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Health Services at Risk in “Vulnerable” Rural Places

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Some places in rural America are at risk of (vulnerable to) being without adequate health care services for the following reasons:

- They lack a sufficient number of people to support a practice/provider.
- They lack a sufficient number of people who are able to pay the full cost of care.
- The population size and composition do not warrant the level of services currently available. If conditions in adjoining places change, the network dissolves, and/or subsidy is withdrawn, the place will no longer be adequately served.

This *Policy Brief* describes a method to identify such places and the implications of using this method.

The method for assessing the implications of *place* for providing health care services that is described in this *Brief* is useful to three audiences:

- State government—Offices of rural health can use this method to identify places in their states that they should target with programs designed to support health care providers. These might include loan repayments as financial incentives, technical assistance to providers to help them achieve efficiencies within the constraints of lower revenues, incentives to establish regional systems of care, and direct assistance where needed.
- Federal policymakers—Federal policymakers can use this method to identify places where providers can qualify for special payment considerations. This method also identifies places that can be targeted by special federal programs, including incentives to health care providers to locate in underserved areas.
- Health care providers—Hospital administrators, for example, can use this method in strategic planning. For example, hospitals located in vulnerable places might approach network arrangements differently than those located in places with more potential for payment from privately insured patients.

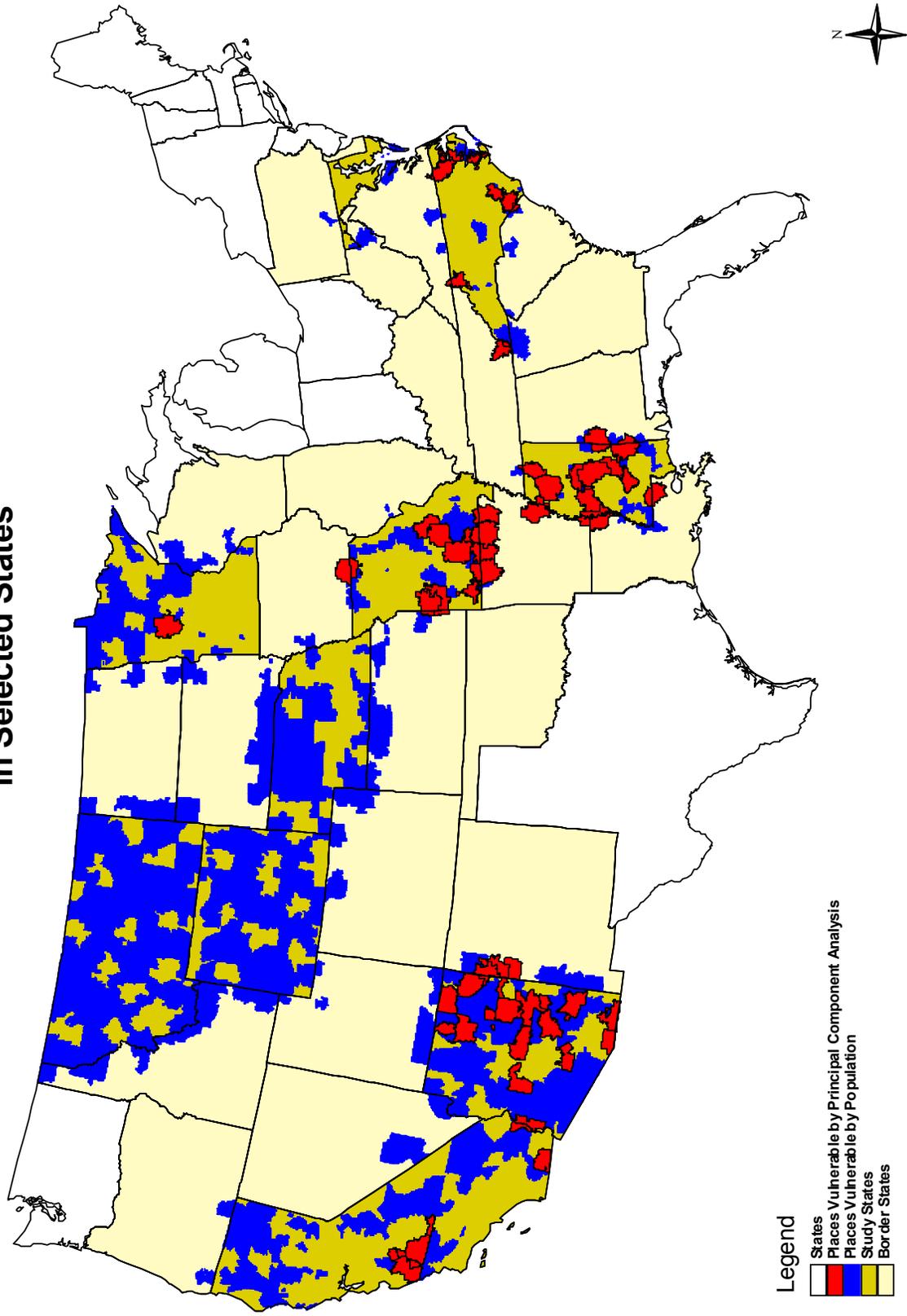
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Vulnerable Places in Non-Metropolitan Areas in Selected States *



