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Physicians in Nonmetro Areas During the Seventies

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Abstract

The gap between number of physicians in nonmetro and metro areas widened during the seventies, with nonmetro areas lagging by almost 100 physicians per 100,000 population. Nonmetro areas had more general practitioners and fewer specialists per 100,000 population than did metro areas. While the number of physicians in all nonmetro areas rose, the rate of increase was slower than in metro areas, except in urbanized nonmetro areas not adjacent to a standard metropolitan statistical area (SMSA). The number of office-based general practitioners per 100,000 population fell while the number of office-based specialists rose in all regions and for all residential categories.

Keywords: Rural health, physicians, nonmetro area

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Summary

The gap between the number of physicians in nonmetro and metro areas widened during the seventies, with nonmetro areas lagging by almost 100 physicians per 100,000 people in 1979. This report analyzes changes in the per capita distribution in nonmetro areas during the seventies. Major findings include:

- Nonmetro areas had more general practitioners and fewer specialists per 100,000 population than metro areas.
- While the number of physicians per 100,000 population rose in all nonmetro areas during the seventies, the rate of increase was slower than in metro areas, except for urbanized nonmetro areas not adjacent to a standard metropolitan statistical area (SMSA).
- The number of office-based general practitioners per 100,000 population fell, while the number of office-based specialists per 100,000 population rose in all regions and for all residential categories.
- Distribution of physicians in nonmetro areas varied widely among regions. Nonmetro areas in the Northeast had the most physicians per 100,000 population in 1979 (106), while the South had the fewest (71).
- Availability of hospital resources had the strongest impact on patterns of physician location.
- Nonmetro persistent low-income areas had 38 physicians per 100,000 population in 1979, compared with 82 in other nonmetro areas. This gap widened during the seventies.
- Both the increase in the national supply of physicians and the increase in Federal programs of the last two decades have contributed to the increase in the number of physicians in nonmetro areas.

Glossary—Residential Classification Scheme of Counties

This classification system is based on the metro-nonmetro county delineation announced in 1973 based on the results of the 1970 Census of Population.

Contiguous—Geographic contiguity at more than a single point or corner and where at least 1 percent of the labor force commutes to the metro central county for work.

Urban—Place or township, incorporated or unincorporated, of 2,500 or more population.

Metropolitan counties—Counties classified as Standard Metropolitan Statistical Areas (SMSA's) are defined as counties or groups of counties with at least one city of 50,000 residents or more, or twin cities with a combined population of at least 50,000. Contiguous counties are included in an SMSA if, according to a set criteria, they are socially and economically integrated with the central city.

Nonmetropolitan counties—Counties not classified as SMSA's.

Urbanized—Counties with 20,000 or more urban residents.

Adjacent to SMSA—Counties contiguous to an SMSA with 20,000 or more urban residents.

Not adjacent to SMSA—Counties not contiguous to an SMSA with 20,000 or more urban residents.

Less urbanized—Counties with 2,500-19,999 urban residents.

Adjacent to SMSA—Counties contiguous to an SMSA with 2,500-19,999 urban residents.

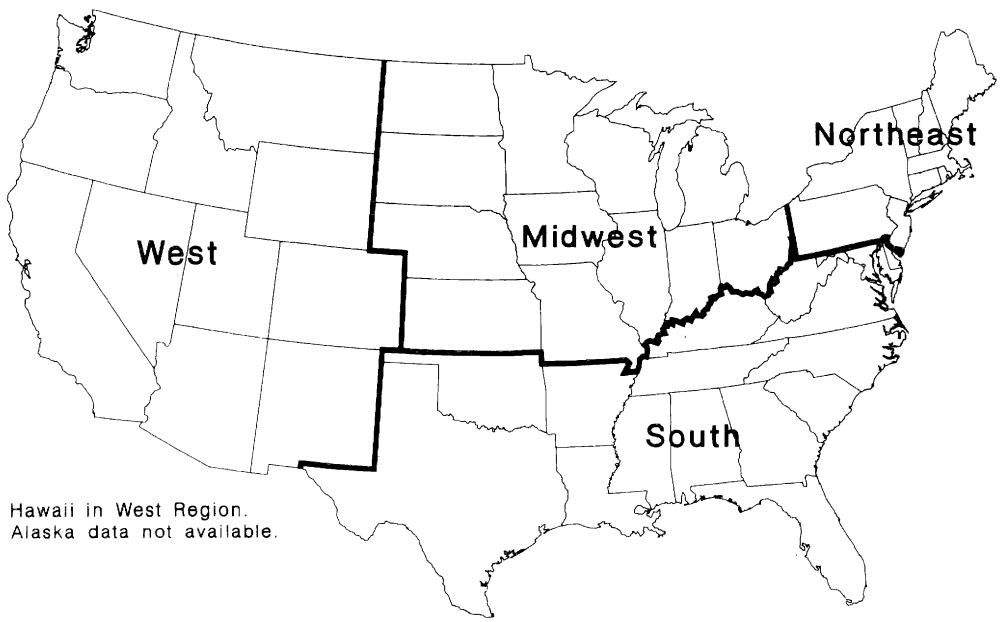
Not adjacent to SMSA—Counties not contiguous to an SMSA with 2,500-19,999 urban residents.

Thinly populated—Counties with fewer than 2,500 urban residents.

Adjacent to SMSA—Counties contiguous to an SMSA with fewer than 2,500 urban residents.

