National and Regional Variation in Local Primary Care Physician Density Relative to the Uninsured and the Affordable Care Act

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Abstract

This study is the first to examine primary care physician (PCP) density relative to the uninsured at the local level prior to and after insurance expansion under the Affordable Care Act. Primary care physician density is associated with access to care, lower inpatient and emergency care, and primary care services. However, access to primary care among the uninsured may be limited due to inadequate availability of PCPs. Core-Based Statistical Area (CBSA) data from the Area Health Resource File were retrospectively examined before and after Medicaid expansion. Multiple logistic regressions were modeled for PCP density with predictor interaction effects for percentage uninsured, Medicaid expansion status, and US Census regions. Medicaid expansion CBSAs had significantly lower proportions of uninsured and higher PCP density compared with their nonexpansion counterparts. Nationally, increasing proportions of the uninsured were significantly associated with decreasing PCP density. Most notably, there is an expected 32% lower PCP density in Western Medicaid expansion areas with many uninsured (90th percentile) compared with those with few uninsured (10th percentile). Areas expanding Medicaid with greater proportions of people becoming insured postexpansion had significantly fewer PCPs. Areas with greater proportions of the uninsured may have reduced access to primary care due to the paucity of PCPs in these areas. Efforts to improve access should consider a lack of local PCPs as a limitation for ensuring accessible and timely care. Health care and policy leaders should focus on answers to improve the local availability of primary care clinicians in underserved communities.

Keywords

health services accessibility, medically uninsured, primary health care, health policy, health professions workforce

What do we already know about this topic?
Primary care physician density is associated with access to care, lower utilization of inpatient and emergency care, and reception of primary care services.
How does your research contribute to the field?
This study is the first to examine national and regional PCP density among the uninsured at the local level prior to and after health insurance expansion under the Affordable Car Act.
What are your research's implications toward theory, practice, or policy?
Given the magnitude of geographical disparity between the supply of primary care physicians and the uninsured and newly insured, policy and health care leaders should consider methods of creating a more equitable distribution of primary care providers.

Introduction

Primary care physician (PCP) density has been associated with reductions in hospital admissions, emergency department visits, and surgery[1-3]; improvements in population health outcomes[4,5]; and an increased likelihood of having a PCP and receiving preventive health screenings.[6] Conversely, a lack of local PCP availability may limit access to care, as demand exceeds supply. Consequently, low-income areas may have notably fewer PCPs due to a lack of economic

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opportunities or inadequate incentives to practice in those locations. Although public programs such as Medicaid provide a financial mechanism, lower reimbursement rates, paperwork burdens, reimbursement delays, high complexity of care, and longer visit durations make this reimbursement option less desireable.[7] As a result, many in areas with lower PCP density are likely to have disproportionally restricted access to care, even after obtaining health insurance.

From a historical perspective, the implementation of the Affordable Care Act (ACA) provided 20 million nonelderly individuals with Medicaid or federally subsidized health insurance as of March 2016.[8] However, following the 2006 Massachusetts health insurance expansion, many new recipients of coverage reported many physicians were not accepting their specific type of coverage or not accepting any new patients.[9,10] One likely explanation is that the number of PCPs may have been insufficient to absorb the influx of newly insured patients.[9,10] Similarly, following the ACA, this problem is likely exacerbated in other states as Massachusetts had the greatest concentration of PCPs and the lowest rate of uninsurance. Combined with well-documented national PCP shortages[11-14] and geographic variation in PCP supply,[6,14,15] there may not be enough PCPs in areas where many are becoming insured under the ACA.

New Contribution

Despite the link between PCP density and access to care, only 2 studies to the authors' knowledge have examined PCP density in relation to the uninsured.[16,17] However, these studies have been limited to state-level analyses, which may conceal greater variation within smaller geographical areas. This study is the first to examine national and regional PCP density variation in relation to the uninsured at the local level. Findings from this study have implications for the extent geographical PCP density variation may contribute to limited access to primary care for the uninsured and those previously uninsured prior to the ACA. Accordingly, the research questions this study sets out to answer are 3-fold: (1) nationally and regionally, is there lower PCP density in areas with greater proportions of the uninsured? (2) at the local level, does PCP density decrease as the percentage of uninsured increase? (3) and at the local level, is there lower PCP density in areas with a greater percentage becoming insured post-Medicaid expansion?