Legend

- States
- Places Vulnerable by Principal Component Analysis
- Places Vulnerable by Population
- Study States
- Border States

*We included 10 states in the study discussed in this *Brief* based on geographic representation, population characteristics, and familiarity to the research team.

Table 1: Characteristics of Vulnerable Places as Identified by the Principal Components Analysis

Place	Principal Component 1	Principal Component 2	Unemployed	65+	Minority	100% of Poverty	100-200% of Poverty	Education
NE AZ-NM Brdr	.95	.03	.25	.06	.96	.60	.21	.56
NE AZ-UT Brdr	.89	-.03	.20	.05	.95	.46	.24	.52
NC AZ	.85	-.08	.19	.06	.94	.45	.25	.44
Cent CA Valley	.82	.14	.14	.05	.88	.27	.44	.68
Cent CA Valley	.73	.12	.19	.10	.79	.27	.39	.61
Cent CA Valley	.73	.12	.19	.10	.79	.27	.39	.61
NW NM-AZ Brdr	.71	-.12	.12	.06	.84	.39	.24	.37
NW NM-AZ Brdr	.70	-.12	.12	.06	.83	.38	.24	.37
SE AZ-Mex Brdr	.63	-.06	.09	.10	.78	.26	.29	.43
Cent AZ-NM Brdr	.62	-.13	.08	.07	.77	.35	.23	.35
Cent MS	.62	.07	.10	.13	.68	.47	.23	.50
So CA-Mex Brdr	.61	-.02	.13	.09	.74	.23	.30	.47
SE AZ-Mex Brdr	.53	-.02	.13	.14	.65	.33	.24	.41
Cent AR-MS Brdr	.50	.11	.11	.15	.57	.43	.25	.49
Cent CA Valley	.48	.01	.09	.05	.60	.21	.29	.47
Cent CA Coast	.48	.00	.11	.07	.62	.13	.31	.47
Cent CA Coast	.48	.00	.11	.07	.62	.13	.31	.47
Cent CA Valley	.47	.00	.09	.05	.59	.21	.28	.47
Cent CA Valley	.47	.00	.09	.05	.59	.21	.28	.47
NE LA-MS Brdr	.46	.11	.12	.14	.53	.40	.26	.49
Cent MS-AL Brdr	.44	-.02	.10	.12	.57	.31	.24	.39
NE NC-VA Brdr	.41	.03	.06	.16	.55	.23	.28	.43
NE Cent AZ	.39	-.11	.12	.08	.55	.22	.23	.32
SC AZ	.39	-.01	.09	.11	.52	.24	.28	.39
SC AZ	.39	-.01	.09	.11	.52	.24	.28	.39
Cent MS	.38	.11	.09	.16	.47	.33	.29	.47
CA-AZ Brdr	.36	.04	.07	.12	.49	.23	.29	.43
SE NC	.35	.04	.06	.16	.49	.23	.29	.41
NE NC	.35	.03	.07	.16	.49	.22	.28	.40
NE NC	.34	.02	.06	.16	.49	.22	.28	.40
Cent AZ	.33	-.04	.10	.14	.48	.23	.23	.35
No MS	.33	.06	.08	.13	.43	.30	.25	.43
Cent MS	.32	.11	.07	.15	.41	.30	.29	.45
SC MS-LA Brdr	.30	.09	.10	.13	.39	.33	.26	.43
SC MS	.29	.09	.07	.14	.39	.28	.28	.43
EC AZ	.28	-.09	.14	.10	.44	.28	.24	.26
Cent MS	.26	.09	.06	.15	.37	.27	.29	.43
NC AZ-UT Brdr	.25	-.19	.08	.05	.45	.17	.16	.23
SC MS-AL Brdr	.25	.08	.09	.13	.36	.27	.28	.42
SE NC-SC Brdr	.25	.05	.06	.14	.38	.22	.27	.41
SE NC-SC Brdr	.23	.07	.06	.14	.35	.23	.26	.42
SE AZ-Mex Brdr	.22	-.13	.10	.11	.41	.19	.22	.23
