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FINDINGS BRIEF

RURAL & MINORITY Health Research Center

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Identification of High-Need Rural Counties to Assist in Resource Location Planning

- This report demonstrates how a relatively simple technique can be used to measure the level of potential health care need across communities.
- It illustrates how sorting counties by need can identify areas in greatest need of additional safety net providers and resources.
- There was a total of 174 (8.5%) out of 1,975 rural counties that did not have access to a Critical Access Hospital, Federally Qualified Health Center, or Rural Health Clinic within their county boundaries.
- Out of those 174 rural counties, 36 were geographically isolated from core safety-net providers and faced significant health challenges. The vast majority of these 36 counties were in the South.

BACKGROUND

Analyses of location selection by healthcare providers in the U.S. are often retrospective, mapping the results of previous decisions. Examples include studies of the location choices of new physicians [1], freestanding emergency departments [2], and diabetes self-management educations programs [3]. These studies have generally documented that providers preferentially locate in urban, well-resourced areas, rather than areas with high rates of illness and/or low-income populations. Prospective analyses, which attempt to provide recommendations for future facility location based on need, are more common in situations where resources are administered through a central authority at the state or national level [4]. In the U.S., disaster management and emergency services use geospatial analyses for planning purposes, but generally employ computationally complex methodologies that may be difficult to implement [5, 6].

The emergence of population health as a key element of the "Triple Aim" for healthcare [7] has increased interest in the identification of high need areas for planning purposes. Resources such as the Robert Wood Johnson Foundation *County Health Rankings* have made local-level data on

Technical Notes

This analysis used Health Center Service Delivery Sites (HCSD) available from the Health Resources & Services Administration, supplemented by data from the US Census Bureau, *County Health Rankings*, and CDC WONDER mortality data. All analyses were performed at the county level.

Geographic definitions

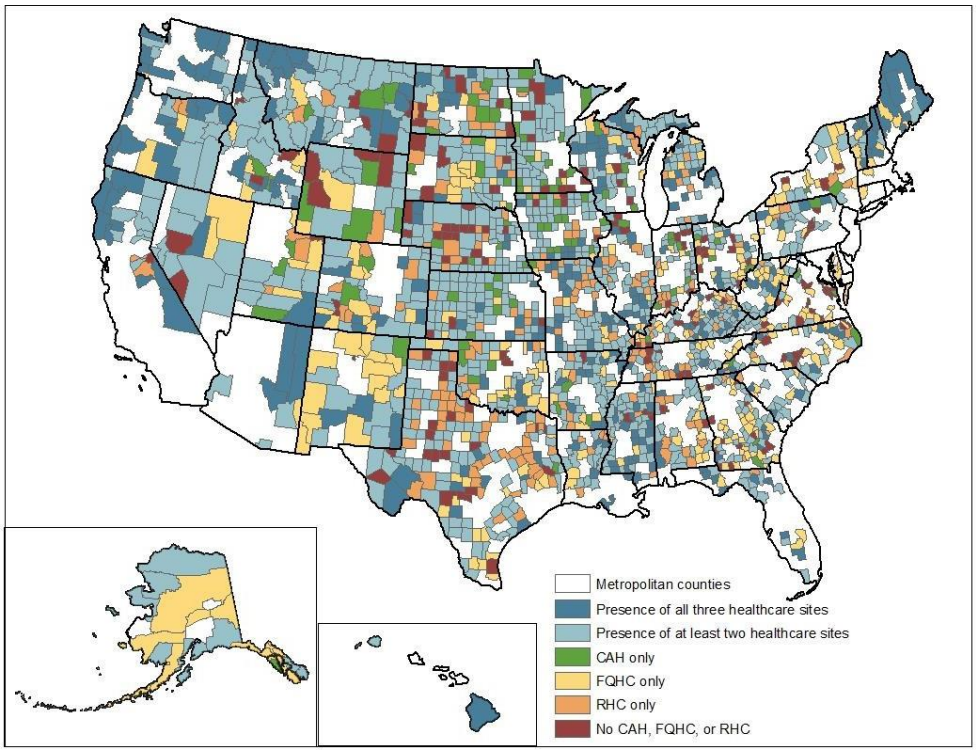
Our geographic analysis is based on the county of residence. Counties were characterized based on level of rurality using Urban Influence Codes (UIC) developed by the U.S. Department of Agriculture Economic Research Service: Urban (UICs 1, 2) and Rural (UICs 3 - 12).

disease prevalence, health behaviors, and health care resources accessible in a readily understandable format to state and local planners. The purpose of the present report is to demonstrate a technique for identifying rural counties that are simultaneously at risk for poor health outcomes and have few or no Federally-supported safety net providers available to meet local needs. The methodology relies solely on publicly available data that can easily be downloaded (at no cost) and sorted for comparative analyses.

Rural Counties and Core Safety Net Providers

To identify high-need, low-resource locations, we began by identifying counties that lacked safety-net providers. For the purposes of this analysis, we identified Medicare-certified Rural Health Clinics (RHCs), Federally Qualified Health Centers (FQHCs) and Critical Access Hospitals (CAHs) as core rural safety net providers as each of these provider types get special consideration under Medicare or Medicaid reimbursement. Nationally, there are >4,000 RHCs and >1,300 CAHs and up to 50 percent of the FQHC services sites are located or serve rural communities. While we realize this configuration of the "core" rural safety net leaves out some important providers, we believe focusing on these three providers serves as an effective proxy for the broader safety net in rural communities. The distribution of core safety net providers across rural counties is not uniform (see Figure 1). In 2017, there were 627 rural counties (31.7% of all rural counties) that had access to only one of these core safety net providers. Additionally, there were another 174 rural counties (8.8%) that did not have access to a CAH, FQHC, or RHC within their county boundaries.