Not adjacent to SMSA—Counties not contiguous to an SMSA with fewer than 2,500 urban residents.

Regional Classification Scheme



Hawaii in West Region.
Alaska data not available.

Physicians in Nonmetro Areas During the Seventies

Mary C. Ahearn and Michelle D. Fryar*

Introduction

Adequate medical care is important in maintaining the productivity of the labor force and enhancing the well-being of society. This fact was recognized in the Rural Development Policy Act of 1980, charging the Secretary of Agriculture to develop a comprehensive rural development strategy to improve rural health care services (*24*).[1] Maintaining an adequate supply of physicians is particularly important. Physicians act as the gatekeepers to our medical delivery system, although the demand for physician services is derived from the demand for medical and institutional services. A patient cannot get private hospital care, ambulatory care, nursing care, or medication without the authorization of a physician.

This study describes the availability of physicians in nonmetro areas during 1970-79 in light of the changes in population, supply of physicians, and demand for medical care over that decade. Physician availability in chronically low-income areas, which have been important target areas for many economic and social programs, is emphasized through description and analysis of physician distribution patterns.

Background

The lack of medical care, particularly physicians, in nonmetropolitan areas has long been a matter of concern and study (*1, 16, 20*).[2,3] As of 1970, there were 67 physicians per 100,000 population in nonmetro areas, compared with 143 per 100,000 population in metro areas.[4]

The demand for physician services in nonmetro areas remained high and may have grown during the seventies. Nonmetro people experience poorer health than metro people. They suffer from more numerous chronic conditions and have higher maternal and infant mortality rates than their urban counterparts (*10, 17*). Growth of the nonmetro population was a major factor in increasing the demand for medical services. As the seventies progressed, population growth in nonmetro areas exceeded that in metro areas. The general rural-to-urban migration of the previous decades had begun to reverse; nonmetro counties experienced a 15.8-percent increase in population during 1970-80, compared with 9.8 percent in metro areas (*3*). Retirement, urban flight, resort activities, energy developments, and economic decentralization were thought to be the important sources of this growth (*3, 4*). Many of the new residents—the elderly and the well-educated, for example—were those who had traditionally been frequent users of medical care.

Population growth in nonmetro areas was accompanied by important changes to the medical care delivery system which affected patterns of physician location. First, the number of the Nation's physicians increased by 34 percent during the seventies, compared with about a 10-percent increase in total U.S. population. The increase in the number of physicians has been so remarkable that some researchers feel an oversupply currently exists (*12*). This has led to an increase in the incentives for physicians to relocate in underserved nonmetro areas to develop a full-time practice.

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[1]Italicized numbers in parentheses refer to references listed at the end of this report.

[2]Nonmetro areas are defined as those counties not designated SMSAs. Alaska was omitted because of data availability considerations.

[3]See Roemer for an historical account (*23*).

[4]Physicians are defined as active, non-Federal physicians in patient care. Office and hospital-based physicians, including residents, are included but doctors of osteopathy are not.

Second, demand for medical care has increased and has affected physician location patterns. The establishment of the publicly funded medical finance programs in 1965 for the aged and poor, Medicare and Medicaid, respectively, has also affected physician location patterns. These programs covered over 27 percent of all personal health care expenditures in 1979. Thus, the elderly, and especially the poor, have access to medical care which otherwise would be unavailable to them.

Data and Concepts

Data on the distribution of U.S. physicians is presented by physician specialty and geographic location. Physicians are defined as physicians actively engaged in patient care and not employed by the Federal Government. They are divided into two major categories: office-based physicians by specialty, and hospital-based physicians. This report describes and analyzes changes in the residential and regional distribution of the physician categories during 1970-79 using the latest set of years for which data are available.[5]

Although some data are reported as the total number of physicians, most data are reported as the ratio of the number of the physicians per 100,000 population. The physician-population ratio is calculated on an aggregate basis for regional and residential categories. The ratio is the primary instrument used to measure the availability of medical care. The ratio standardizes for population size and is thus useful in making comparisons across areas of different population size.

There are two major limitations, however, in using the physician-population ratio for measuring the availability of physicians. First, it does not give a precise measure of availability. For example, the ratio does not adjust for the fact that physicians are unequal in terms of hours worked, productivity, and quality of care. In addition, the ratio only measures availability within a specified geopolitical boundary, although residents sometimes do cross boundaries when seeking care. The ratio is not the only concept useful in analyzing the medical care delivery system. Concepts such as access (for example, the ability to pay for care or distance to care), an economic view of a shortage, equilibrium, or surplus, or the medical profession's view of adequacy or need are also useful for understanding and describing the medical care situation.[6] The physician-population ratio is adequate for many purposes, however, and national-level data are more readily available for it than for other measures.

The data analyzed in this study are at the county level. The data were obtained from the U.S. Department of Health and Human Services' (DHHS) Area Resource File (*26*).[7] The file is a compendium of health data which includes measures of availability of practitioners and services, health status, utilization of medical services, and general population characteristics.

Trends in Physician Location

Although the number of physicians per 100,000 population increased in all nonmetro areas during the seventies, the rate of increase was less than in metro areas, except in urbanized nonmetro areas not adjacent to an SMSA. Nonmetro areas still experienced a relative shortage of physicians—79 per 100,000 population, compared with 177 in metro areas.

