Assessment of Changes in Rural and Urban Primary Care Workforce in the United States From 2009 to 2017

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Abstract

IMPORTANCE Access to primary care clinicians, including primary care physicians and nonphysician clinicians (nurse practitioners and physician assistants) is necessary to improving population health. However, rural-urban trends in primary care access in the US are not well studied.

OBJECTIVE To assess the rural-urban trends in the primary care workforce from 2009 to 2017 across all counties in the US.

DESIGN, SETTING, AND PARTICIPANTS In this cross-sectional study of US counties, county rural-urban status was defined according to the national rural-urban classification scheme for counties used by the National Center for Health Statistics at the Centers for Disease Control and Prevention. Trends in the county-level distribution of primary care clinicians from 2009 to 2017 were examined. Data were analyzed from November 12, 2019, to February 10, 2020.

MAIN OUTCOMES AND MEASURES Density of primary care clinicians measured as the number of primary care physicians, nurse practitioners, and physician assistants per 3500 population in each county. The average annual percentage change (APC) of the means of the density of primary care clinicians over time was calculated, and generalized estimating equations were used to adjust for county-level sociodemographic variables obtained from the American Community Survey.

RESULTS The study included data from 3143 US counties (1167 [37%] urban and 1976 [63%] rural). The number of primary care clinicians per 3500 people increased significantly in rural counties (2009 median density: 2.04; interquartile range [IQR], 1.43-2.76; and 2017 median density: 2.29; IQR, 1.57-3.23; P < .001) and urban counties (2009 median density: 2.26; IQR, 1.52-3.23; and 2017 median density: 2.66; IQR, 1.72-4.02; P < .001). The APC of the mean density of primary care physicians in rural counties was 1.70% (95% CI, 0.84%-2.57%), nurse practitioners was 8.37% (95% CI, 7.11%-9.63%), and physician assistants was 5.14% (95% CI, 3.91%-6.37%); the APC of the mean density of primary care physicians in urban counties was 2.40% (95% CI, 1.19%-3.61%), nurse practitioners was 8.64% (95% CI, 7.72%-9.55%), and physician assistants was 6.42% (95% CI, 5.34%-7.50%). Results from the generalized estimating equations model showed that the density of primary care clinicians in urban counties increased faster than in rural counties (β = 0.04; 95% CI, 0.03 to 0.05; P < .001).

CONCLUSIONS AND RELEVANCE Although the density of primary care clinicians increased in both rural and urban counties during the 2009-2017 period, the increase was more pronounced in urban than in rural counties. Closing rural-urban gaps in access to primary care clinicians may require increasingly intensive efforts targeting rural areas.

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Key Points

Question What are the changes in the rural-urban distribution of the primary care workforce in the US from 2009 to 2017?

Findings In this cross-sectional study of 3143 US counties (1167 urban and 1976 rural) using county-level data, the density of primary care clinicians increased significantly in both rural and urban counties from 2009 to 2017. The increase in primary care clinician density was more pronounced in urban counties compared with rural counties.

Meaning In this study, the density of primary care clinicians increased overall, yet rural-urban disparities in the primary care workforce are increasing in the US.
Introduction

In recent decades, disparities in population health between rural and urban residents have widened in the US.\(^1\) One notable disparity is the higher prevalence of coronary heart disease, stroke, and all-cause mortality among rural vs urban populations.\(^2\)\(^-\)\(^5\) Primary care workforce supply is a key factor in access to primary care clinicians,\(^6\) which is necessary for improving quality of care and population health.\(^7\) However, rural-urban disparities occur in access to primary care clinicians.\(^8\) Despite efforts to address these disparities, the shortages of rural primary care clinicians have persisted.\(^2\)\(^,\)\(^9\)\(^,\)\(^10\) Lack of an adequate number of rural physicians is a major barrier preventing individuals living in rural and underserved areas from accessing coordinated and integrated care that is essential to healthy and productive lives.\(^11\)

