A Geographic Analysis of Counties Without an Active Non-Federal Physician, United States, 1963-71

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THE NUMBER of physicians in the United States totaled 260,484 in 1960. A decade later the number rose to 334,028, an increase of almost 75,000. During the same period the number of physicians per 100,000 population also increased from 141 to 159 (*1*). Despite these marked increases, the number of counties without a practicing non-Federal physician grew from 98 in 1963 to 132 in 1970 (*2*).

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These counties, which contain nearly half a million people, have encountered great difficulty in attracting a physician (*3*). Clinics have been built, incomes guaranteed, numerous letters written to medical schools, and full-page advertisements published in newspapers and medical journals in the hope of attracting a physician. The seriousness of this situation has been further expressed by local newspaper editorials, civic groups, and politicians. One resident of a West Virginia county without a physician expressed the problem in the following way (*4*):

> We are 35 miles away from hospital facilities. We have sent people in an ambulance into Clarksburg and we have had people die on the way in, and immediate medical attention could have saved some of these people. . . . We have tried everything we know to get a physician. We have advertised in periodicals, medical journals, newspapers; we sent out 120 letters to medical universities all over the country and Army discharge

centers. We haven't had a direct reply from any of these. We have had people come in, but for one reason or another they didn't want to locate there.

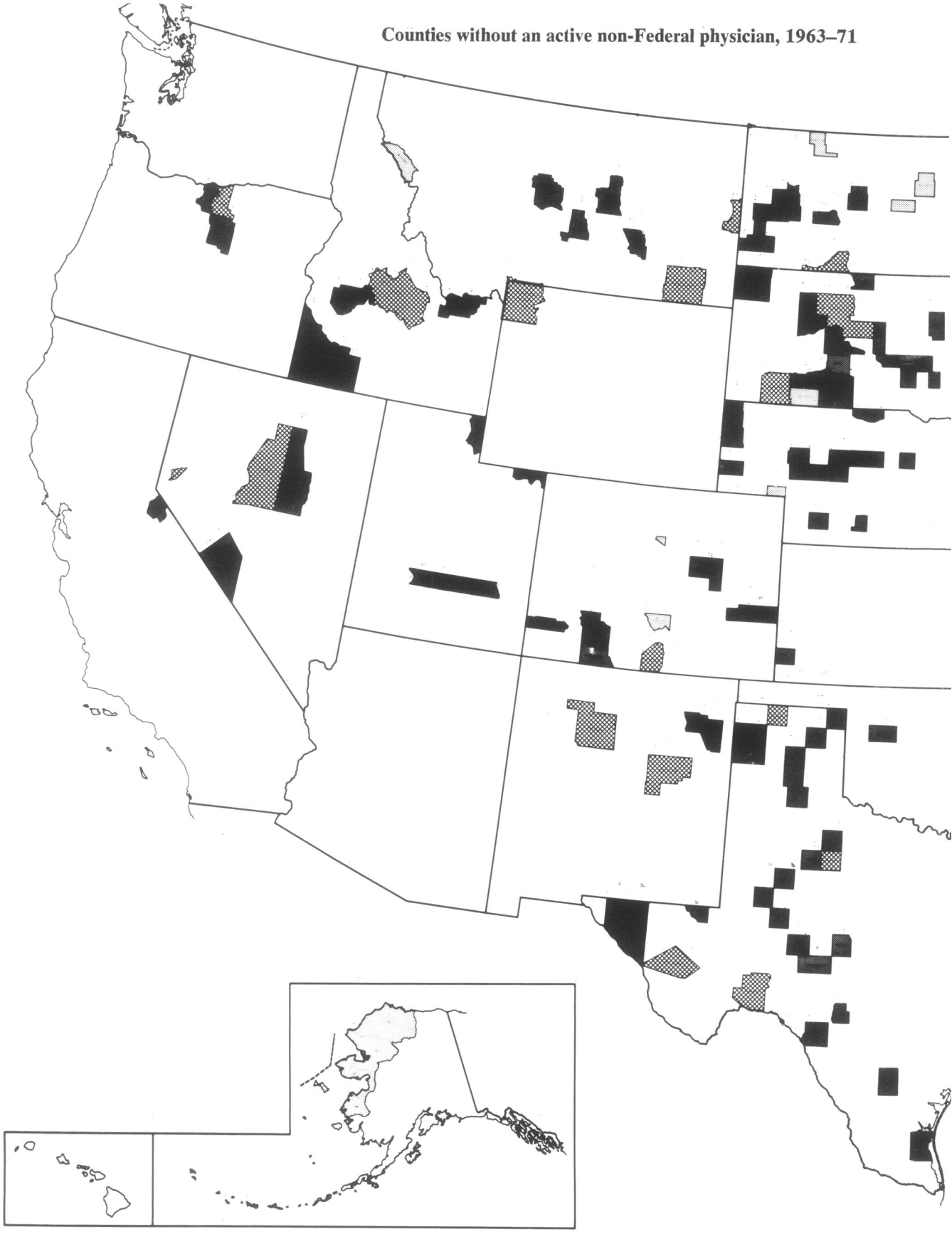
Although many authors have written about the maldistribution of physicians in the United States, few have discussed or attempted to analyze the specific factors related to the growing number of counties lacking a physician. We have investigated this important problem from a geographic perspective. Specifically, our objective was twofold: (*a*) to investigate the temporal and spatial pattern of counties lacking physicians and (*b*) to analyze variations among these counties in terms of their socioeconomic, ethnic, and spatial characteristics. The unit of analysis employed in this study was limited to those counties without an active non-Federal physician for 1 or more years during the period 1963–71. As such, it should be noted that the findings, generalizations, and inferences of this investigation are limited to, and specific for, counties with this characteristic. It would be unwarranted to interpolate the findings of this study to counties which have had the continued services of a non-Federal physician during this period. Data for the study were obtained from the American Medical Association's Distribution of Physicians series for each of the 9 years (*5*).