Total Physicians

The number of U.S. physicians in patient care grew about three times as rapidly as the U.S. population during 1970-79 (*25, 26*). The physician-population ratio increased by 21 percent (table 1). In 1970, there were 123 physicians per 100,000 population: by 1979, there were 149. Most physicians in patient care are in office-based rather than hospital-based practices. Hospital-based physicians per 100,000, however, grew slightly faster than office-based physicians during the seventies (25 versus 20 percent).

Metro residents continued to have more physicians per 100,000 population than nonmetro residents during the seventies. The ratio of physicians per 100,000 population in nonmetro areas was 79 by 1979, compared with 177 in metro areas. Thinly populated areas

[5]Residential distribution refers to the classification scheme developed at the U.S. Dept. of Agriculture which delineates counties into metro and nonmetro categories. Regional distribution refers to the four Census regions—Northeast, Midwest, South, and West.

[6]The U.S. Dept. of Health and Human Services has proposed that there should be at least one primary care physician per 2,000 population (*9*).

[7]The only exception to this were the data on percentage of the population 65 years old or older, obtained from unpublished data provided by the DHHS' Administration on Aging.

Table 1—Distribution of residential population and physicians per 100,000 population, by type of practice

Residential distribution[1]	Population[2]			Physicians per 100,000 population[3]								
				Total			Office-based			Hospital-based practice		
	1970	1980	Percent-age change	1970	1979	Percent-age change	1970	1979	Percent-age change	1970	1979	Percent-age change
	---Thousand---		*Percent*	*--Number--*		*Percent*	*-Number-*		*Percent*	*-Number-*		*Percent*
United States	203,213	226,546	11	123	149	21	91	109	20	32	40	25
Metro total	148,809	163,526	10	143	177	24	102	124	22	41	52	27
Nonmetro total	54,404	63,020	16	67	79	18	60	69	15	7	10	43
Urbanized	21,045	24,396	16	86	108	26	76	92	21	10	16	60
Adjacent	12,650	14,802	17	81	97	20	71	84	18	9	13	44
Not adjacent	8,395	9,594	14	95	124	31	83	104	25	11	20	82
Less urbanized	26,726	30,879	16	59	67	14	54	60	11	5	7	40
Adjacant	13,092	15,350	17	55	62	13	50	55	10	6	7	17
Not adjacent	13,634	15,529	14	62	71	15	57	65	14	5	6	20
Thinly populated	6,633	7,745	17	37	40	8	36	37	3	1	3	200
Adjacent	2,268	2,737	21	35	36	3	33	32	−3	1	4	300
Not adjacent	4,365	5,008	15	39	43	10	37	40	8	2	3	50

[1]See glossary for definition.
[2]As of April.
[3]Physicians are defined as active, non-Federal patient-care physicians. Population data are as of July and physician data are as of December 31.
Source: (*25, 26*).

had only 40 physicians per 100,000 population in 1979, or 1 physician for every 2,500 residents (table 1). Although the absolute numbers of physicians locating in thinly populated areas increased, the increase in total population in these areas was relatively high. The ratio of physicians per 100,000 population in thinly populated areas thus increased only 8 percent during 1970-79.

Distribution of physicians within nonmetro areas in 1979 was about the same as in 1970. As the level of urbanization increased from thinly populated to less urbanized to urbanized areas, the physician-population ratio increased. Within each urbanization level, areas not adjacent to metro areas had more physicians per 100,000 population than areas adjacent to metro areas in all cases for both years. This fact likely reflects the willingness and ability of some residents in adjacent nonmetro areas to travel to nearby metro areas to seek medical care.

Hospital-Based Physicians

Hospital-based physicians (including resident physicians) have increased much faster in nonmetro areas than in metro areas (43 versus 27 percent, respectively). This is a curious finding given that the number of hospital beds grew more slowly in nonmetro areas than in metro areas during 1970-79 (*26*). Perhaps this can be explained by the need for nonmetro hospitals to 'catch up.' Hospital-based physicians and hospital beds are complementary inputs into the production of hospital care. Nonmetro areas have a higher hospital bed-population ratio than metro areas. But because nonmetro areas continue to have lower physician-population ratios for hospital-based physicians, the surge in the number of hospital-based physicians has allowed the number of physicians to catch up with the number of beds. There were 10 hospital-based physicians per 100,000 population in nonmetro areas in 1979 compared with 52 in metro areas. Physicians may also be more willing to locate in nonmetro hospitals rather than set up nonmetro office practices because they have access to more advanced technology and support from their counterparts in hospitals.

Office-Based Physicians

Office-based physicians are generally considered a patient's regular source of medical care, representing 73 percent of all physicians. The American Medical Association classifies physicians as general practitioners and

specialists. General practitioners (GPs), generally the physicians of first contact, accounted for 19 percent of all office-based physicians in 1979, down from 27 percent in 1970.[8] The remaining 81 percent of office-based physicians in 1979 were comprised of medical specialists, 27 percent; surgical specialists, 31 percent; and other specialists, 23 percent. Because the residential distribution patterns of the three groups of specialists are similar, they are combined into one specialist group for this report (table 2).

The number of office-based GPs per 100,000 population fell by 17 percent, from 24 to 20, between 1970 and 1979 (table 2). For an increasing population, a decrease in the physician-population ratio can result from either the population increasing faster than the increase in physicians, or from a decrease in the absolute number of physicians. For the GP situation, the latter was true as the number of office-based GPs fell from 50,304 to 46,061 during the seventies. Total number of GPs, however, did increase slightly from 57,948 in 1970 to 58,130 in 1979.