Figure 1. Distribution of Core Safety Net Providers in Rural Counties (n=1,975)



Sources: United States Department of Agriculture, Economic Research Service, 2013 Urban Influence Codes; Health Resources & Services Administration (HRSA) Data Warehouse; U.S. Census Bureau, 2010 TIGER/Line shapefiles.
Notes: Healthcare sites include Critical Access Hospitals (CAH), Federally Qualified Health Centers (FQHC), and Rural Health Clinics (RHC).

The absence of core safety net facilities does not necessarily mean that a population is underserved. Areas with relatively high-income residents may attract enough health care providers to serve the population without requiring safety net resources. Similarly, counties without a core safety net provider within its administrative boundaries may have ready access to such providers in neighboring counties. To demonstrate how facility availability and health status indicators might be combined to identify under-served areas, we further explored the 174 rural counties without a CAH, FQHC, or RHC.

The location of counties not served by a core safety net provider are dispersed throughout the U.S. Although the population health indicators of these 174 rural counties as a group are similar to the national average (see Table 1), deeper examination demonstrates a wide range of health outcomes, health behaviors, health care accessibility, socioeconomic factors, and environmental factors (see Minimum and Maximum columns in Table 1). For example, 17.6% of adults reported smoking in the studied counties, virtually identical to the national average of 17.9%. Within the 174 counties, however, the prevalence of adult smoking ranged from 8.0% in a county in Utah to 40.1% in a county in South Dakota. Similarly, the proportion of adults reporting fair to poor health ranged from 9.5% in a county in South Dakota to 34.1% in a county in Georgia.

Table 1. Characteristics of Rural Counties Not Served by a CAH, FQHC, or RHC (n=174) with National Comparison

Characteristic	Mean (SD)	Median	Minimum	Maximum	U.S. Mean (SD)
Travel Time to nearest Core Safety Net Provider (in minutes)	42.3 (21.2)	37.2	5.5	158.1	-
Health Outcomes					
Adults reporting poor to fair health (%)	16.4 (4.7)	15.3	9.5	34.1	17.0 (4.8)
Average number of poor physical health days per adult	3.8 (0.8)	3.7	2.6	6.5	3.9 (0.7)
Average number of Poor mental health days per adult	3.6 (0.6)	3.6	2.5	5.6	3.8 (0.6)
All-cause mortality rate per 100,000	778.4 (178.7)	771.9	318.3	1,370.1	823.5 (137.9)
Socioeconomic Factors					
Poverty (%)	15.1 (6.6)	13.4	4.0	47.1	16.3 (6.5)
Unemployment rate	5.0 (1.8)	4.7	1.9	11.6	5.5 (2.0)
Children in single parent households (%)	30.7 (13.3)	30.5	0.0	100.0	32.6 (10.3)
Adults ≥ age 25 with some college or more (%)	56.8 (13.4)	55.9	5.3	89.5	56.8 (35.9)

Health Behaviors					
Adult smoking (%)	17.6 (3.8)	16.8	8.0	40.1	17.9 (3.6)
Adult obesity (%)	30.5 (4.0)	30.9	12.7	42.9	31.0 (4.5)
Physical inactivity (%)	26.0 (4.5)	25.6	10.8	38.1	26.0 (5.2)
Food environment index	6.7 (1.6)	7.2	1.2	8.9	7.0 (1.3)
Excessive drinking (%)	16.8 (3.0)	16.7	9.4	25.4	16.6 (3.1)
Access to Care					
Primary care physicians per 100,000 population	44.8 (44.4)	43.0	0	274.7	52.8 (35.9)
Dentists per 100,000 population	33.6 (32.2)	29.0	0	153.1	42.2 (29.3)
Uninsured (%)	14.9 (5.4)	14.2	4.0	33.5	14.4 (5.2)
Physical Environment					
Severe housing problems (%)	13.5 (5.0)	13.3	3.1	45.7	14.5 (4.8)
Drive alone to work (%)	77.3 (10.4)	80.0	31.2	94.6	79.2 (7.5)
Long commute to work (%)	28.6 (11.1)	27.9	2.2	61.3	30.4 (12.1)

Note: U.S. mean was calculated by taking the mean of all counties in the United States (n=3,136 counties).

Building an Index of Need: Selecting and Ranking Health Measures

Composite health measures, such as the ratings in the *County Health Rankings* data set [8] and the state-level metrics developed by the United Health Foundation [9], group clusters of outcomes into a single measure of population health. There are some challenges, however, associated with using similar methodologies to identify *rural* counties with the greatest health needs. Specifically, small rural counties, due to low populations, frequently are missing data for multiple health measures in these data sets. Previous composite health indices have used several methods to reduce the amount of missing data, including aggregating multiple years of data together, case deletion, and single imputation methods. Although the intent of these methods was to facilitate the inclusion of rural counties with small populations, there are some limitations that can impact the quality of the composite health index for small populations. [10]

To avoid these limitations, variable selection was limited to measures available for all rural counties. When necessary, proxy measures were identified and used instead of population health indicators with missing data, or if no proxy measure was identified, that variable was excluded (e.g., low birthweight [number of missing = 93 rural counties], access to exercise opportunities [missing=70], alcohol-impaired driving deaths [missing=142], sexually transmitted infections [missing=39], and teen births [missing=102]). Variables were primarily drawn from *County Health Rankings* and fall under five domains of population health: health outcomes, health behavior, access to care, socioeconomic factors, and physical environment.