Methods

Study Design and Secondary Data Set

This study examines retrospective data from the Area Resource Health File (ARHF), which contains county-level data for all US counties and county equivalents (Health Resources and Services Administration [HRSA]). The ARHF database is maintained by the HRSA and contains statistics from governmental and professional organizations including the US Census Bureau, the American Medical Association (AMA) Physician Masterfile, and the Centers for Medicare and Medicaid Services. All variables taken from the ARHF are from the years 2010, 2013, 2014, and 2016.

County-level data (or equivalent entities) were organized into Metropolitan Statistical Areas and Micropolitan Statistical Areas, which account for significant social and economic interaction between neighboring counties. The Office of Management and Budget[18] defined Metropolitan Statistical Areas as having an urban core of 50 000 or more inhabitants and Micropolitan Statistical Areas as having an urban core of at least 10 000, but less than 50 000 inhabitants. Collectively, these definitions have been defined as Core-Based Statistical Areas (CBSAs).[19] To examine differences by Medicaid expansion, CBSAs that cross state boundaries where one state expanded Medicaid and the other did not were separated into 2 CBSAs. This method relies on 2 arguments: (1) many state Medicaid programs do not reimburse for nonemergent out-of-state services (2) and care is rarely or inconsistently sought out-of-state.

All analyses were stratified by state Medicaid expansion status given differences in the proportion of people becoming insured and the uncertain nature of continued state Medicaid expansion.

Independent Variables

The AHRF[20] data for the number of uninsured less than 64 years of age and total population are taken from the Small Area Health Insurance Estimates file and the US Census Bureau, respectively. The independent variable for analyses was the proportion of the uninsured in each CBSA. This variable was constructed by dividing the number of uninsured by the total population. The proportion of the population that became insured post-Medicaid expansion was calculated by subtracting the proportion of uninsured in the preexpansion period from the proportion of uninsured in the postexpansion period. The preexpansion period was 2013 to coincide with the launch of the state marketplaces and Medicaid expansion. The postexpansion period was 2016, the most recent data year available. However, because some states expanded at different times, preexpansion data years were modified accordingly (see Table 1).[21,22] It should be noted that Virginia and Maine expanded in 2019, but were left as nonexpanders in analyses. Regions were defined according to the US Census Bureau region definitions of Northeast, Midwest, South, and West.[23] Medicaid expansion was coded dichotomously as those states that expanded Medicaid, either through Federal Medicaid expansion or expanding Medicaid on their own, and those that did not expand Medicaid.[21]

Dependent Variable

Consistent with previous studies,[1,24] PCPs were defined as general practice, internal medicine, family medicine, and pediatric MDs and DOs. Physicians with an MD were classified as

Table 1. Early and Late Medicaid Expansion States.

State/district	Date Medicaid expanded	Preexpansion	Postexpansion
Early Expanders			
California	July 1, 2011	2010	2016
Connecticut	April 1, 2010	2010	2016
District of Columbia	July 1, 2010	2010	2016
Minnesota	March 1, 2011	2010	2016
New Jersey	April 14, 2011	2010	2016
Washington	January 3, 2011	2010	2016
Late Expanders			
Pennsylvania	January 1, 2015	2013	2016
Indiana	February 1, 2015	2013	2016
Alaska	September 1, 2015	2013	2016
Montana	January 1, 2016	2013	2016
Louisiana	July 1, 2016	2013	2016

Note. Virginia and Maine did not expand Medicaid until 2019 and were therefore not classified as Medicaid expansion states as of 2016.

nonfederal, office-based physicians. Due to lack of data availability, DO physicians in general practice, internal medicine, family medicine, and pediatrics could only be classified as nonfederal, total patient care PCPs. The PCP density was calculated as the number of PCPs/10 000 of the population.