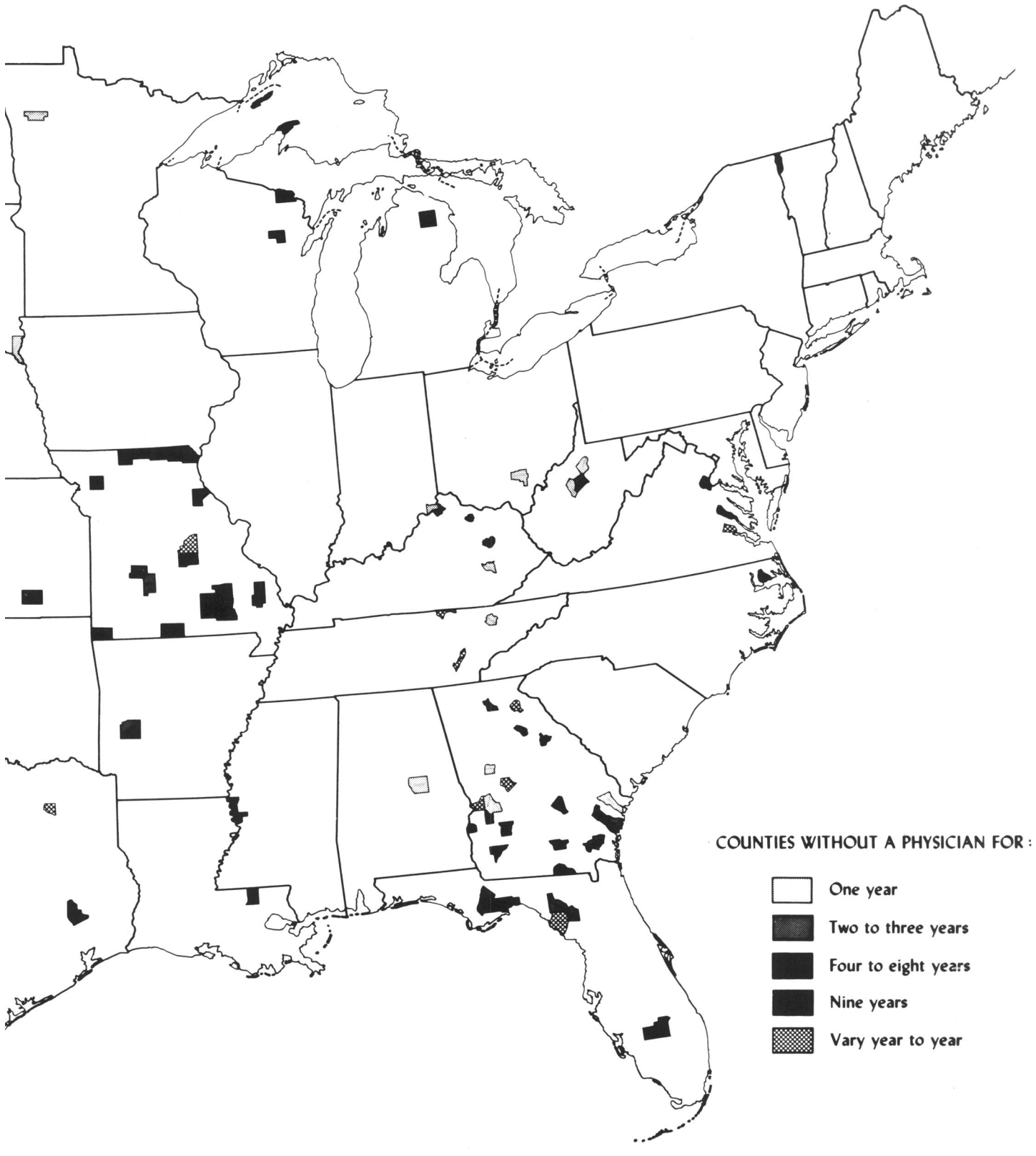
Methodology

After the data were collected, 179 counties were identified which had lacked the services of a physician for 1 or more years. To investigate temporal variations, these counties were divided into five groups. The first group (N = 22) consisted of those counties without a physician for 1 year. The second group (N = 23) was composed of those counties which lacked a physician for 2 to 3 years. Group 3 (N = 38) consisted of those counties without a physician for 4 to 8 consecutive years. Group 4 (N = 69) was composed of those counties without a physician for the total length of the study period, 9 years. The last group (N = 27) consisted of those counties which varied from year to year with respect to having a physician. For example, if a county did not have a physician for 2 consecutive years, then had one for 1 year, and later did not have a physician for the rest of the period, it was included in the fifth group.

To investigate the spatial variation of the counties, the five groups were plotted on a map (see chart). From the map, five patterns can be recognized. First, a majority of the counties are in isolated rural areas with small populations—for example, Alpine, Calif., with a population of 484; Clark, Idaho, with 741; and Petroleum, Mont., with 675 (*6*). Second, several are adjacent to highly