In the US health care system, the main primary care workforce includes primary care physicians such as internists, family physicians, and general practitioners, as well as nonphysician clinicians such as nurse practitioners and physician assistants.\(^12\) Historically, people living in rural areas of the US have experienced limited access to primary care clinicians compared with those living in urban areas.\(^13\)\(^,\)\(^14\) More than one-third of rural US residents live in federally designated health professional shortage areas\(^15\)\(^,\)\(^16\) and approximately 82% of rural counties are classified as medically underserved regions.\(^17\) The shortage of primary care physicians in rural areas is associated with longer travel distance to accessing services, which may mitigate the prevention and management of the prevalent chronic diseases.\(^18\)\(^,\)\(^19\) While this shortage has been described and incentives to attract more physicians to rural areas have been adopted, few analyses have characterized the potential changes in urban-rural physician distributions over the past 10 years.\(^20\)

This study examines and compares the primary care workforce and its growth between urban and rural counties or county-equivalents from 2009 to 2017 in the US. Rural clinician shortages may be associated with the widening gap in population health outcomes between rural and urban residents.

Methods

Data on all registered primary care clinicians who had an active National Provider Identifier record in the National Plan and Provider Enumeration System from 2009 to 2017 were obtained from the Centers for Medicare & Medicaid Services.\(^21\) Data were analyzed from November 12, 2019, to February 10, 2020. We used the National Uniform Claim Committee Health Care Provider Taxonomy code in the National Plan and Provider Enumeration System to identify the main primary care workforce. The workforce included general practitioners, physicians who practiced family medicine and those who specialized in internal medicine only (without other subspecialty), nurse practitioners, and physician assistants.\(^12\) All the data on health care clinicians were deidentified and linked with the American Community Survey database collected from the US Census Bureau.\(^22\) Per Common Rule, this study was exempt from institutional review board review because all data were deidentified and publicly available and, therefore, did not qualify as human subjects research. We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline for cross-sectional studies to report our findings.\(^23\)

Primary outcome measures included the density of primary care physicians, nurse practitioners, and physician assistants in each county derived from the number of each type of primary care clinician per 3500 residents in each county. This is the definition used by the Health Resources and Services Administration to identify primary care health professional shortage areas.\(^24\) According to the Urban-Rural Classification Scheme for Counties defined by the Centers for Disease Control and Prevention National Center for Health Statistics in 2013,\(^15\) we classified counties as rural or urban, assuming that their rural or urban status did not change during the study period.\(^15\) Counties with an urban-rural score of 1 to 4 were classified as metropolitan (urban [≥250,000 inhabitants]) and those with a score of 5 to 6 were classified as nonmetropolitan (rural [<250,000 inhabitants]).\(^15\)
We tested for linear trends in the density of primary care clinicians (primary care physicians, nurse practitioners, and physician assistants) using the Jonckheere-Terpstra test for rural and urban counties. A nonparametric method (ie, the Jonckheere-Terpstra test) was used because the outcome measure (density of primary care clinicians) was not normally distributed over the study period. In addition, we presented the descriptive statistics of the mean densities of the 3 types of clinicians from 2009 to 2017 across rural and urban counties and calculated the average annual percentage change (APC) in the means.

To estimate the changes in annual rates of the densities of each type of primary care clinicians by rural and urban counties, we fitted generalized estimating equations adjusting for county-level sociodemographic variables. From the generalized estimating equations analysis, we compared the changes in the densities of primary care clinicians between rural and urban counties over time using the Wald $\chi^2$ test. County-level sociodemographic variables included the proportion of women, White individuals, Black individuals, Asian individuals, population aged 65 years and over, born outside the US, and population with a 4-year college degree residing in the county. The yearly county-level median household income was categorized according to the published household income quintiles from the Census Bureau Historical Income Tables and was included in the generalized estimating equations analysis. A 2-tailed $P < .05$ was regarded as statistically significant. Data management and analysis were performed with R, version 3.6.2 (R Foundation for Statistical Computing), and SAS, version 9.4 (SAS Institute Inc).

**Results**

The study included yearly data from 3143 US counties (1167 urban and 1976 rural counties). The trend analysis comparing the distribution of primary care clinicians per 3500 people in 2009 and 2017 reported in Figure 1 depicts a geographic distribution in the density of all 3 types of primary care clinicians across the US. The overall density of primary care clinicians has been increasing from 2009 to 2017 (ie, the 2017 maps in the right panel have higher numbers of darker shade counties than the 2009 maps in the left panel).