Statistical Analyses

Statistical analyses were conducted with SAS statistical software package version 9.3 (SAS Institute Inc.).[25] A nonparametric 1-way analysis of variance model was used to test for median differences between Medicaid expansion status. To test for differences between regions, a pairwise 2-sided comparison was used as a generalization of the median test. Because the data were stratified by both US Census regions and Medicaid expansion status, a Bonferroni multiple comparisons approach was used to account for the probability that associations would be observed by chance. National and regional analyses were investigated using logistic regressions to model the log-odds of PCP density using maximum likelihood estimation. This procedure also made it possible to examine interaction effects between predictors to determine whether the relationship between PCP density and percentage uninsured differed between regions and Medicaid expansion status. Approximate *t* tests were performed for the national and regional models to test for differences in slope parameters by Medicaid expansion status.

Results

Nationally and Regionally, Is There Lower PCP Density in Areas With Greater Proportions of the Uninsured?

Analyses in the present study included a total of 1013 CBSAs after separating CBSAs crossing state boundaries that differ by Medicaid expansion status. At the national level, CBSAs with Medicaid expansion contained significantly lower percentages of the uninsured and higher PCP supply compared with nonexpansion CBSAs (see Table 2). Similarly, at the regional level, Southern states had higher median percentages of the uninsured and lower median PCP supply compared with other regions in both the preexpansion and postexpansion periods. Conversely, Northeastern states had lower median percentages of the uninsured and higher median PCP supply compared with other regions. These findings answer the first research question and confirm that, from a macro population perspective, there is a geographical mismatch between where PCPs are concentrated and where many of the uninsured reside.

Significant variation also was noted at the regional level. Compared with Western states, Midwestern and Northeastern states had significantly lower percentages of the uninsured and Southern states had significantly lower PCP density. Stratifying by region and Medicaid expansion revealed even more significant variation as noted in Table 2.

At the Local Level, Does PCP Density Decrease as the Percentage of Uninsured Increase?

Based on the fitted national model, CBSAs in states that expanded Medicaid saw PCP density decrease by a factor of approximately $e^{(-0.0177)} = 0.9825$ for every 1 percentage point increase of percentage uninsured (see Table 3) or roughly a 1.2% decrease in PCP density per 1% increase in percentage uninsured. Applying this modeled slope across the percentiles of percentage uninsured for CBSAs in expansion states during the preexpansion period, the expectation is a 9.28% decrease in PCP density between CBSAs at the 25th percentile (9.44%) and CBSAs at the 75th percentile (14.95%) of percentage uninsured. Between CBSAs at the 10th percentile (7.90%) and those at the 90th percentile (17.42%) of percentage uninsured, the logistic regression model predicts a 15.49% decrease in PCP density. Looking

Table 2. Medians (IQR) for Percentage Uninsured and PCP Density by Region and Medicaid Expansion[a].

Percentage uninsured					
	Nation	West[b]	South	Midwest	Northeast
Preexpansion					
		15.46 (4.39)	15.72 (3.91)	10.42 (3.13)**	9.18 (2.45)**
ME 0[c]	15.40 (5.10)	14.70 (4.36)	16.24 (4.24)*	10.68 (3.80)**	10.59 (1.19)**
ME 1	11.79 (5.51)**	15.76 (4.34)	14.57 (3.00)**	10.28 (2.87)**	9.05 (2.47)***
Postexpansion					
		7.84 (3.69)	10.29 (4.38)**	5.61 (2.92)**	4.95 (1.94)**
ME 0[c]	10.40 (4.06)	9.73 (2.57)	11.37 (4.34)**	7.82 (3.64)**	7.81 (0.46)
ME 1	5.68 (2.61)**	7.24 (3.54)**	5.86 (3.62)**	5.17 (2.11)**	4.89 (1.73)***
PCP density					
	Nation	West	South	Midwest	Northeast
Preexpansion					
		6.62 (3.10)	5.26 (2.66)**	5.78 (3.14)	6.94 (3.19)
ME 0[c]	5.46 (2.60)	5.30 (2.42)	5.12 (2.61)	6.03 (2.62)	11.22 (3.21)**
ME 1	6.13 (3.33)**	6.85 (2.97)**	5.70 (3.05)**	5.66 (3.29)**	6.69 (3.17)*
Postexpansion					
		6.24 (3.12)	5.19 (2.64)**	5.46 (3.17)	6.64 (3.42)
ME 0[c]	5.30 (2.62)	4.95 (2.41)	5.06 (2.53)	5.72 (2.56)	11.13 (3.48)**
ME 1	5.90 (3.34)**	6.37 (3.11)**	5.48 (3.12)	5.31 (3.47)**	6.55 (3.43)*