urbanized counties defined by the census as a Standard Metropolitan Statistical Area (SMSA). From this fact, one can conjecture that the large urban areas tend to create a "shadowing effect" with respect to physicians locating in adjacent counties. Examples of this pattern include Hudspeth, Tex., adjacent to the El Paso SMSA; Union, Tenn., which is contiguous to the Knoxville SMSA; and De Kalb, Mo., adjacent to the St. Joseph SMSA (*7*). Third, many of the counties, especially those in the Great Plains and the Rocky Mountain regions, are located at great distances from medical schools. Billings, N. Dak.; Harding, S. Dak.; and Judith Basin, Mont., are examples of this (*8*). Fourth, several counties without physicians have high concentrations of ethnic groups, such as American Indians and blacks. In fact, many contain Indian reservations. Todd, S. Dak., is part of the large Rosebud Indian Reservation; Glades, Fla., contains the Brighton Reservation; and Sandoval, N. Mex., contains the Jemez, Zia, Santo Domingo, and Cochita Reservations (*9*). Counties with high concentrations of blacks included Issaquena, Miss., Taliaferro, Ga., and Charles City, Va., with 62, 63, and 74 percent, respectively, in this ethnic group (*6*). It should be noted that the patterns just described are not mutually exclusive. Significant overlap is more the rule than the exception.