Items in the *County Health Rankings* data set are derived from different sources and have different units of measurement. For example, some values, such as proportion of adults who smoke, are expressed as percentages, while others are calculated differently, such as physician/ population ratios. To make relative rankings easier to use across different measures, we rescaled each item by ranking the selected rural counties without any core safety net providers from lowest to highest and grouping values into 10 equal intervals. Each county was assigned a value from 1 to 10, with "1" representing the best and "10" the poorest outcomes. Thus, a value of "10" indicated that a county fell into the "worst" 10 percent of the selected rural counties without any core safety net providers for that particular measure, while a value of "1" indicated that it was in the "best" 10%.

After being rescored from 1 through 10, individual measures were averaged across five domains (i.e. health outcomes, health behaviors, access to care, socioeconomic factors, and physical environment) with each variable receiving the same weight within its respective domain. This resulted in one overall score for each domain.

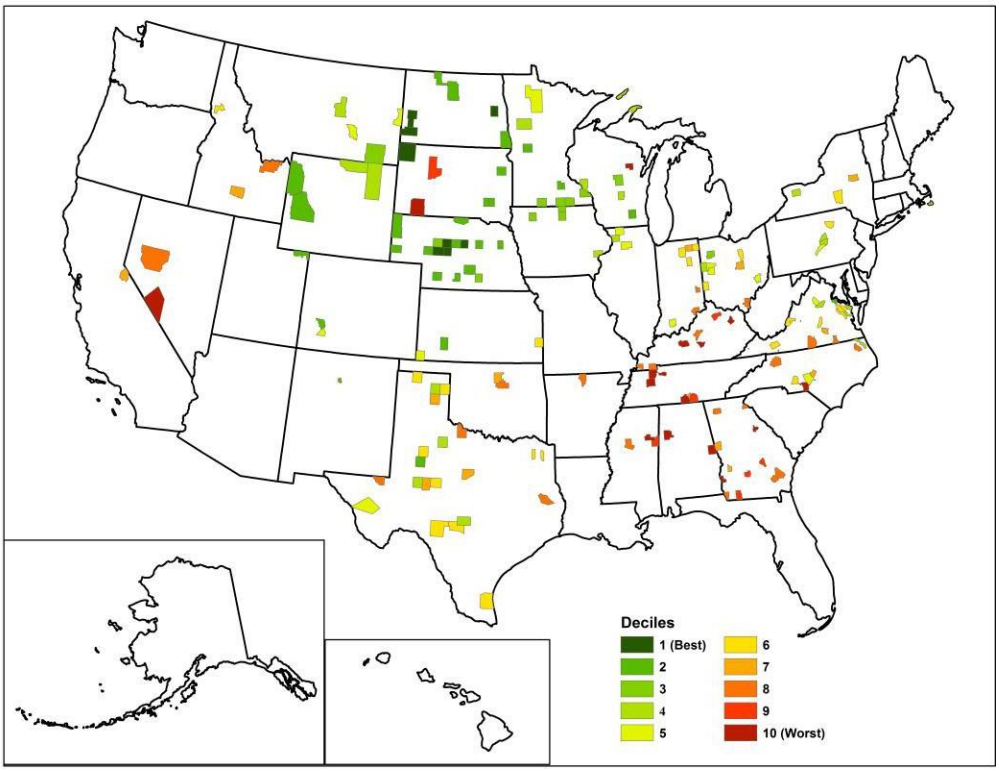
One metric not available in the *County Health Rankings* set, geographic isolation, was calculated using Geographic Information Systems (GIS) software. We accounted for geographic isolation by calculating the drive times from the population-weighted centroid of each rural county without a core safety net provider to the nearest CAH, FQHC, or RHC in a neighboring county using Network Analyst in ArcGIS. [11]

The process described above resulted in five health-related scores plus distance to the closest facility. Results of the scoring applied to the 174 counties that do not have a CAH, FQHC, and RHC are shown in the following pages.

Distribution of Average Decile Scores and Geographic Isolation across the United States Health Outcomes

There were 16 rural counties that had an average score of 10 for health outcomes, indicating that the population health of these counties was consistently ranked in the worst 10 percent for quality of life (self-reported poor or fair health and number of poor physical and mental health days) and all-cause mortality. These counties were predominantly located in the Southeast part of the United States (see Figure 2). Conversely, counties with the best health metrics, scores of 1 to 3, were concentrated in the Midwest.

Figure 2. Distribution of Average Decile Scores for Health Outcomes among Rural Counties without a Core Safety Net Provider (n=174)