Note. IQR = interquartile range; PCP = primary care physician; ME 1 = Medicaid expansion; ME 0 = No Medicaid expansion.
[a]Adjustments may be made for multiple comparisons using a Bonferroni approach by comparing *P* values to the α level (0.05) divided by 6 when comparing regions.
[b]Reference column for pairwise 2-sided Dwass, Steel, Critchlow-Flinger comparison analyses by row.
[c]Reference row for median tests nationally and within each region (column).
*$P < .05$. **$P < .01$, for comparisons with reference region (West) within each row.

forward at the postexpansion period, these findings remain largely unchanged at the national level with a predicted 19.44% and 18.38% decrease in PCP density for expansion and nonexpansion CBSAs, respectively, when comparing the 10th and 90th percentiles of percentage uninsured. Overwhelmingly, these observations put to rest the second research question. Of note, at the regional level, Western and Southern CBSAs in Medicaid expansion states had the greatest downward slopes with an expected 32.27% and 20.83% decrease, respectively, in PCP density between the 10th and 90th percentiles of percentage uninsured. Similarly, Southern nonexpansion CBSAs had a 17.77% decrease in PCP density when comparing the 10th and 90th percentiles of percentage uninsured. To understand these prior figures, it is important to simultaneously consider both PCP density and percentage uninsured at the regional (and national) levels and the local geographic variation nested within these areas. For example, not only do Southern states have lower PCP density and greater percentages of the uninsured compared with other regions, but the local geographic distribution of these providers within Southern states is less equitably distributed with respect to the uninsured.

Results from Northeastern states that elected not to expand Medicaid are inconclusive due to low numbers of CBSAs in these areas (n = 5). Interestingly, there was a positive, but nonsignificant, slope for nonexpansion Western CBSAs. However, this anomaly may be due to influential outliers in areas with relatively few CBSAs (n = 33).

At the Local Level, Is There Lower PCP Density in Areas With a Greater Percentage Becoming Insured Post-Medicaid Expansion?

At the national level, CBSAs in states that expanded Medicaid had significantly lower PCP density in areas where greater proportions became insured over the preexpansion to postexpansion period (see Table 3), confirming the third research question. Between CBSAs at the 10th percentile and those at the 90th percentile of the proportion becoming insured, the logistic regression model predicts an 8.76% decrease in PCP density. At the regional level, Southern and Western states have a predicted 16.15% and 12.92% decrease, respectively, when modeling the difference between the 10th and 90th percentiles of the proportion becoming insured. Although these figures are considerable, it should be noted that the postexpansion effect sizes (20.83% and 32.27% respectively) are much larger in magnitude. Thus, while local geographical PCP distribution is less than ideal with respect to areas with many newly insured, the greater challenge is the areas in which many

Table 3. Modeled Relationship Between Physician Density and Percent Uninsured by Region and Medicaid Expansion.

	Medicaid expansion			No Medicaid expansion			
Geographic area	Log (OR)	25th-75th percentiles[b]	10th-90th percentiles	Log (OR)	25th-75th percentiles[b]	10th-90th percentiles	*P* value[a]
Preexpansion							
Nation	−1.77**	−9.28	−15.49	−1.67**	−8.14	−16.01	.75
Northeast	−1.18*	−2.89	−5.22	−5.71	−6.56	−11.64	.73
Midwest	−0.92	−2.61	−4.97	−3.40*	−12.14	−22.18	.13
South	−4.30**	−11.84	−23.90	−1.46**	−6.01	−11.93	<.01
West	−2.82**	−11.53	−21.31	3.12	14.57	25.85	.040
Postexpansion							
Nation	−3.80**	−9.42	−19.44	−2.29**	−8.88	−18.38	<.01
Northeast	−1.14	−1.95	−3.43	−3.42	−1.56	−8.44	.83
Midwest	−1.87	−3.86	−7.04	−2.85	−9.84	−16.48	.62
South	−4.12**	−13.85	−20.83	−2.40**	−9.87	−17.77	.19
West	−6.48**	−20.43	−32.27	5.71	15.78	35.75	<.01
Post-Preexpansion[c]							
Nation	−1.64**	−5.41	−8.76	−1.13	−2.00	−3.68	.53
Northeast	−2.40*	−2.34	−4.95	−3.80	−0.72	−6.22	.96
Midwest	3.01	3.31	6.66	−3.19	−3.23	−7.34	.19
South	−3.30*	−7.34	−16.15	0.63	0.92	1.81	.02
West	−2.61**	−6.20	−12.92	−1.74	−5.58	−9.56	.86

