in poor health by almost 0.5 percentage points. Prior to Virginia's policy change in 2018, approximately 19.5% of North Carolina's citizens reported fair or poor health. In other words, North Carolina residents in interior counties experienced an increase in fair and poor health days of 2.4% relative to bordering Virginia counties. We also find evidence that the average number of unhealthy physical and mental health days increase slightly by 0.08 and 0.09 days respectively. The average for each for North Carolina residents is 4.1 and 4.4 days respectively. We do not estimate any effect on preventable hospital stays, mammograms, or vaccination.

Table 3: Estimates of Differences in Health Outcomes in North Carolina and Bordering Counties

	Contiguous VA vs Interior NC (1)	Contiguous TN vs Interior NC (2)	Contiguous GA vs Interior NC (3)	Contiguous SC vs Interior NC (4)
Population in Fair or Poor Health	0.473* (0.249)	-0.078 (0.202)	-0.192 (0.224)	-0.212 (0.201)
Average Number of Physically Unhealthy Days	0.076** (0.034)	-0.032 (0.023)	-0.068* (0.038)	-0.011 (0.031)
Average Number of Mentally Unhealthy Days	0.086** (0.043)	0.019 (0.034)	0.017 (0.027)	0.035 (0.048)
Preventable Hospital Rate	-0.024 (0.039)	0.003 (0.096)	0.084 (0.176)	0.128** (0.062)
Percentage with Annual Mammogram	-1.066 (0.859)	-0.839 (0.800)	-1.530* (0.782)	1.209* (0.675)
Percent Vaccinated	-0.952 (0.587)	0.609 (0.547)	0.692 (0.775)	0.598 (0.508)

Note: Data from the Robert Wood Johnson Foundation County health ranking data. Standard Errors in parentheses.

*Significance: *:0.1, **: 0.05, ***: 0.01*

Recommendations

Due to primary care physician shortages, North Carolina is struggling to meet the increase in demand for primary care. A number of longer term policy solutions can help alleviate the shortage of primary care physicians, like expanding the supply of physicians, encouraging more physicians to practice in HPSAs, and expanding telemedicine services. We believe that full practice authority for NPs is an important component of any policy to ensure primary care access. Importantly, full practice authority for NPs can immediately increase the number of qualified professionals able to provide primary care. NPs are skilled professionals who are currently being trained to provide primary care. Research consistently finds that NPs offer the same quality of care as physicians. NPs are also sensitive to scope of practice laws; states that allow NPs to practice independently experience greater growth in supply.³²

In 2016, North Carolina had more NPs per 100,000 residents than Virginia. However, after Virginia implemented full practice authority for NPs, this advantage decreased, in part because the regulatory change attracted NPs from North Carolina's interior counties. Our statistical analysis finds evidence that the number of NPs per 100,000 residents decreased by 10.5 (a more than 20% decline) in North Carolina interior counties relative to Virginia bordering counties after Virginia's policy change. We do not find any evidence of an effect along any of North Carolina's other borders, suggesting that the change is due to Virginia's policy change in 2018.

Greater access to care in Virginia appears to have had a slight impact on patient's health outcomes. This difference is associated with a 0.5 percentage point increase in the percentage of North Carolina residents in interior counties reporting fair or poor health. The North Carolina interior counties also have 0.08 days more days of poor mental health and 0.09 more days of poor mental health.

Previous studies show this relationship holding in the opposite direction as well. Meaning that increasing the number of NPs and allowing them to practice independently would improve patient health outcomes. Coupled with our findings, this suggests that North Carolina can improve access to primary care and ultimately improve patient outcomes by allowing NPs to work to the full extent of their training. NPs are highly trained professionals capable of providing primary care, if the state's regulatory environment allows them to do so. North Carolina would also not be deviating from the norm if it moved in this direction since 28 other states already allow nurse practitioners to work to the full extent of their specialized training.

32. Shakya, Shishir, and Alicia Plemmons. "Does scope of practice affect mobility of nurse practitioners serving Medicare beneficiaries?" *Journal of Labor Research* 41 (2020): 421-434.; Bae, K., C. Norris, S. Shakya, and E. Timmons. "Maryland's Health Care Lesson for Pennsylvania: How Full Practice Authority Can Increase Access and Improve Outcomes" *Commonwealth Foundation Policy Brief*. (2022).