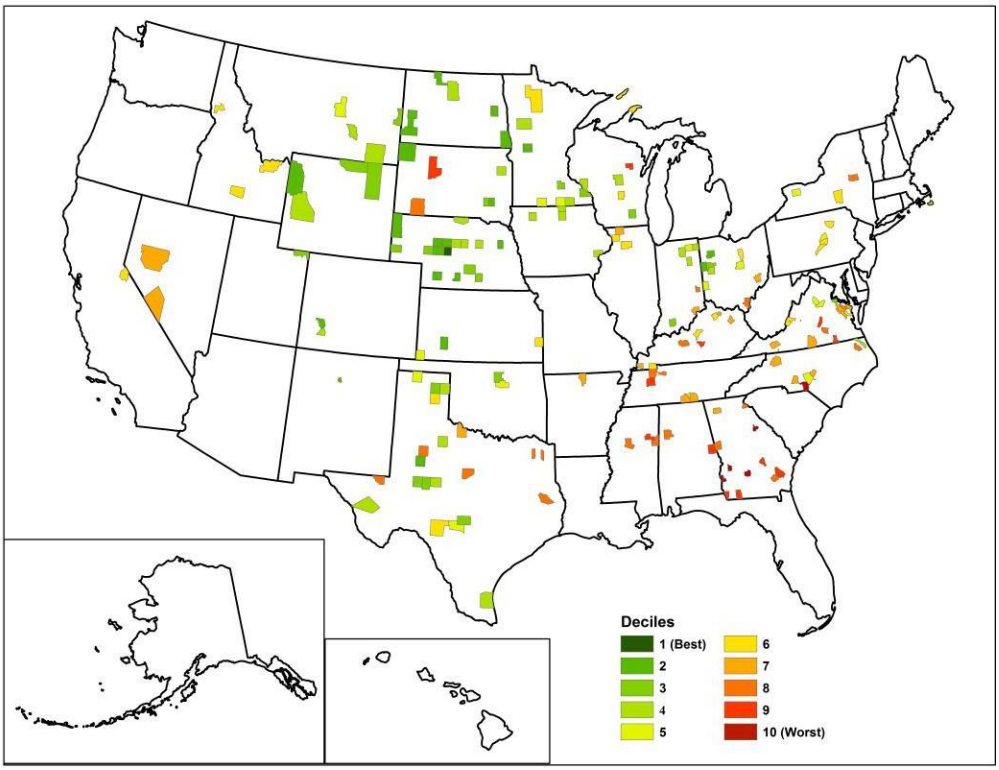


Sources: United States Department of Agriculture, Economic Research Service, 2013 Urban Influence Codes; Health Resources & Services Administration (HRSA) Data Warehouse; U.S. Census Bureau, 2010 TIGER/Line shapefiles; 2017 *County Health Rankings*.
Notes: Health outcomes included poor to fair health, poor physical health days, poor mental health days, and all-cause mortality.

Socioeconomic Characteristics

Among the 174 counties studied, 5 rural counties fell into the poorest decile for socioeconomic factors; these counties were located primarily in the Southeast (see Figure 3). Paralleling the previous indicator, rural counties in the Midwest had the best scores for socioeconomic characteristics.

Figure 3. Distribution of Average Decile Scores for Socioeconomic Characteristics among Rural Counties without a Core Safety Net Provider (n=174)

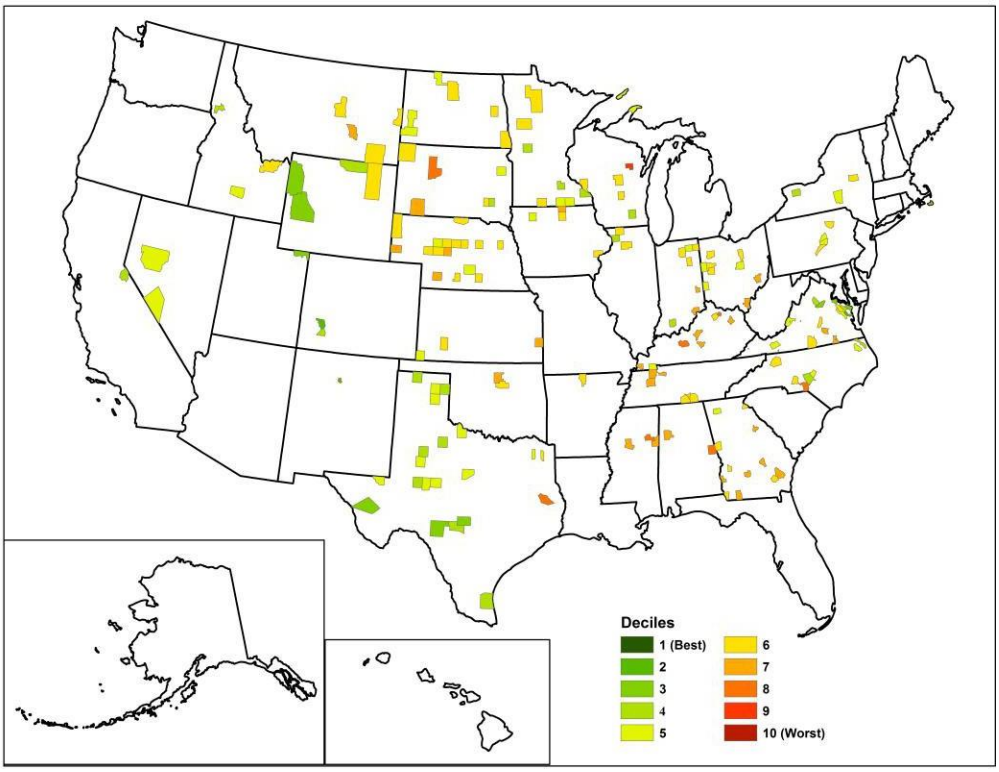


Sources: United States Department of Agriculture, Economic Research Service, 2013 Urban Influence Codes; Health Resources & Services Administration (HRSA) Data Warehouse; U.S. Census Bureau, 2010 TIGER/Line shapefiles; 2017 *County Health Rankings*.
Notes: Socioeconomic factors included poverty, unemployment, children in single parent households, and some college.

Health Behaviors

In general, the rural counties that do not have a core safety net provider fall in the mid-range for health behavior scores, with 98 counties having scores of 5 or 6 (see Figure 4). There were 8 rural counties with an average decile score of 8 or more; these were scattered throughout the United States.