Note. Log (OR)—log (odds ratio, ie, slope coefficient) of PCP vs No PCP per unit change in Proportion Uninsured. PCP = primary care physician; CBSA = Core-Based Statistical Area.

[a]*P* value for approximate *t* tests for log (OR) (slope) differences for each geographic between Medicaid expansion and No Medicaid expansion.

[b]25th to 75th percentiles and 10th to 90th percentiles are expressed as the expected (modeled) difference in PCP density between CBSAs in the 25th to 75th and 10th to 90th percentiles, respectively, of percentage uninsured within geographic area and Medicaid expansion status.

[c]Logit model for postexpansion year PCP density using difference in percentage uninsured between postexpansion and preexpansion periods as predictor, by region and Medicaid expansion status.

*$P < .05$. **$P < .01$.

remain uninsured. As people in these areas become insured, they are likely to have more difficulty accessing care than those in areas that experienced greater increases in the number of insured as of 2016.

Discussion

Regarding the first research question, at the national and regional levels, variation in gaps between PCP density and the uninsured seem to indicate certain states have difficulties attracting, training, or retaining PCPs. Prime examples are Southern states that, at the time the ACA was enacted into law, had both the highest proportion of uninsured individuals and the lowest PCP density. Leaders in these states, and others with low PCP density, should consider ways of addressing shortages in the primary care workforce. For example, state leaders may consider methods of increasing the number of nonphysician clinicians (ie, nurse practitioners and physician assistants) who are more likely to practice in shortage areas and care for more Medicaid and uninsured patients.[26] Many states facing the most significant PCP supply challenges have fewer nonphysician clinicians per PCP and restrictive scope-of-practice laws.[17,27] Expanding the role of these providers to their full potential and allowing them more clinical autonomy, as many other states have done, may be a simple and effective way of attracting and retaining skilled clinicians to work in areas where they might not have otherwise practiced.

Regarding the second research question, in addition to national and regional variation, there also are significant geographical disparities among the uninsured at the local CBSA level. Even in areas such as Western expansion states where PCP supply is relatively high, PCPs are not equally distributed with respect to the uninsured at the local level within those areas. Federally Qualified Health Centers (FQHCs) are important sources of care in underserved communities and may be a crucial means of attracting additional physicians to work in underserved areas and correcting local PCP maldistributions.[28] Provisions of the ACA allocated US$11 billion in funding to create new FQHCs and to expand the capacity of existing FQHCs.[29] However, the success of increasing access through expanded FQHC capacity may be limited by difficulties in recruiting PCPs to work in these settings.[30] To help address these shortages, the ACA increased the National Health Service Core loan repayment amount and created the Students to Service Loan Repayment Program. This program provides significant financial assistance for

committing to primary care and working in underserved areas for a minimum of 3 years.[29] The ACA also increased the payment of Medicaid services to match Medicare rates, but this temporary provision expired at the end of 2014. However, provider financial incentives may simply help to offset low FQHC salaries in a marketplace where low supply and high demand may lead PCPs to more competitive earning and benefit arrangements[28,30] and more desirable practice locations. Given the enormity of the local PCP maldistributions with respect to the uninsured, these (and similar) efforts should be evaluated for their ability to attract and retain PCPs to practice in underserved areas and to inform future efforts for making these areas more desirable practice locations.