Although GPs are about evenly distributed over residence types, there were 19 GPs per 100,000 population in metro areas compared with 24 in nonmetro areas in 1979. The percentage decrease in the GP-population ratio during the seventies was also rather uniformly distributed. GPs per 100,000 population fell 17 percent in both metro and nonmetro areas. The number of GPs within nonmetro areas varied somewhat, with urbanized areas not adjacent to an SMSA experiencing the smallest decline (13 percent), and thinly populated adjacent areas experiencing the largest decline (21 percent), but overall the trend is rather consistent.

Unlike GPs, the specialist-population ratios vary greatly across county types. Specialists must draw their patients from larger base populations and need more advanced medical technology than GPs, so it is not surprising that specialists are more prevalent in metro areas. There were 105 specialists per 100,000 population in metro areas in 1979, compared with 45 in nonmetro areas. The uneven distribution of specialists thus accounts for some of the uneven distribution of all physicians by residence.

Within nonmetro areas, the specialists per 100,000 population were positively related to the degree of urbanization; the more urbanized the area, the more specialists per unit of population. Within nonmetro urbanization levels, adjacency to an SMSA was associated with lower specialist-population ratios. The areas with the lowest specialist-population ratios, thinly populated areas, had 12 specialists per 100,000 population in 1979. These were the only areas where GPs

[8]GPs include family practitioners. Certain specialists do provide primary care, such as pediatricians, specialists in obstetrics and gynecology, and internists.

Table 2—Office-based physicians per 100,000 population by specialty and residential distribution[1]

Residential distribution[2]	General practitioners			Specialists		
	1970	1979	Percentage change	1970	1979	Percentage change
	----*Number*----		*Percent*	----*Number*----		*Percent*
United States	24	20	−17	67	89	33
Metro total	23	19	−17	80	105	31
Nonmetro total	29	24	−17	31	45	45
Urbanized	25	21	−16	51	71	39
Adjacent	26	21	−19	45	63	40
Not adjacent	24	21	−13	59	83	41
Less urbanized	32	27	−16	21	33	57
Adjacent	31	25	−19	19	29	53
Not adjacent	34	28	−18	24	37	54
Thinly populated	29	24	−17	7	12	71
Adjacent	29	23	−21	5	9	80
Not adjacent	30	25	−17	7	14	100

[1]Active, non-Federal physicians in patient care.
[2]See glossary for definition.
Source: (26).

still outnumbered the specialists. The seventies, however, did see a tendency toward a more even distribution of specialists. The number of specialists per 100,000 population increased by 45 percent in nonmetro areas, compared with a 31-percent increase in metro areas. The rate of increase within nonmetro areas was also greater the more rural the area.

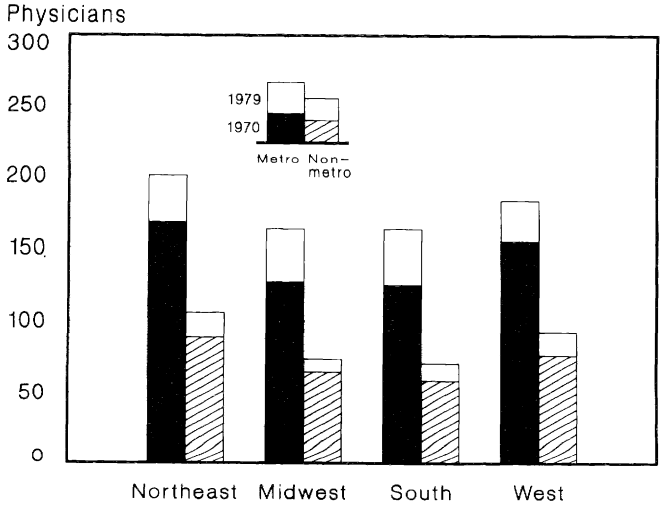
Regional Trends

Regional trends parallel the national trends of fewer total physicians, fewer hospital-based physicians, and fewer specialists but more GPs per 100,000 population in nonmetro areas than in metro areas (see app. tables 1-4). The physician-population ratio was also positively related to the level of urbanization in almost all the nonmetro areas, except for GPs. The less urbanized and thinly populated areas actually had more GPs per unit of population than did urbanized nonmetro areas and metro areas, but GPs were more evenly distributed than specialists.

Although the trends are similar, the number of physicians per 100,000 population and the changes which occurred during the seventies vary by region (fig. 1). The Northeast had the highest physician-population ratio of all regions in both metro and nonmetro areas in 1970 and 1979. In 1979, there were 106 physicians in patient care per 100,000 population in nonmetro areas of the Northeast, 93 in the West, 74 in the Midwest, and 71 in the South. The physician-population ratios vary among regions for all nonmetro residential categories. In general, the Midwest and South had much lower physician-population ratios than other regions.

Figure 1

Physicians per 100,000 Population in Metro and Nonmetro Areas, by Region



Active nonfederal physicians in patient care.
Source: (26).

Metro/nonmetro differences in physician distribution patterns also vary by region. In 1979, total physicians per 100,000 population in nonmetro areas were only 45 percent of the total physicians per 100,000 population in metro areas. This indicator of the disparity between metro and nonmetro areas for the four regions shows that the greater the physician availability in the region, the less the metro-nonmetro disparity. Regions with the lowest physician-population ratios in 1979, the Midwest and South, had the greatest disparity between metro and nonmetro areas—a disparity which worsened during the seventies.