*Figure 2* shows the trend in the average densities for primary care clinicians in the period from 2009 to 2017. The density of primary care physicians in urban counties increased by 20.8%, from 2.69 in 2009 to 3.25 in 2017. In rural counties, the density increased by 14.3%, from 2.22 in 2009 to 2.54 in 2017. Likewise, the density of nurse practitioners in urban counties increased by 93.6% from 1.65 to 3.20, while in rural counties, it increased by 90.1% from 1.31 to 2.49. The density of physician assistants in urban counties increased by 64.9% from 0.73 to 1.20, and it increased by 49.3% from 0.65 to 0.97 in rural counties.

*Table 1* reports the trend analysis and results from the Jonckheere-Terpstra test. The density of primary care physicians increased substantially from 2009 to 2017 in rural counties (2.04 [interquartile range (IQR), 1.43-2.76] for 2009 vs 2.29 [IQR, 1.57-3.23] for 2017; $P < .001$), for nurse practitioners (1.16 [IQR, 0.61-1.80] for 2009 vs 2.24 [IQR, 1.39-3.30] for 2017; $P < .001$), and for physician assistants (0.43 [IQR, 0.00-0.96] for 2009 vs 0.69 [IQR, 0.16-1.37] for 2017; $P < .001$). Similar increasing trends were observed in urban counties for primary care physicians (2.26 [IQR, 1.52-3.23] for 2009 vs 2.66 [IQR, 1.72-4.02] for 2017; $P < .001$), nurse practitioners (1.28 [IQR, 0.72-2.11] for 2009 vs 2.52 [IQR, 1.61-3.99] for 2017; $P < .001$), and physician assistants (0.56 [IQR, 0.22-0.95] for 2009 vs 0.90 [IQR, 0.42-1.55] for 2017; $P < .001$).

*Table 2* presents the mean densities of primary care clinicians and the APCs from 2009 to 2017. In urban counties, the APC in the mean density of primary care physicians was 2.40% (95% CI, 1.19%-3.61%), for nurse practitioners was 8.64% (95% CI, 7.72%-9.55%), and for physician assistants was 6.42% (95% CI, 5.34%-7.50%). In rural counties, the APC for the density of primary care physicians was 1.70% (95% CI, 0.84%-2.57%), for nurse practitioners was 8.37% (95% CI, 7.11%-9.63%), and for physician assistants was 5.14% (95% CI, 3.91%-6.37%). The APC in the mean density of primary care clinicians is more prominent in urban than in rural counties.
Results from the generalized estimating equations analysis adjusting for county-level sociodemographic characteristics are shown in Table 3. The adjusted estimates show that the densities of primary care physicians ($\beta = 0.04; 95\% \text{CI}, 0.03-0.05; P < .001$), nurse practitioners ($\beta = 0.16; 95\% \text{CI}, 0.15-0.16; P < .001$), and physician assistants ($\beta = 0.04; 95\% \text{CI}, 0.04-0.05; P < .001$) have been increasing during the study period, although at faster rates in urban counties. The difference in annual changes of the primary care physician density between urban and rural counties was significant ($\beta = 0.03; 95\% \text{CI}, 0.02 to 0.04; P < .001$). Similarly, the density of nurse practitioners has also been increasing ($\beta = 0.16; 95\% \text{CI}, 0.15-0.16; P < .001$), although the increase has been slower compared to urban counties ($\beta = 0.03; 95\% \text{CI}, 0.02 to 0.04; P < .001$).

Figure 1. Distribution of Primary Care Physicians and Nonphysician Clinicians Across US Counties, 2009 vs 2017

A. Density of primary care physicians by US county in 2009
B. Density of primary care physicians by US county in 2017
C. Density of nurse practitioners by US county in 2009
D. Density of nurse practitioners by US county in 2017
E. Density of physician assistants by US county in 2009
F. Density of physician assistants by US county in 2017

The map contours conform to the default setting of the mapping platform ArcGIS (esri).
practitioners was also increasing faster in urban counties than in rural counties ($\beta = 0.05; 95\% CI, 0.03-0.06; P < .001$). The same discrepancy between urban and rural areas was observed in changes of the physician assistant density ($\beta = 0.02; 95\% CI, 0.01-0.02; P < .001$). The density of primary care physicians was positively associated with the median household income categories, the proportion of Asian residents ($\beta = 7.04; 95\% CI, 2.37-11.71; P = .003$), and residents with a college degree ($\beta = 1.37; 95\% CI, 0.04-2.69; P = .04$). But there was no significant association between the median household income quintiles and the density of nurse practitioners. Counties with a higher proportion