To test the validity of these patterns with respect to the five county groups, 14 socioeconomic, ethnic, and spatial variables were obtained for each county and used in an analysis of variance test. Twelve variables—total population, population density, percent population change, percent Indian, percent black, percent total nonwhite, median income, percent of population with income below the poverty level, median age, percent of population 65 years or older, fertility ratio, and percent of population rural—were obtained from the 1970 U.S. Census of population. The 13th and 14th variables, distance to the nearest SMSA and distance to the nearest medical school, were obtained by plotting the total number of SMSAs and medical schools in 1970 on a map and measuring the linear distance from each county to each of these variables (*7,8*).


Counties without an active non-Federal physician, 1963–71


COUNTIES WITHOUT A PHYSICIAN FOR:
One year
Two to three years
Four to eight years
Nine years
Vary year to year

A one-way analysis of variance test was then applied to determine significant differences among the means of the five groups for each of the 14 variables (*10*). The level of significance was set at the 0.05 level. After calculation of the *F* values, six variables were found to vary significantly: total population, population density, percent population change, percent of population 65 years or older, distance to the nearest SMSA, and percent of population rural. The results of the analysis are shown in table 1.

Results

The results reveal that two of the patterns identified earlier, distance from medical schools and high concentrations of ethnic populations, did not vary significantly among the five groups. Although the four variables used to test these relationships, percent Indian, percent black, percent total nonwhite, and distance to nearest medical school, were not significant, the last variable was just under the significance level. It should also be noted that the two economic variables used in this study, median income and percent of population with incomes below poverty level, although seemingly important in attracting and supporting a physician, were not significant.

Since the analysis just described tested only for the overall hypothesis of differences among the five means for each variable, a followup analysis of variance test, using all pairwise combinations for each of the six significant variables, was undertaken (*10*). The followup test was employed to indicate which means among each variable were significantly different. Again the level of significance was set at the 0.05 level. The results are shown in table 2.

If one looks at the significant variables in table 2, it is apparent that total population and population density for group 4, those counties without a physician for 9 years, varied from all other groups. These counties in group 4, with an average population of only 2,331 and an average density of 4 persons per square mile, were below a population threshold level capable of attracting a physician. These findings tend to support Marshall and co-workers who stated that population size is the most important single element in determining physician location (*11*).

For the variable, percent population change, group 4 varied significantly from groups 3 and 5. Group 4 experienced the sharpest rate of population decline, —11.1 percent, while only group 3, those counties without a physician for 4 to 8 years, and group 5, those counties which varied from year to year, had an increase in population, 1.6 percent and 8.4 percent respectively.

For the next variable, percent of population 65 years or older, group 5 varied from groups 1, 2, and 3. Group 5 had the lowest percentage of elderly, 9.8 percent, while group 2, those counties without physicians for 2 to 3 years, had the highest, 13.4 percent. Groups 1 and 3 both had values of 12.7 percent. These results indicate that no specific trend appears to exist with respect to

Table 1. Mean and *F* values of selected variables for counties without a non-Federal physician, 1963–71

Variable	Group 1 (1 year without)	Group 2 (2–3 years without)	Group 3 (4–8 years without)	Group 4 (9 years without)	Group 5 (varying period)	F value
Total population	5,551.9	5,013.0	4,730.6	2,331.4	5,430.4	[1] 7.70
Persons per square mile	15.4	12.6	11.2	4.2	12.0	[1] 4.21
Percent population change	—2.1	—3.0	1.6	—11.1	8.4	[1] 5.53
Percent Indian	1.5	.4	5.0	3.6	9.3	1.50
Percent black	9.5	8.0	7.0	5.8	7.1	.24
Percent total nonwhite	11.1	8.7	12.4	9.6	16.8	.71
Median income (dollars)	$6,352.4	$5,851.6	$6,463.4	$6,318.8	$6,441.9	.48
Percent population with incomes below poverty level	22.2	24.8	21.6	20.3	23.9	1.08
Median age of population (years)	30.3	31.8	30.9	30.8	27.5	1.94
Percent population 65 years or older	12.7	13.4	12.7	11.5	9.8	[1] 3.52
Cumulative fertility rate[2]	409.8	382.0	394.1	401.6	422.5	.71
Miles to nearest medical school	154.7	138.6	168.8	208.2	193.7	2.29
Miles to nearest SMSA	68.8	72.2	85.8	113.4	98.0	[3] 3.06
Percent of population rural	81.9	80.4	90.7	94.8	78.8	[1] 5.64