Since the physician-population ratio standardizes only for population variation, one must be cautious in comparing regions which differ in such respects as population density and topography. Nowhere is this more true than in very sparsely populated areas of the West, which compare favorably to other regions in physician-population ratios, but where the distance to the nearest physician may be considerable. The population density of the West in 1980 was 24.6 persons per square mile, compared with the national average of 64. The rural population also grew faster in the West—18.2 percent—than in any other region during the seventies. Although the great majority of Westerners live in urbanized areas, approximately 7 million residents live in rural areas. These individuals likely travel longer distances to obtain physician care than rural residents of other regions.

Physicians in Low-Income Areas

Many of the economic and social gaps between metro and nonmetro areas are narrowing, but in 1980, nonmetro residents accounted for 28 percent of the total population but 34 percent of the persons (9.3 million) living in poverty (25). Some nonmetro areas, bypassed by development, have been persistently poor during the past several decades. Low-income areas are identified either as those with large portions of the population below the poverty line, or with low per capita incomes. Davis used the per capita concept in defining nonmetro persistent low-income (PLI) areas (8). PLI

crease in the national supply of physicians and Federal programs of the last two decades have contributed to the increase in the number of physicians in nonmetro areas. These findings are consistent with the general improvement in the quality of life in nonmetro areas. The number of specialists per 100,000 population is still much lower in nonmetro areas than in metro areas, but nonmetro areas saw a higher rate of increase during the seventies. The population density of an area has generally had a strong positive effect on the specialist-population ratio.

The number of office-based GPs per 100,000 population, on the other hand, declined nationwide during the seventies. Nonmetro areas actually had a higher ratio of GPs to population than did metro areas; the decline in the number of GPs to the population was constant between metro and nonmetro areas. Because GPs traditionally were more evenly distributed than specialists, the decline in general practitioners had a strong impact on the nonmetro medical delivery system.

Availability of hospital resources had the strongest effect on patterns of physician location. The medical education system has recognized both the increasing dependence of physicians on sophisticated technology as well as the decline in the number of GPs. The medical system has thus focused on the family practitioner as a specialty, and offered training in this specialty in underserved areas. This new focus may encourage new physicians to locate in these areas, particularly thinly populated areas. Some specialists, such as pediatricians, are already providing general primary care, a practice likely to continue with the decrease in GPs. Further research is needed to determine the extent that specialists are providing general primary care before the effects of the decline in number of GPs can be understood.

Despite improvements in the availability of physician services in nonmetro areas, some nonmetro areas have been overlooked. This is particularly evident in sparsely populated areas and in PLI areas. Sparsely populated areas, through development, may be linked to regional medical systems. Until that occurs, however, emergency medical systems will be the only source of care in the most isolated communities. Government intervention through such programs as the National Health Service Corps will remain necessary where poverty, or lack of demand, has deterred development and been the root cause of lack of physicians.

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Appendix Table 1—Residential distribution of total active, non-Federal, patient care physicians per 100,000 population, by region

Residential distribution	Northeast			Midwest			South			West		
	1970	1979	Percentage change	1970	1979	Percentage change	1970	1979	Percentage change	1970	1979	Percentage change
	-Number-		Percent	-Number-		Percent	-Number-		Percent	-Number-		Percent
Total	157	186	18	108	135	25	100	129	29	140	164	17
Metro total	168	200	19	127	163	28	125	163	30	155	183	18
Nonmetro total	89	106	19	65	74	14	59	71	20	77	93	21
Urbanized	91	108	19	87	109	25	82	106	29	89	109	22
Adjacent	82	96	17	86	103	20	72	90	25	85	103	21
Not adjacent	130	166	28	89	119	34	91	121	33	94	117	24
Less urbanized	87	103	18	58	62	7	53	61	15	68	83	22
Adjacent	92	110	20	52	54	4	50	58	16	65	79	22
Not adjacent	81	94	16	63	69	10	56	65	16	69	84	22
Thinly populated	69	83	20	36	35	-3	34	37	9	51	55	8
Adjacent	55	58	5	36	32	-11	31	34	10	54	49	-9
Not adjacent	77	98	27	36	36	0	36	40	11	49	57	16

Source: (26).

Appendix Table 2—Residential distribution of active, non-Federal, patient care, hospital-based physicians, per 100,000 population, by region

Residential distribution	Northeast			Midwest			South			West		
	1970	1979	Percentage change	1970	1979	Percentage change	1970	1979	Percentage change	1970	1979	Percentage change
	-Number-		Percent	-Number-		Percent	-Number-		Percent	-Number-		Percent
Total	52	63	21	28	38	36	22	31	41	26	33	27
Metro total	57	71	25	38	52	37	33	45	36	31	39	26
Nonmetro total	14	20	43	6	9	50	5	9	80	5	7	40
Urbanized	13	19	46	11	17	55	10	16	60	6	9	50
Adjacent	8	13	63	15	20	33	6	9	50	7	9	29
Not adjacent	37	52	41	4	12	200	14	23	64	4	9	125
Less urbanized	16	22	38	4	5	25	4	6	50	5	6	20
Adjacent	22	31	41	4	4	0	4	6	50	6	6	100
Not adjacent	8	11	38	5	6	20	4	6	50	4	6	50
Thinly populated	1	9	800	1	2	100	2	3	50	3	5	67
Adjacent	1	4	300	1	2	100	1	4	300	6	5	-17
Not adjacent	1	12	1100	1	2	100	2	3	50	2	5	150

Source: (26).