Regarding the third research question, considerable gains in health insurance status were observed over the preexpansion to postexpansion period. Unfortunately, as the data demonstrate, many of the areas with the greatest gains in health insurance had significantly fewer PCPs to care for the influx of patients, most notably in Southern and Western expansion states. This observation may help explain relatively moderate increases in having a personal physician despite much larger increases in the number of insured post-ACA.[31] Similarly, while others noted improvements in access for Medicaid expansion states, as compared with nonexpansion states, these gains fell short of expectations considering the much larger number of people becoming insured under Medicaid.[32] States that elected not to expand Medicaid may face considerable challenges with access to care for the newly insured and those who will become insured if Medicaid expansion is pursued in the future.

One of the most important findings is that the mismatch between supply and demand is much greater than what is observed by only considering the decrease in PCP density alone. For example, based on modeled slopes, on average, PCP density (supply) in Medicaid expansion CBSAs is estimated to decrease by 15.49% between CBSAs at the 10th percentile of uninsured (7.90%) and the 90th percentile of percentage uninsured (17.42%). If an increase in percentage uninsured above 7.90% is considered to represent additional demand for care that will be sought once insured, this equates to a $10.34\% = (92.10 - 82.58)/92.1$ increase in demand. As a result, there are fewer physicians to care for a defined population in low PCP density areas, and PCPs in these areas may have full (or nearly full) caseloads already. Consequently, there may be little capacity to accommodate the large influx of newly insured patients, and yet-to-be insured patients, in these areas. Efforts to increase access to primary care such as the ACA Medicaid expansion and the creation of the insurance marketplace may need to place additional emphasis on recruiting and retaining primary care providers to practice in states with low PCP supply and in underserved areas. Considering the magnitude and significance of the findings, this study suggests access to care is likely to be constrained by a lack of PCPs in areas where many of the uninsured and previously uninsured reside.

As policy considerations continue to explore the concept of universal access to care, these findings highlight challenges with the local availability of PCPs if financial barriers to primary care are removed for everyone in the US. Following the basic economic principle of supply and demand, geographic PCP distribution may adjust in response to the increased market demand for health care services in areas with many of the newly insured. However, low Medicaid reimbursement rates may not provide enough financial incentive to practice in these areas unless conditions are improved, or rates are either increased or supplemented through other programs.

Like any study, there are limitations. Implications for distance-to-provider access barriers are limited at the CBSA level because these areas often comprise several adjacent counties with significant travel from one county to another. Previous studies showed low PCP densities were associated with difficulties accessing care due to increased travel distances for Medicaid patients and the uninsured.[33] Therefore, findings from this study likely overestimate the accessible supply of PCPs at the CBSA level. Another issue with county-level data is that AMA Masterfile physician data are reported through either an office-location or mailing-address, which may be in different counties. McLafferty et al. demonstrated that PCPs in the Chicago areas were identified as being in the correct county 80% of the time using mailing addresses.[34] However, the present study likely mitigates much of this discrepancy by coding at the CBSA level, which accounts for social and economic integration between adjacent counties. Another well-known limitation of the AMA Masterfile is a lag period in data reporting for physician retirements and changes in professional activities, resulting in an overestimation of physician supply.[35] Rural counties that are not part of metropolitan areas were not included in this study, but should be examined in future research due to even greater PCP shortages in these areas. Although this study was not designed to examine changes in PCP practice location following the ACA, more long-term studies are needed to evaluate whether efforts to address maldistributions have proven effective. Another issue is the noninclusion of nonphysician clinicians due to a lack of data specificity. Future research should examine the geographical location of these providers for their significant and growing contribution to the primary care workforce.

This study is the first to clearly document the existence, pervasiveness, and extent of inequities in the distribution of PCPs with respect to the newly insured and uninsured before and after the ACA. Considering the magnitude of the findings at the national and regional levels, efforts to provide universal access to basic primary care should consider the lack of local PCPs among the uninsured as an important

issue. Considering the potential to improve access to primary care services and population health and to reduce the use of costly health care services, health care and policy leaders should focus on answers to improve the local availability of primary care clinicians in underserved communities.

Authors' Note

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