Figure 2. Trends in the Density of Primary Care Clinicians in US Rural vs Urban Counties From 2009 to 2017

A  Trend in primary care physicians per 3500 population

B  Trend in nurse practitioners per 3500 population

C  Trend in physician assistants per 3500 population
of Black (β = 1.01; 95% CI, 0.33-1.70; P = .004) and Asian residents (β = 4.45; 95% CI, 1.46-7.44; P = .004) were more likely to have a higher density of nurse practitioners. In contrast, an inverse association was observed between the proportion of Black individuals (β = -1.24; 95% CI, -1.63 to -0.85; P < .001) and the density of physician assistants.

Discussion

This cross-sectional study examined trends in the density of primary care physicians, nurse practitioners, and physician assistants across rural and urban counties in the US from 2009 to 2017. Overall, there were increasing trends in the density of each type of primary care clinicians across all counties. While there is an overall increase, our study revealed significant geographic disparities in the density of primary care clinicians (primary care physicians, nurse practitioners, and physician assistants) between rural and urban areas. Rural-urban disparities widened during the study period. Moreover, the rural-urban differences continued to be substantial and significant after adjusting for county-level sociodemographic variables.

Prevalence of chronic disease is 1 of the major contributors to rising healthcare costs in the US. For rural residents who are at a higher risk of developing coronary heart disease and stroke, greater access to primary care clinicians would improve the coordination of care and health outcomes.2,3,26 Furthermore, the shortage of primary care clinicians may be related to worse health outcomes in US rural counties.7,9,27 Basu et al27 found an association between primary care physicians supply and

Table 1. Medians of the Density of the Different Primary Care Clinicians Stratified by County Rural and Urban Status, 2009-2017

| Variable                  | Clinicians per 3500 individuals, median (interquartile range) No. | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | P for trend |
|---------------------------|-------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|-------------|
| Primary care physicians   |                                                                 |      |      |      |      |      |      |      |      |      |             |
| Urban                     | 2.26 (1.52-3.23)                                                  | 2.31 (1.53-3.32) | 2.39 (1.61-3.52) | 2.46 (1.61-3.60) | 2.47 (1.64-3.73) | 2.55 (1.65-3.81) | 2.57 (1.68-3.88) | 2.61 (1.70-3.98) | 2.66 (1.72-4.02) | <.001        |
| Rural                     | 2.04 (1.42-2.76)                                                  | 2.06 (1.42-2.80) | 2.13 (1.47-2.89) | 2.15 (1.50-2.98) | 2.18 (1.52-3.03) | 2.21 (1.53-3.08) | 2.25 (1.56-3.14) | 2.27 (1.56-3.21) | 2.29 (1.57-3.23) | <.001        |
| Nurse practitioners       |                                                                 |      |      |      |      |      |      |      |      |      |             |
| Urban                     | 1.28 (0.72-2.11)                                                  | 1.37 (0.82-2.27) | 1.52 (0.90-2.49) | 1.64 (0.98-2.67) | 1.82 (1.10-2.88) | 1.98 (1.21-3.11) | 2.14 (1.36-3.37) | 2.35 (1.50-3.69) | 2.52 (1.61-3.99) | <.001        |
| Rural                     | 1.16 (0.61-1.80)                                                  | 1.21 (0.65-1.91) | 1.34 (0.72-2.08) | 1.41 (0.80-2.23) | 1.55 (0.91-2.41) | 1.68 (1.01-2.61) | 1.88 (1.14-2.83) | 2.05 (1.25-3.09) | 2.24 (1.39-3.30) | <.001        |
| Physician assistants      |                                                                 |      |      |      |      |      |      |      |      |      |             |
| Urban                     | 0.56 (0.22-0.95)                                                  | 0.60 (0.24-1.03) | 0.65 (0.27-1.10) | 0.70 (0.29-1.17) | 0.74 (0.32-1.23) | 0.78 (0.35-1.31) | 0.82 (0.37-1.39) | 0.86 (0.41-1.49) | 0.90 (0.42-1.55) | <.001        |
| Rural                     | 0.43 (0.00-0.96)                                                  | 0.46 (0.00-1.00) | 0.49 (0.00-1.06) | 0.52 (0.00-1.09) | 0.56 (0.10-1.13) | 0.61 (0.13-1.21) | 0.64 (0.14-1.26) | 0.66 (0.15-1.34) | 0.69 (0.16-1.37) | <.001        |

* Median of primary care clinicians over time.  
b P value for linear trend over the years determined by the Jonckheere-Terpstra test.