Appendix Table 3—Residential distribution of active, non-Federal, patient care, office-based general practitioners per 100,000 population, by region

Residential distribution	Northeast			Midwest			South			West		
	1970	1979	Percentage change	1970	1979	Percentage change	1970	1979	Percentage change	1970	1979	Percentage change
	-Number-		Percent	-Number-		Percent	-Number-		Percent	-Number-		Percent
Total	24	18	-25	24	21	-13	22	19	-14	30	24	-20
Metro total	24	17	-29	21	18	-14	19	17	-11	29	23	-21
Nonmetro total	27	21	-22	31	27	-13	27	22	-19	34	28	-18
Urbanized	25	19	-24	25	22	-12	23	20	-13	30	26	-13
Adjacent	26	19	-27	27	22	-19	24	20	-17	29	26	-10
Not adjacent	23	18	-22	22	21	-5	22	19	-14	31	26	-16
Less urbanized	30	23	-23	35	30	-14	30	24	-20	38	31	-18
Adjacent	28	23	-18	35	28	-20	29	23	-21	36	30	-17
Not adjacent	32	24	-25	36	31	-14	30	25	-17	38	32	-16
Thinly populated	39	29	-26	30	26	-13	26	22	-15	40	31	-23
Adjacent	41	30	-27	30	24	-20	26	21	-19	44	32	-27
Not adjacent	37	28	-24	30	26	-13	26	23	-12	39	31	-21

Source: (26).

Appendix Table 4—Residential distribution of active, non-Federal, patient care, office-based specialists per 100,000 population, by region

Residential distribution	Northeast			Midwest			South			West		
	1970	1979	Percentage change	1970	1979	Percentage change	1970	1979	Percentage change	1970	1979	Percentage change
	-Number-		Percent	-Number-		Percent	-Number-		Percent	-Number-		Percent
Total	82	104	27	55	75	36	56	78	39	83	107	29
Metro total	87	111	28	67	93	39	74	100	35	95	120	26
Nonmetro total	48	65	35	27	39	44	27	40	48	38	58	53
Urbanized	52	69	33	51	70	37	49	70	43	54	75	39
Adjacent	48	64	33	44	61	39	42	61	45	48	68	42
Not adjacent	70	96	37	63	86	37	55	79	44	60	82	37
Less urbanized	41	57	39	18	27	50	20	31	55	25	45	80
Adjacent	41	56	37	14	21	50	17	28	65	22	44	100
Not adjacent	41	59	44	21	32	52	22	34	55	27	46	70
Thinly populated	28	45	61	5	7	40	6	12	100	7	19	171
Adjacent	12	25	108	5	6	20	5	9	80	4	12	200
Not adjacent	38	58	53	5	8	60	8	14	75	8	21	163

Source: (26).

Appendix Table 5—Regression estimates of active, non-Federal, office-based, patient-care general practitioners per 100,000 population, by region in nonmetro counties

Region/independent variables	1970		1978	
	Beta	b	Beta	b
		Number		
Northeast:				
Per capita income	0.182	0.005	0.177	0.004
Percent 65 years and older	.411	[1]2.256	.271	[2]1.130
Percent nonwhite	−.027	−.199	−.033	−.181
Hospital beds per population	.073	.003	.101	.003
Population per square mile	−.187	−.024	−.262	[3]−.026
Constant	NA	−10.981	NA	−4.361
R^2	NA	.2678	NA	.1543
N	NA	116	NA	116
F	NA	[1]8.05	NA	[2]4.01
Chow test—Northeast 1970 versus Northeast 1978		[1]F 6,220 = 9.38		
		Number		
Midwest:				
Per capita income	0.148	[1]0.005	0.118	[1]0.003
Percent 65 years and older	.143	[1].720	.095	[3].447
Percent nonwhite	−.070	[3]−.195	−.051	−.117
Hospital beds per population	.370	[1].019	.419	[1].019
Population per square mile	−.046	−.022	−.044	−.020
Constant	NA	−.054	NA	2.420
R^2	NA	.2247	NA	.2474
N	NA	873	NA	873
F	NA	[1]50.25	NA	[1]56.99
Chow test—Midwest 1970 versus Midwest 1978		[1]F 6,1734 = 16.44		

See footnotes at end of table.

Continued—

Appendix Table 5—Regression estimates of active, non-Federal, office-based, patient-care general practitioners per 100,000 population, by region in nonmetro counties—Continued

Region/independent variables	1970		1978	
	Beta	b	Beta	b
		Number		
South:				
Per capita income	0.101	[1]0.003	0.036	0.001
Percent 65 years and older	.151	[1].581	.144	[1].479
Percent nonwhite	.012	.010	.002	.001
Hospital beds per population	.307	[1].016	.286	[1].014
Population per square mile	-.109	[1]-.041	-.109	[1]-.033
Constant	NA	[1]11.086	NA	[1]12.394
R^2	NA	.1711	NA	.1407
N	NA	1106	NA	1106
F	NA	[1]45.41	NA	[1]36.02
Chow test—South 1970 versus South 1978		[1]F 6,2200 = 15.44		
		Number		
West:				
Per capita income	0.043	0.001	0.086	0.002
Percent 65 years and older	.070	.045	.055	.024
Percent nonwhite	-.108	[3]-.242	-.132	[3]-.228
Hospital beds per population	.336	[1].025	.210	[1].012
Population per square mile	-.057	-.059	-.034	-.025
Constant	NA	[1]23.921	NA	[1]19.545
R^2	NA	.1451	NA	.0933
N	NA	351	NA	351
F	NA	[1]11.71	NA	[1]7.10
Chow test—West 1970 versus West 1978		[2]F 6,690 = 3.29		

NA = Not applicable.
[1]$p < .001$.
[2]$p < .01$.
[3]$p < .05$.
Source: (26).