[1] Significant at 0.01 level.
[2] Ratio of cumulative number of children born per 1,000 women in the age group 35–44 years.
[3] Significant at 0.05 level.

SOURCES: Reference 6 for data on all but two variables; reference 8 for distance to the nearest medical school; reference 7 for distance to the nearest SMSA.

Table 2. *F* values for selected variables from intergroup comparisons of counties without a non-Federal physician, 1963–71

Variable and group	Group 2	Group 3	Group 4	Group 5
Total population:				
1	.384	.698	[1] 40.486	.008
2		.084	[1] 26.744	.107
3			[1] 18.191	.352
4				[1] 17.755
5				
Population density:				
1	.718	.811	[1] 41.857	.455
2		.093	[1] 25.490	.013
3			[1] 7.852	.024
4				[1] 8.528
5				
Percent population change:				
1	.027	.547	3.593	1.949
2		1.222	3.890	3.053
3			[1] 12.294	1.331
4				[1] 15.409
5				
Percent 65 and over:				
1	.456	.003	1.493	[1] 8.511
2		.470	3.878	[1] 11.415
3			1.919	8.073
4				3.751
5				
Distance to nearest SMSA:				
1	.035	.983	[2] 6.599	2.066
2		.814	[2] 6.706	2.101
3			[2] 4.137	.538
4				.913
5				
Percent rural:				
1	.071	3.117	[1] 11.335	.209
2		[2] 4.326	[1] 14.355	.055
3			1.654	[2] 4.517
4				[1] 14.189
5				

[1] Significant at 0.01 level. [2] Significant at 0.05 level.

the distribution of physicians and percent of elderly population. An interesting aspect which the investigators are currently following up is whether counties with relatively larger proportions of persons over 65 years were able to attract physicians more easily after the institution of Medicare than before its inception.

With respect to the variable of distance to the nearest SMSA, group 4 varied from groups 1, 2, and 3. Group 4 was the farthest away, on the average, from the nearest SMSA, a mean distance of 113 miles, while the mean distance for group 1 was 69 miles, 72 miles for group 2, and 86 miles for group 3. From this, one can conjecture that geographic distance is an important variable to a physician in that the greater the distance from a large urban center, the less likely it is that a county can attract a physician.

The last variable, percent of population rural, demonstrated the greatest variation among the groups. The main pattern consisted of group 4's varying from groups 1, 2, and 5. Group 4 was the most rural, 94.8 percent, while group 5 was the least rural, 78.8 percent. The other patterns consisted of group 2's varying from group 3 and group 3's varying from group 5. One can conclude that the two groups which lacked a physician for the longest periods (groups 3 and 4) were also the most rural and tended to vary most from the other groups.

Conclusion

This analysis distinguished a core group from a fringe group of counties with respect to attracting a physician. The core group consisted of those 69 counties which did not have a physician for

the entire 9 years of the study period. The fringe group, on the other hand, consisted of the other 110 counties which had no physician for from 1 to 8 years. The core group, as this study indicated, can be differentiated from the fringe group by small total population and sparse density, steep rate of population decline, and geographic isolation from urban centers.