Table 2. Annual Mean Changes in the Density of the Different Primary Care Clinicians in US Rural and Urban Counties, 2009-2017

| Variable                  | Annual mean change of the density of primary care clinicians per 3500 individuals, % | 2009-2010 | 2010-2011 | 2011-2012 | 2012-2013 | 2013-2014 | 2014-2015 | 2015-2016 | 2016-2017 | Mean (95% CI) |
|---------------------------|------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------------|
| Primary care physician    |                                                                                     | 2.97      | 5.42      | 2.40      | 2.68      | 2.28      | 1.59      | 1.25      | 0.62      | 2.40 (1.19-3.61) |
| Rural                     |                                                                                     | 0.45      | 4.04      | 1.72      | 1.27      | 1.67      | 1.65      | 1.62      | 1.20      | 1.70 (0.84-2.57) |
| Nurse practitioner        |                                                                                     | 7.88      | 10.67     | 8.12      | 8.92      | 8.19      | 9.16      | 9.12      | 7.02      | 8.64 (7.72-9.55) |
| Rural                     |                                                                                     | 5.34      | 10.14     | 7.24      | 9.20      | 8.43      | 8.81      | 9.52      | 8.26      | 8.37 (7.11-9.63) |
| Physician assistant       |                                                                                     | 6.85      | 8.97      | 7.06      | 5.49      | 6.25      | 4.90      | 6.54      | 5.26      | 6.42 (5.34-7.50) |
| Rural                     |                                                                                     | 4.62      | 7.35      | 5.48      | 6.49      | 6.10      | 3.45      | 4.44      | 3.19      | 5.14 (3.91-6.37) |

* Calculated by averaging the annual mean changes of the density of primary care clinicians over time.
mortality in the US. These outcomes have been analyzed with socioeconomic status, health care coverage, and travel distance to health care facilities, in addition to access to primary care clinicians.13,27–32

To our knowledge, this study is the first to analyze trends in density of primary care clinicians in rural and urban counties adjusting for sociodemographic factors that may be associated with the characteristics of each county. We found a positive linear correlation between the number of primary care clinicians per 3500 people and median household income quintile categories, and the proportion of some race/ethnicity categories.

The findings have implications for policy. For example, programs and policies to improve access to and quality of care in rural areas such as geographically based adjustments in Medicare payment,33 or programs that encourage clinical practice in rural areas may be necessary to reduce the gaps. State actions related to the expansion of Medicaid have led to hospital closures in rural areas,34 which might act as a disincentive for physicians to practice in rural areas. The extensive availability of Medicaid coverage provides the needed linkages and payment infrastructure for primary care clinicians to serve patients in need of care but with limited resources.35 In addition, studies have shown that primary care provided by nonphysician clinicians such as nurse practitioners and physician assistants are increasingly accepted by patients.36 However, variation in practice regulations across states and communities exists, and some regions may lag behind in the national trend of growing nonphysician clinicians.37 Furthermore, the expansion of telemedicine has the potential to improve access, use, and outcomes among rural residents, partially mitigating health disparities due to rural clinician shortages.38,39

Limitations
This study has 3 key limitations. First, because it is difficult to dissect the complex employment-related decision-making process of individual clinicians, including dual careers, childcare, cultural background and geographic attachment, our analysis is not immune to omitted variable biases. Second, many factors may affect the supply of primary care clinicians. The number of explanatory variables for a county in this study was limited by the availability of existing data sources and, thus,