Appendix Table 6—Regression estimates of active, non-Federal, office-based, patient-care specialists per 100,000 population, by region in nonmetro counties

Region/independent variables	1970		1978	
	Beta	b	Beta	b
		Number		
Northeast:				
Per capita income	0.117	[2]0.017	0.094	0.012
Percent 65 years and older	.027	.565	−.039	−1.003
Percent nonwhite	−.078	−2.143	−.056	−1.912
Hospital beds per population	.802	[1].139	.786	[1].150
Population per square mile	.110	.052	.158	[3].098
Constant	NA	[1]−77.963	NA	−46.618
R^2	NA	.6841	NA	.6435
N	NA	116	NA	116
F	NA	[1]47.65	NA	[1]39.71
Chow test—Northeast 1970 versus Northeast 1978		F 6,220 = .41		
		Number		
Midwest:				
Per capita income	0.002	0.0001	0.026	0.001
Percent 65 years and older	−.098	[2]−.677	−.172	[1]−1.482
Percent nonwhite	.004	.016	.005	.020
Hospital beds per population	.366	[1].026	.322	[1].026
Population per square mile	.390	[1].263	.388	[1].324
Constant	NA	4.432	NA	[3]15.521
R^2	NA	.3182	NA	.3233
N	NA	873	NA	873
F	NA	[1]80.92	NA	[1]82.84
Chow test—Midwest 1970 versus Midwest 1978		[1]F 6,1734 = 4.83		

See footnotes at end of table.

Continued—

Appendix Table 6—Regression estimates of active, non-Federal, office-based, patient-care specialists per 100,000 population, by region in nonmetro counties—Continued

Region/independent variables	1970		1978	
	Beta	b	Beta	b
		Number		
South:				
Per capita income	0.194	[1]0.007	0.167	[1]0.007
Percent 65 years and older	.040	.234	.054	[3].404
Percent nonwhite	.040	.047	.054	[3].093
Hospital beds per population	.275	[1].021	.288	[1].031
Population per square mile	.516	[1].290	.542	[1].377
Constant	NA	[1]−26.928	NA	[1]−35.406
R^2	NA	.4552	NA	.4796
N	NA	1106	NA	1106
F	NA	[1]183.81	NA	[1]202.73
Chow test—South 1970 versus South 1978		[1]F 6,2200 = 5.15		
		Number		
West:				
Per capita income	0.097	0.004	0.258	[1]0.011
Percent 65 years and older	−.019	−.015	−.056	−.042
Percent nonwhite	.027	.073	.082	.251
Hospital beds per population	.102	[3].009	−.060	−.006
Population per square mile	.407	[1].508	.316	[1].403
Constant	NA	−1.721	NA	−18.049
R^2	NA	.1955	NA	.2007
N	NA	351	NA	351
F	NA	[1]16.77	NA	[1]17.33
Chow test—West 1970 versus West 1978		F 6,690 = 1.83		

NA = Not applicable.
[1]$p < .001$.
[2]$p < .01$.
[3]$p < .05$.
Source: (26).

Appendix: Regression Results of the Distribution of General Practitioners and Specialists, by Region

The distribution of physicians differs by specialty as a result of the division of labor within the medical system. Separate equations are thus estimated for GPs and specialists because the factors in the analysis should affect location patterns differently. The distribution of physicians also differs by Census region. Preliminary analyses used a single national level equation for GPs and for specialists, and included dummy variables for the Census regions to determine whether the regional differences are accounted for by differences in other variables. All dummy variables for the specialists model and two of the dummy variables in the GP model were statistically significant ($p < .05$). This result indicates that relationships differ among regions. Separate equations were thus estimated by Census region and the regional trends became apparent. The regional equations allow for a better understanding of the factors affecting physician distribution throughout the Nation.

Although differences were expected between the GPs' and specialists' models and by regions, these differences were generally expected to be one of the magnitude of the relationships rather than the direction of the relationships, with one exception. Based on evidence from the descriptive section (table 2), population density was expected to be negatively related to the distribution of GPs and positively related to the distribution of specialists. The independent variables and the direction of their expected relationship to the physician-population ratios were hypothesized to be:

- Per capita income was expected to be positively related to the physician-population ratio because higher income persons can better afford to pay for physician care and because higher incomes may indicate a higher quality of life which would attract more physicians. The magnitude of this relationship may be greater for specialists than for GPs because of the added expense of specialty care.

- Percentage of the population 65 or older was expected to be positively related to the physician-population ratio because older persons require more health care than persons in other age groups. Thus, the magnitude of the relationship in the specialist model was expected to be greater than in the GP model.

- Percentage of the population which was nonwhite was expected to be negatively related to the physician-population ratio because nonwhite persons may use physician services less than white persons for social and economic reasons. No difference in magnitude or direction was expected between this factor and its relationship to the specialists- or GPs-population ratio.

- Hospital beds per 100,000 population was expected to be positively related to the physician-population ratio because many medical procedures require the technology and support services of a hospital. The magnitude of this relationship was expected to be greater in the specialists' model because their practice generally requires more dependence on hospital technology.