NC MS-TN Brdr	.20	.06	.08	.13	.31	.23	.24	.40
SE AZ	.16	-.01	.10	.14	.32	.18	.28	.31
SE AZ	.16	-.01	.10	.14	.32	.18	.28	.31
EC AZ	.15	-.08	.11	.09	.32	.23	.27	.23
EC NC Coast	.12	-.05	.06	.15	.30	.16	.22	.29
EC AZ	.10	-.08	.07	.08	.28	.16	.30	.23
WC AZ	-.03	.10	.08	.29	.13	.21	.27	.30
SE TN-NC Brdr	-.05	.19	.07	.14	.04	.18	.25	.46
NE AR-MO Brdr	-.06	.17	.07	.15	.04	.20	.28	.41
SC MO	-.08	.18	.07	.16	.02	.25	.32	.38
SC MO-AR Brdr	-.08	.20	.07	.18	.01	.24	.33	.40
SC MO	-.08	.13	.07	.16	.03	.19	.26	.37
NW NC-VA Brdr	-.08	.14	.05	.13	.02	.18	.24	.40
NC AR-MO Brdr	-.08	.21	.07	.23	.02	.23	.33	.39
SC MO	-.10	.16	.07	.15	.01	.15	.27	.41
SW MO-KS Brdr	-.11	.12	.06	.20	.02	.19	.26	.34
NC AR-MO Brdr	-.11	.17	.07	.25	.01	.19	.30	.36
SW MO-KS Brdr	-.11	.10	.07	.20	.03	.18	.26	.32
SW MO-KS Brdr	-.11	.11	.07	.20	.02	.17	.26	.33
Cent MN	-.12	.12	.06	.18	.01	.19	.30	.32
Cent AZ	-.12	.10	.08	.29	.04	.13	.29	.29
SW MO	-.12	.10	.06	.20	.02	.15	.30	.31
SW MO-AR Brdr	-.13	.11	.06	.19	.01	.15	.28	.32
NC MO-IA Brdr	-.13	.11	.06	.23	.01	.19	.28	.29

Vulnerable Places

We included 10 states in the study discussed in this *Brief*, based on the following criteria: geographic representation, population characteristics (expected rural minority population, income, rural elderly population, education levels), and familiarity to the research team (for the purpose of face validity). The states chosen were Arizona, California, Maryland, Minnesota, Mississippi, Missouri, Montana, Nebraska, North Carolina, and Wyoming. Data were from the 1990 Census of Population and Housing.¹

The map on page 2 identifies the vulnerable places in the 10 study states, and Table 1 shows the principal component scores and the traits of the places identified based on population characteristics. We classified places as vulnerable if:

- they were census blocks located more than 25 miles from the outer boundaries of any community (defined by the U.S. Bureau of the Census) of at least 3,500 persons or
- they were places that include communities of at least 3,500 persons; with total populations less than 100,000; and with high index values based on proportions of persons characterized as unemployed, 65 and older, minority, below 100% of federal poverty guidelines, between 100% and 200% of federal poverty guidelines, and age 25 or over and not graduated from high school.