Further, the one characteristic which seemed to hamper most the ability of these counties to attract a physician was a small total population. This study indicated that, for this variable, there is a population threshold level below which a physician will not locate. One may also conjecture that this threshold has been and will be increasing with time. For example, in 1963 the average population of counties without a physician was 3,008, while in 1971 the average population was 3,629. Several recent trends in medicine also appear to support this conjecture. First, a smaller number of physicians have been entering into general private practice, while conversely, a greater number have been entering specialized hospital-based practice (*12*). Kissick, in discussing this trend, stated (*13*):

> Specialization in medical practice, a post-World War II occurrence, and concentration of health manpower in hospitals, or institutionalization, have reached major proportions. . . . At the present time, the situation is rapidly approaching in which almost nine out of every ten graduates of the nation's medical schools enter specialty training.

The second trend is increased medical technology. Physicians are becoming increasingly reluctant to locate in counties without, for example, standard laboratory facilities and are more prone to locate where specialized equipment, colleagues, and allied personnel are readily available. Mechanic said that practice without these amenities tends to frustrate ". . . the physician who feels he cannot implement the level of scientific training he received." He further stated that the physician feels that rural practice ". . . would isolate him from a colleague network, more complex diagnostic and treatment aids, and the ancillary assistance available in more densely populated areas" (*14*).

Last, the trend toward group practice has been increasing. For example, Somers indicated that in 1967 approximately 60 percent of all physicians were in some sort of group practice or hospital-based practice. With the advent of increased group practice, population threshold levels have further increased, thus tending to intensify differences between medical "haves" and "have nots" (*15,16*).

REFERENCES

(*1*) Walsh, R. J., and Aherne, P.: Socioeconomic issues of health. Center for Health Services Research and Development, American Medical Association, Chicago, 1972, p. 41.

(*2*) Walsh, R. J., Aherne, P., and Ryan, G. A.: The profile of medical practice. Center for Health Services Research and Development, American Medical Association, Chicago, 1972, p. 110.

(*3*) Staff of the Senate Committee on Ways and Means: Basic facts on the health industry. Committee Print. 92d Cong. 1st Sess. U.S. Government Printing Office, Washington, D.C., 1971, pp. 78, 79.

(*4*) Kennedy, E. M.: In critical condition: the crisis in America's health care. Simon and Schuster, Inc., New York, 1972, p. 120.

(*5*) Center for Health Services Research and Development, American Medical Association: Distribution of physicians, hospitals, and hospital beds in the U.S. Chicago, for the years 1963–71.

(*6*) U.S. Bureau of the Census: 1970 census of population: number of inhabitants. U.S. Government Printing Office, Washington, D.C., 1971.

(*7*) U.S. Bureau of the Census: Number of inhabitants: United States summary. U.S. Government Printing Office, Washington, D.C., 1971, pp. 8–9.

(*8*) American Medical Association: Medical education in the United States 1970–71. Chicago, 1971, pp. 1206–1207.

(*9*) U.S. Department of the Interior: The national atlas of the United States of America. U.S. Government Printing Office, Washington, D.C., 1970.

(*10*) Biomedical computer programs (BMD), program BMDO1V, analysis of variance for one-way design. *In* Biomedical computer programs, edited by W. J. Dixon. University of California Press, Berkeley, 1968, pp. 483–494.

(*11*) Marshall, C. L., Hassanein, K. M., Hassanein, R. S., and Marshall C. L.: Principal components analysis of the distribution of physicians, dentists and osteopaths in a midwestern State. Am J Public Health 61: 1556–1564, August 1971.

(*12*) Glazier, W. H.: The task of medicine. Sci Am 228: 16. April 1973.

(*13*) Kissick, W. L.: Health policy directions for the 1970's. N Engl J Med 282: 1344, June 11, 1970.

(*14*) Mechanic, D.: Public expectations and health care; essays on the changing organization of health services. John Wiley & Sons, Inc., New York, 1972. p. 287.

(*15*) Somers, A. R.: Health care in transition; direction for the future. Hospital Research and Educational Trust, Chicago, 1971, p. 9.

(*16*) Shimkin, D. B.: Man, ecology, and health. Arch Environ Health 20: 116, January 1970.