Table 3. Association Between Density of Primary Care Clinicians and Sociodemographic Characteristics in US Rural and Urban Counties, 2009–2017*

| Parameters                          | Primary care physicians | Nurse practitioners | Physician assistants |
|-------------------------------------|-------------------------|---------------------|---------------------|
|                                     | β (95% CI)              | P value             | β (95% CI)          | P value             | β (95% CI)          | P value             |
| Intercept                           | 1.41 (0.63 to 2.18)     | <.001               | 1.25 (0.26 to 2.24) | .01                 | 1.15 (0.53 to 1.78) | <.001               |
| Ruralb                             | NA                      | NA                  | NA                  | NA                  | NA                  | NA                  |
| Urban                              | 0.39 (0.20 to 0.57)     | <.001               | 0.16 (0.04 to 0.28) | .01                 | 0.03 (-0.05 to 0.10) | .51                 |
| Year                               | 0.04 (0.03 to 0.05)     | <.001               | 0.16 (0.15 to 0.16) | <.001               | 0.04 (0.04 to 0.05) | <.001               |
| Year × urban                        | 0.03 (0.02 to 0.04)     | <.001               | 0.05 (0.03 to 0.06) | <.001               | 0.02 (0.01 to 0.02) | <.001               |
| Median household income, quintile   |                         |                     |                     |                     |                     |                     |
| Lowest (<1st)                       | NA                      | NA                  | NA                  | NA                  | NA                  | NA                  |
| 1st to 2nd, inclusive               | 0.15 (0.05 to 0.26)     | .004                | -0.18 (-0.54 to 0.17)| .3                  | 0.10 (0.02 to 0.18) | .02                 |
| 2nd to 3rd, inclusive               | 0.14 (0.03 to 0.25)     | .01                 | -0.27 (-0.62 to 0.08)| .13                 | 0.10 (0.01 to 0.19) | .03                 |
| ≥3rd to 4th, inclusive              | 0.14 (0.01 to 0.27)     | .03                 | -0.24 (-0.51 to 0.14)| .22                 | 0.09 (-0.01 to 0.18)| .07                 |
| Highest (>4th)                      | 0.04 (-0.26 to 0.35)    | .78                 | -0.29 (-0.76 to 0.19)| .24                 | -0.01 (-0.22 to 0.20)| .91                 |
| Woman, %                            | 0.56 (-0.72 to 1.84)    | .39                 | 0.90 (-0.58 to 2.38)| .23                 | 0.06 (-0.95 to 1.08)| .90                 |
| Age ≥65 y, %                        | -0.12 (-1.35 to 1.10)   | .84                 | -2.84 (-4.40 to -1.28)| <.001               | -0.75 (-1.52 to 0.01)| .05                 |
| White, %                            | 0.30 (-0.33 to 0.93)    | .35                 | 0.09 (-0.46 to 0.64)| .75                 | -0.54 (-0.90 to -0.17)| .004                |
| Black, %                            | 0.64 (-0.14 to 1.42)    | .11                 | 1.01 (0.33 to 1.70) | .004                | -1.24 (-1.63 to -0.85)| <.001               |
| Asian, %                            | 7.04 (2.37 to 11.71)    | .003                | 4.45 (1.46 to 7.44) | .004                | 2.85 (1.00 to 4.70) | .003                |
| Born outside the US, %              | 1.69 (-3.15 to 6.53)    | .49                 | 3.14 (-0.93 to 11.21)| .45                 | 0.37 (-3.17 to 3.90)| .84                 |
| With college education, %           | 1.37 (0.04 to 2.69)     | .04                 | 1.10 (-0.27 to 2.47)| .12                 | 0.54 (-0.37 to 1.45)| .24                 |

Abbreviation: NA, not applicable.

* Estimates from the generalized estimating equations.

b National Center for Health Statistics 2013 Urban-Rural Classification Scheme for Counties.35

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our conclusions may be difficult to generalize. For example, international medical graduates contribute to rural health in some states by helping reduce rural health care workforce gaps.\textsuperscript{40,41} The National Plan and Provider Enumeration System does not contain individual-level information such as age, gender, race/ethnicity and place of birth, thus, we were unable to assess the association between clinicians born outside the US and the size and change over time of the primary care workforce in rural and urban counties, particularly with regard to health professional shortage areas. Third, we did not use a causal approach to assessing the factors contributing to changes over time of the primary care workforce in our generalized estimating equations analysis given data limitations.

Conclusions
While the density of primary care clinicians increased in both rural and urban counties, the pace of growth of primary care clinicians in urban counties has been faster than that in rural counties from 2009 to 2017. Reducing urban-rural disparities in access to primary care clinicians requires policy and intervention efforts that can meaningfully increase the supply of primary care clinicians in rural areas.

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