Vulnerable Places Based on Sparse Population

We defined sparsely populated regions by a process of exclusion. First, we identified and removed all metropolitan statistical areas (MSA) and census blocks whose geographic center was within 25 miles of MSA outer boundaries. We then removed communities of 3,500 residents or more and the census blocks whose geographic center was within 25 miles of their outer boundaries. This process left 2,207 census blocks, aggregated into the regions identified in the map on page 2.

Vulnerable Places Based on Population Characteristics

We selected non-metropolitan communities of 3,500 or more persons for further analysis. Those places, because of overlapping boundaries, may aggregate into larger regions with much larger populations. We assumed that any area with 100,000 or more persons would not be classified as vulnerable based on national averages of uninsurance, Medicaid, and private insurance coverage. Given those averages, well over half of the population should be “paying clients,” which, in a population of 100,000 or more, would generate more than sufficient income to cover fixed costs and losses incurred from non-paying patients. In some sub-areas, certain providers, such as community hospitals, might still struggle, but identifying them would require an approach other than the spatial model being used here.

¹Data were taken from the 1990 Census, since at the time of the analysis the summary tape file 3A (STF-3A file), which contains sample data weighted to represent the total population down to the block group level, was not yet available from the 2000 Census.

We chose the following six variables to describe the characteristics of the study places:

- Percent of persons in the labor force who are unemployed—selected with an expectation that it represents uninsurance more than Medicaid.
- Percent of persons aged 65 and over—selected to represent the likely dependence on Medicare payment. Since there is very little penetration of Medicare+Choice plans in rural areas, a high percentage of Medicare business implies accepting the Medicare payment schedules, which are below charges.²
- Percent of the population that is racial or ethnic minority—selected to represent reduced service utilization and likely lack of health insurance.
- Percent of the population with incomes below the federal poverty level—selected to represent a combination of dependence on Medicaid and those who are uninsured.
- Percent of the population between 100% and 200% of the federal poverty level—selected to represent the uninsured.
- Percent of individuals with less than a high school education among individuals who are at least 25 years old—selected to represent those individuals most likely to be uninsured.

We conducted a principal components analysis using data from 236 non-metropolitan places to derive a weighted sum of the community characteristics of interest. The results of the principal components analysis are summarized in Table 2. The top portion of the table identifies the weightings for each place characteristic suggested by the four principal components that explained the most variability in the data. The bottom of the table summarizes the amount of variability in the data explained by each of the four components, the cumulative variance explained (summing over the components to the left), and the variance of each component. The first two principal components explain 95% of the variability in the data. The variance of the components decreases notably between the first and second components (from 0.06 to 0.01) and then changes only slightly between subsequent components.

²Payment from Medicare may or may not generate positive operating margins. Many rural providers and analysts would argue that providers cannot maintain their business (be it physician practice or institutional provider) on Medicare margins alone.

Table 2: Principal Component Analysis Summary

Variable	Principal Component Weights			
	1	2	3	4
Proportion Unemployed	0.10	-0.001	0.12	-0.05
Proportion 65 and Older	-0.11	0.34	0.13	0.87
Proportion Minority	0.90	-0.32	-0.13	0.25
Proportion Below 100% Poverty	0.25	0.25	0.90	-0.12
Proportion 100-200% Poverty	0.06	0.34	-0.25	0.23
Proportion \geq age 25 with $<$ HS Education	0.31	0.78	-0.29	-0.34
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Variability Explained	0.85	0.09	0.03	0.02
Cumulative Variability Explained	0.85	0.95	0.97	0.99
Variance of Component (Eigenvalue)	0.06	0.01	0.002	0.001
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Total Variance	0.07			

We used the principal component weights given in Table 2 to calculate two weighted scores of the characteristics for each place, corresponding to the first and second principal components. Then, we classified places with similar weighted place characteristic scores into clusters by choosing cut-points for the first and second principal component scores. The first two principal components explain 95% of the variability in the data. The variance of the components decreases notably between the first and second components (from 0.06 to 0.01) and then changes only slightly in subsequent components.