Figure 4. Distribution of Average Decile Scores for Health Behaviors among Rural Counties without a Core Safety Net Provider (n=174)

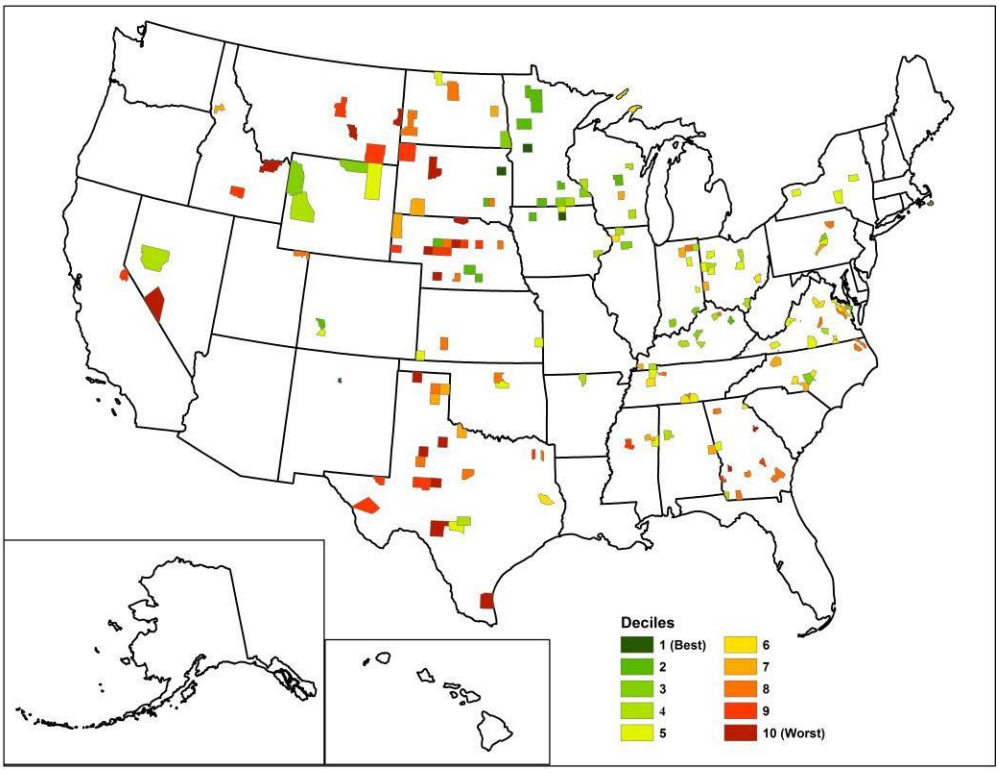


Sources: United States Department of Agriculture, Economic Research Service, 2013 Urban Influence Codes; Health Resources & Services Administration (HRSA) Data Warehouse; U.S. Census Bureau, 2010 TIGER/Line shapefiles; 2017 *County Health Rankings*.
Notes: Health behaviors included obesity, physical inactivity, smoking, and excessive drinking.

Access to Health Care

Counties with the poorest access to health care, average decile scores of 8 or higher, were principally located in the Midwest of the United States (see Figure 5). Poor access scores reflect high levels of uninsurance and/or limited access to primary care providers and dentists. There were 17 rural counties with an average decile score of 10 with the majority of those located in Texas (n = 6) and Nebraska (n = 4).

Figure 5. Distribution of Average Decile Scores for Access to Health Care among Rural Counties without a Core Safety Net Provider (n=174)

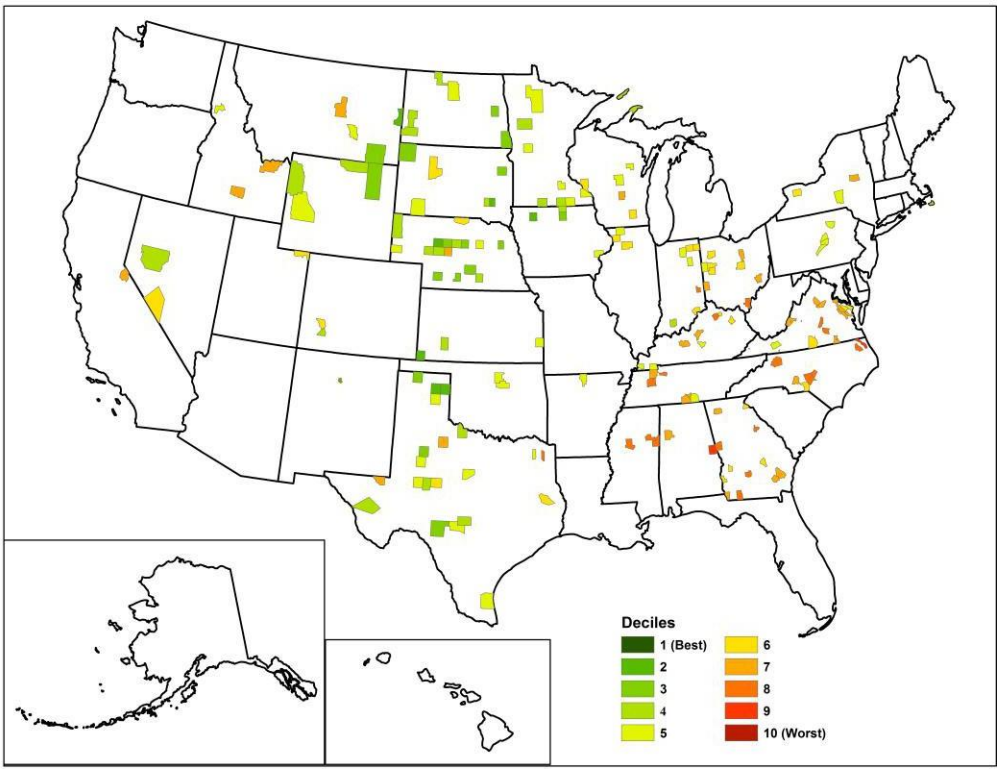


Sources: United States Department of Agriculture, Economic Research Service, 2013 Urban Influence Codes; Health Resources & Services Administration (HRSA) Data Warehouse; U.S. Census Bureau, 2010 TIGER/Line shapefiles; 2017 *County Health Rankings*.
Notes: Access to health care included uninsured, primary care physician rate, and dentist rate.