The weighting of each variable by a particular principal component can be interpreted in terms of the data contrasts that explain a certain amount of variability in the data. The first component is most heavily weighted by the proportion minority followed by the proportion of individuals at least 25 years old with less than a high school education and the proportion below 100% of the poverty limit. The most heavily weighted place characteristics are those characteristics that are the most variable across the places. The proportion of unemployed individuals and the proportion between 100% and 200% of the poverty limit receive a smaller weighting. The negative sign for the proportion 65 and older can be interpreted as a contrast between the proportion of individuals 65 and older and the other place characteristics. So, we can account for variability among the places by contrasting the proportion of individuals 65 and older with the other place characteristics.

The second principal component is most heavily weighted by the proportion of individuals 25 and older with less than a high school education followed by the proportion 65 and older, the proportion between 100% and 200% of the poverty limit, and the proportion below 100% of the poverty limit. The proportion unemployed receives essentially a zero weighting. The negative sign for the minority proportion indicates that we can account for variability, not explained by the first principal component, among the places by contrasting the minority proportion with the other place characteristics.

The characteristics of the 66 vulnerable places can be described to determine whether the principal component weighting algorithm identifies places that would subjectively be defined as vulnerable. For example, we classified as vulnerable based on the principal component weighting scheme:

- all places with an unemployment proportion of at least 25% (n=1),
- three of the four places with elderly proportions above 25%,
- all of the 42 places with a minority proportion of at least 35%,
- all of the 15 places with a proportion of individuals below 100% of the poverty limit of at least 30%,
- thirteen of the 15 places with a proportion of individuals between 100% and 200% of the poverty limit of at least 30%, and
- all of the 48 places with a proportion of individuals 25 and older with less than a high school education of at least 35%.

Thus, it appears that the principal component weighting scheme is identifying places that we would classify as vulnerable based on intuitive cut-points for each of the six place characteristics.

The characteristics of the 170 places that are not classified as being vulnerable are contrasted with the 66 vulnerable places in Table 3. Note that vulnerable places, in general, have a higher proportion of individuals who are minority, unemployed, below the 100% poverty limit, between the 100% and 200% poverty limits, and are at least 25 years of age with less than a high school education. On the other hand, the proportion of elderly individuals appears to be larger, in general, for places that are not vulnerable, because those places with higher proportions of elderly individuals usually have lower proportions of individuals in the other risk categories.

Table 3: Mean and Standard Deviation for Characteristics of Vulnerable and Non-vulnerable Places

Characteristic	Potentially Vulnerable n=66	Not Potentially Vulnerable N=170
Proportion Unemployed	0.09 (0.04)	0.06 (0.02)
Proportion 65 and Older	0.13 (0.06)	0.16 (0.04)
Proportion Minority	0.41 (0.29)	0.07 (0.07)
Proportion Below 100% Poverty	0.25 (0.09)	0.13 (0.03)
Proportion Between 100-200% Poverty	0.27 (0.04)	0.23 (0.03)
Proportion 25 and Older with Less than High School Education	0.40 (0.09)	0.23 (0.05)

Policy Implications

Using the method presented in this Brief as a guide for public policy would seem to argue for replacing the current myriad of policies driven by varying definitions of underserved areas or populations. However, replacing one method (albeit a conglomeration of policies) with another would create “winners and losers.” Recognizing this reality, two adjustments could be made. First, if the method described in this Brief or another new method is adopted, it could be done in phases to permit early testing of its effects. Second, if a single method is used, exceptions could be permitted that are consistent with the framework that created the method. For example, if the geography of an area is such that the 25-mile buffer is meaningless due to impassable mountains or lakes, lines could be redrawn and a remote area declared vulnerable. In another example, if the proportions of elderly and low income households are insufficient to achieve component scores making the community vulnerable, but because of patterns of care the proportions of patients actually seen originates disproportionately from those groups, an exception could be made.

Research Implications

To have detailed information for census blocks, we conducted the study described in this Brief using data from the 1990 census. The next step in the research is to repeat the analysis using data from the 2000 census. Should the method continue to achieve face validity, the next research task is to test the effect of the method on public policies, assuming a change from current practices of identifying fiscally vulnerable providers to using a place-based approach.