Physical Environment

Physical environment was measured by quality of housing, distance to work, and driving alone to work. Rural counties with poor scores for physical environment, an average decile score of 8 or higher, were predominantly located east of the Mississippi River (see Figure 6). There were no rural counties with an average decile score of 10 for the physical environment domain. Rural counties located in the Midwest and West were less likely to fall in the higher deciles.

Figure 6. Distribution of Average Decile Scores for Physical Environment among Rural Counties without a Core Safety Net Provider (n=174)

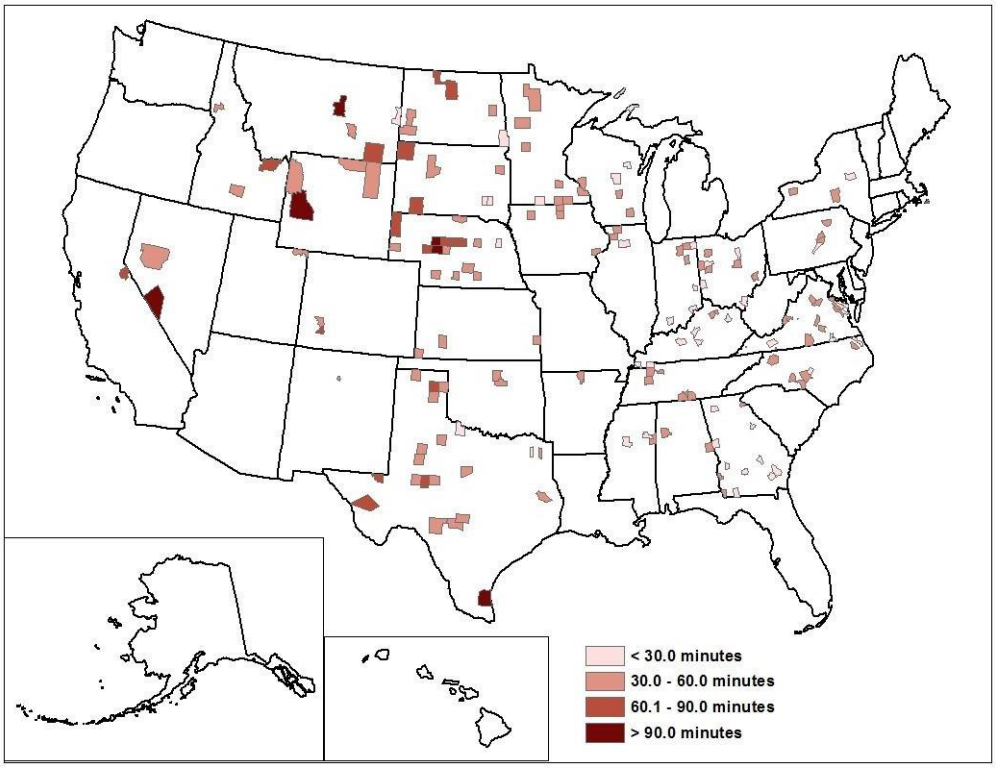


Sources: United States Department of Agriculture, Economic Research Service, 2013 Urban Influence Codes; Health Resources & Services Administration (HRSA) Data Warehouse; U.S. Census Bureau, 2010 TIGER/Line shapefiles; 2017 *County Health Rankings*.
Notes: Physical environment included severe housing problems, drive alone to work, and long commute

Geographic Isolation

Travel time from the population weighted centroid (center) of rural counties without a core safety net provider to the nearest CAH, FQHC, or RHC in a neighboring county ranged from 5.5 minutes to 2 hours and 38 minutes. There were 24 (13.7%) rural counties without a core safety net provider that were greater than 60 minutes from a core safety net provider in a neighboring county. The majority of those counties with greater travel times to the nearest core safety net provider were observed in the Midwest and West (see Figure 7). This wide range in travel times indicates that some rural counties are within close proximity to a neighboring core safety net provider; whereas, access to a core safety net provider in the Midwest and West is greatly hindered by travel time.

Figure 7. Geographic Access (Travel Time) to Nearest Core Safety Net Provider among Rural Counties without a Core Safety Net Provider (n=174)



Sources: United States Department of Agriculture, Economic Research Service, 2013 Urban Influence Codes; Health Resources & Services Administration (HRSA) Data Warehouse; U.S. Census Bureau, 2010 TIGER/Line shapefiles.
Notes: Travel time was calculated from the population-weighted centroid of each rural county to nearest the safety net provider (CAH, FQHC, or RHC) using ArcMap 10.2 Network Analyst tool.

County Selection Process

After counties have been ranked using the decile approach, one can then examine combinations of rankings to explore overall health need. To demonstrate this technique, we used two different threshold criteria to select which rural counties without a core safety net provider had the greatest health needs.

The first average decile scores for health outcomes, socioeconomic factors, health behaviors, access to health care, and physical environment were set at ≥7. In addition, a 30-minute travel time to the nearest core safety net provider was set as the cutoff to eliminate those counties whose population-weighted centroids were within close proximity of a core safety net provider in a neighboring county.

Results are shown in Table 2 (below) and Figure 8 (next page). As each additional outcome was added to the selection criteria, the number of rural counties identified decreased (see Table 2). Thus, there were 36 counties that did not have a core safety net provider, had poor health outcomes (average decile score ≥ 7), and were more than 30 minutes to the nearest core safety net provider. As additional criteria were added, the number of counties that fared poorly on all metrics decreased (i.e., 2 rural counties did not have a core safety net provider and met all 6 criteria).

Table 2. Identifying Rural Counties with the Greatest Health Needs Using Additive Criteria

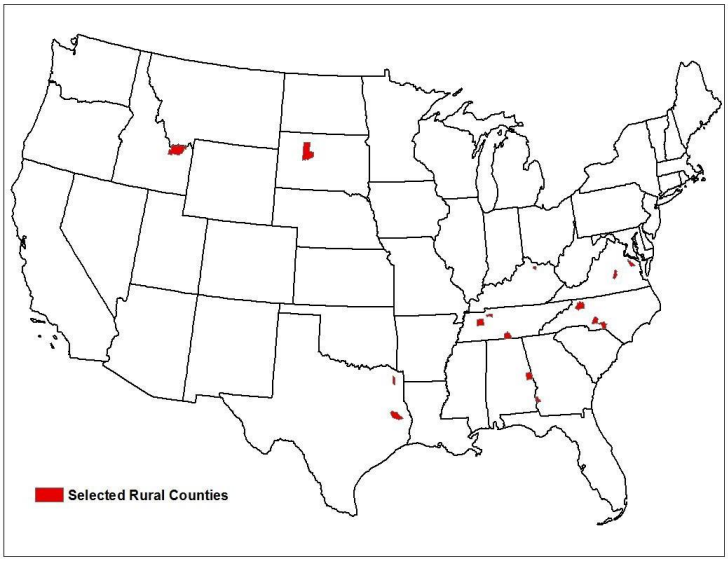
Threshold Criteria	Number of Counties Threshold of ≥7	Number of Counties Threshold of ≥ 6
1. Average decile score for health outcomes 2. Time to nearest core safety net provider > 30 minutes	36	55
1. Average decile score for health outcomes 2. Time to nearest core safety net provider > 30 minutes 3. Average decile score for socioeconomic factors	25	42
1. Average decile score for health outcomes 2. Time to nearest core safety net provider > 30 minutes 3. Average decile score for socioeconomic factors 4. Average decile score for health behaviors	13	28
1. Average decile score for health outcomes 2. Time to nearest core safety net provider > 30 minutes 3. Average decile score for socioeconomic factors 4. Average decile score for health behaviors 5. Average decile score for access to health care	7	17
1. Average decile score for health outcomes 2. Time to nearest core safety net provider > 30 minutes 3. Average decile score for socioeconomic factors 4. Average decile score for health behaviors 5. Average decile score for access to health care 6. Average decile score for physical environment	2	15

Notes: Health outcomes included poor to fair health, poor physical health days, poor mental health days, and all-cause mortality. Socioeconomic factors included poverty, unemployment, children in single parent households, and some college. Health behaviors included obesity, physical inactivity, smoking, and excessive drinking. Access to health care included uninsured, primary care physician rate, and dentist rate. Physical environment included severe housing problems, drive alone to work, and long commute.

Most of the population health indicators for these two rural counties were poorer in comparison to the national average. For example, poverty rates in these two counties ranged from 19.5% to 22.4%, greater than the national average of 16.3%. Overall, these two rural counties have evidence of poor health in addition to high levels of adverse health behaviors (e.g., obesity and physical inactivity) and low socioeconomic status (e.g. poverty, unemployment, and college education). Additionally, there was limited access to primary care providers and dentists in these rural counties.

For the second example, the threshold criteria were set at greater than or equal to 6 for health outcomes, socioeconomic factors, health behaviors, access to health care, and physical environment. The geographic isolation criterion of greater than a 30-minute travel time to the nearest core safety net provider was retained. Use of less restrictive criteria identified more rural counties, n=15, as high need (see Table 2). The majority of these counties were located in the Southeastern United States (see Figure 8, at right). More information regarding specific county characteristics can be requested from the authors.

Figure 8. Rural Counties with Greatest Health Needs, Threshold Criteria of ≥ 6 (n=15)



CONCLUSION

Given the large variation of population health indicators throughout rural America, there are some rural counties whose population health metrics reflect the clustering of low socioeconomic status, adverse health behaviors, limited access to health care, and poor environmental factors. In this brief, we demonstrate a simple selection process that allows a user to identify these rural counties with the greatest health needs using publicly available, population health indicators in the context of the existing safety-net infrastructure. While there are many appropriate methodologies one could use to identify communities with limited access to healthcare and high health needs, we describe an approach that uses a range of different factors including geographic isolation to help policy makers identify rural communities that could benefit from expansion of the safety-net system.

The application provided here examined only those rural counties without the presence of a core safety net provider. However, similar analyses could be performed for all rural counties or for counties without a hospital, counties without an RHC, and so on. The existing infrastructure of health resources, like core safety net providers or small hospitals, can be used to subset the number of rural counties examined. Additional criteria, such as a population size threshold, could be added to further subset the number of counties studied. Adding population size would further facilitate facility expansion or development planning in rural areas. These modifications indicate that the user may adapt the criteria to meet the needs of their project.

There are, however, some limitations to consider when applying the methods of this study to identifying other geographic units with high need. The first is that grouping counties into ten categories (deciles) may not be suitable for all purposes. When real values vary across a small span (e.g., unemployment rates, which vary from 1.9% to 11.6%), counties with only slightly different values may be in a different decile, exaggerating the differences. Conversely, when values have a substantial range, for example physician population ratios which vary from 0 to 274.7 per 100,000, a broad range of values will fall within the same decile. The second limitation is that the calculations for the distance to nearest provider measure used GIS software, which some individuals may not have access to. However, there are free GIS applications that could potentially facilitate similar calculations. [12]

The principal advantage of a "rank and sort" approach to identifying high need categories is its simplicity. Except for the calculation of next nearest facility, all of the analyses done for this report could be accomplished in spreadsheet software, such as Excel®, using the "sort" function. Therefore, this approach could be used by community planners, state offices of rural health, or others interested in identifying the areas of highest need within a region or state.

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For more information about the Rural and Minority Health Research Center, contact the Director Dr. Jan M. Eberth (jmeberth@mailbox.sc.edu) or Deputy Director Dr. Elizabeth C. Crouch (crouchel@mailbox.sc.edu).

APPENDIX

Population

There was a total of 174 rural counties without a CAH, FQHC, and RHC (at the time the data were obtained – February 2017) that were included in this analysis (174 out of 1,975 rural counties).

Data Sources

Data on CAH, FQHC, and RHC location were obtained from the Health Resource & Services Administration (HRSA) data warehouse [13] and ArcGIS was used to map the X and Y coordinates of each core safety net provider. Population weighted centroids were calculated for each rural county in ArcGIS using the Median Center tool. Drive times were calculated from the population-weighted centroid of each county to the nearest CAH, FQHC, or RHC in a neighboring county using Network Analyst in ArcGIS.

Data on county characteristics were obtained from several sources including 2017 *County Health Rankings* (*CHR*) [8], CDC WONDER mortality data [15], and the U.S. Census Bureau [16] (see table A-1). Due to the high levels of missing data for rural counties, variable selection from *County Health Rankings* was limited to those available for all rural counties. Age-adjusted all-cause mortality rate was added to the Health Outcomes category to replace the variable selected to measure premature death (i.e., years of potential life lost before age 75). Additionally, total poverty was used instead of child poverty.

Table A-1. Data Sources and Measures

Data	Definition	Source	Year(s)
CAH, FQHC, and RHC locations	X-Y coordinates of each facility	HRSA Data Warehouse [13]	2017
Population weighted county centroids	Geographic centroid of each county that is weighted to account for the spatial distribution of the population	Calculated in ArcGIS using the Mean Center function	2011-2015
Rurality	Urban Influence Codes	U.S. Department of Agriculture [14]	2013
Health outcomes			
Poor to fair health	Percentage of adults who self-reported fair to poor health	*CHR* – Behavioral Risk Factor Surveillance System (BRFSS) [8]	2015
Poor physical health days	Average number of poor physical health days self-reported in the previous 30 days	*CHR* – BRFSS [8]	2015
Poor mental health days	Average number of poor mental health days self-reported in the previous 30 days	*CHR* – BRFSS [8]	2015
All-cause mortality rate	Age-adjusted mortality rate for all causes of death	CDC WONDER [16]	2006-2015*
Socioeconomic factors			
Poverty	Percentage of population living in poverty	U.S. Census Bureau - Small area poverty estimates [17]	2015

Table A-1. Data Sources and Measures			
Data	**Definition**	**Source**	**Year(s)**
Unemployment	Percentage of population (> 16 years) currently unemployed but looking for a job	*CHR* – Bureau of Labor Statistics [8]	2015
Children in single-parent households	Percentage of children residing in a single-parent household	*CHR* – American Community Survey [8]	2011-2015
Some College	Percentage of adults between 25 and 44 years with some post-secondary education	*CHR* – American Community Survey [8]	2011-2015
Health behaviors			
Adult smoking	Percentage of adults who self-reported smoking	*CHR* – BRFSS [8]	2015
Adult obesity	Percentage of adults self-reporting a body mass index greater than or equal to 30 kg/m2	*CHR* – CDC Diabetes Interactive Atlas [8]	2013
Physical inactivity	Percentage of adults self-reporting no leisure-time physical activity in the previous 30 days	*CHR* – CDC Diabetes Interactive Atlas [8]	2013
Food Environment Index	An index on food environment that ranges from 0 (worst) to 10 (best) and accounts for food insecurity and limited access to healthy foods.	*CHR* – USDA Food Environment Atlas, Map the Meal Gap [8]	2014
Excessive drinking	Percentage of adults who self-reported binge drinking or heavy drinking	*CHR* – BRFSS [8]	2015
Access to health care			
Primary care physician rate	(Number of PCP/population)*100,000	*CHR* – Area Health Resource File/American Medical Association [8]	2014
Dentist rate	(Number of dentists/population)*100,000	*CHR* – Area Health Resource File/American Medical Association [8]	2014
Lack of health insurance	Percentage of population (<65 years) without health insurance	*CHR* – U.S. Census Bureau – Small area health insurance estimates [8]	2014
Physical Environment			
Severe housing problems	Percentage of households with one or more housing problems: housing costs that are greater than 50% of household monthly income, lack of complete kitchen, lack of complete plumbing facilities, and/or more than 1.5 persons per room.	*CHR* - Comprehensive Housing Affordability Strategy (CHAS) data [8]	2009-2013
Drive alone to work	Percentage of workers who drive to work alone	*CHR* – American Community Survey [8]	2011-2015
Long commute	Of the workers who commute alone to work in their car, the percentage who commute greater than 30 minutes	*CHR* – American Community Survey [8]	2011-2015

Table A-1. Data Sources and Measures			
Data	**Definition**	**Source**	**Year(s)**
Travel time to nearest core safety net provider	Travel time in minutes between the population weighted centroid of each rural county to nearest CAH, FQHC, or RHC	Calculated in ArcGIS using Network Analyst	2013

*Due to the small population of Loving County, Texas, data for all-cause mortality was suppressed for the years of 2006–2015. Therefore, we used data from 1999–2015 for Loving County, TX only.

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