- Population per square mile was expected to be positively related to the specialists-population ratio and negatively related to the GP-population ratio. This is because a financially successful medical practice for a specialist requires a larger minimum population base within easy travel distance than does a GP practice. Therefore, GPs have a comparative advantage when locating in less dense areas.[12]

The regressions are estimated with ordinary least squares (OLS), the most common regression estimation technique, which is equivalent to determining the parameter estimates which minimize the residual sum of squares. Regression analysis results include (1) the statistical significance of the overall model based on the "F" distribution, (2) the total variation in the physician-population ratio explained by the model, R^2, (3) the statistical significance of the independent variables based on the "t" distribution, and (4) the amount of change in the physician-population ratio with a one-unit change (unstandardized coefficient

[12]Multicollinearity between these variables is not viewed as a serious concern since 90 percent of the correlations between pairs of variables have a correlation coefficient less than 0.3 and the majority are less than 0.1.

denoted as "b") or a one-standard deviation change (standard coefficient denoted as Beta) in the independent variable. The Chow test is based on a statistic computed from the residual sum of squares of the regressions and follows an "F" distribution (*5, 20*).

General practitioners

The results of the regression analyses indicate that the models were all statistically significant ($p < .05$), and the proportion of variation explained ranged from 9 to 27 percent for the four regions and two time periods (app. table 5).[13] When the variables were significant, per capita income, percentage of the population 65 and over, and hospital beds-population ratios were positively related to GPs per 100,000 population. Percentage of the population which was nonwhite and population density were negatively related to GPs per 100,000 population when they were statistically significant. All independent variables had the expected relationship to GP availability. The statistical tests for structural differences between the factors affecting distribution of GPs in 1970 and 1978 also indicated that there indeed were structural differences between the two time periods for all regions.

Very few variables were significant in the Northeast model. The percentage of the population 65 years or older was significant during both time periods and was the most important community attribute explaining variation in physician location. Population density was also significant in 1978. Comparison of the regression estimates for the two time periods suggests that percentage of the population 65 years or older and the population density may be the source of the structural change indicated by the significant Chow statistic. Overall, the 1970 equation explained more of the variation in the distribution of GPs than did the 1978 equation. The percentage of the population which was elderly was much stronger in 1970 than in 1978 in terms of unit effects, and the population density was significant in the 1978 equation but not in the 1970 equation.

Per capita income, percentage of population which was elderly, and the number of hospital beds per population were significant in both time periods in the Midwest. The number of hospital beds was the most important explanatory variable in this region as indicated by the size of Beta. Percentage of the population which was nonwhite was also significant in the 1970 model. The source of the structural change between the two time periods in the Midwest may be due to the differences in the significance and size of the percentages of the elderly and nonwhite coefficients.

Percentage of the population which was elderly, hospital beds per population, and density were significant in both time periods, and per capita income was significant in 1970 in the South. As in the Midwest, the number of hospital beds was the most important explanatory variable in the South. The structural change between the two time periods there may be due to differences in the significance of per capita income.

Percentage of the population which was nonwhite and hospital beds per population were significant in both time periods in the West. Again, the number of hospital beds was the most important explanatory variable. Both variables were somewhat stronger in the 1970 equation than in the 1978 equation, suggesting that they may have been the source of the structural change.

Specialists

As in the models for GPs, the models for specialists were all statistically significant ($p < .05$) and the proportion of variation in specialists per population explained varied substantially among regions (app. table 6). The proportion of variation explained by the selected independent variables, however, was higher for specialists (from 20 in the West to 68 in the Northeast) than it was for GPs.

The independent variables which were significant in each region had the hypothesized relationships to availability, with two exceptions. Contrary to expectations, the percentage of the population which was nonwhite was positively related to availability in 1978 in the South. Multicollinearity with other independent variables does not appear to explain this surprising result, and no other explanation is obvious. This result should consequently be interpreted with caution until further analysis can provide a better understanding of the relationships. The percentage of the population which was elderly was unexpectedly found to be negatively related to availability in both time periods in the

[13] Hereafter, significant implies significance at $p < .05$.

Midwest. This may be due to multicollinearity between population density and percentage of the population which was elderly, making it impossible to separate out the independent effects of the variables. A positive effect of the percentage of the population which was elderly may have been overshadowed, since density and percentage of the population which was elderly are negatively correlated and density is a significant and positive factor in explaining specialist distribution. The test for structural differences between the two time periods indicated that structural change occurred only in the Midwest and South.

The number of hospital beds per population was significant in both time periods in the Northeast, and was the most important explanatory variable. Per capita income in 1970 and population density in 1978 were also significant. Percentage of the population which was elderly, number of hospital beds per population, and population density were significant factors in explaining the per capita distribution of specialists in both time periods in the Midwest. Population density was the most important explanatory variable followed closely by number of hospital beds. Percentage of the population which was elderly and population density may have been the sources of structural change between the two time periods in the Midwest because both variables had stronger effects in 1970 than in 1978. Per capita income, number of hospital beds per population, and population density were significant in both time periods in the South; population density was by far the strongest explanatory variable. Percentages of the population which were elderly and nonwhite were also significant in 1978; the change in their significance between the two time periods may have been the source of the structural change in this region. The stronger unit effect of hospital beds and population density in the 1978 equation may also have contributed to the structural change. The population density was significant in both time periods, number of hospital beds was significant in 1970, and per capita income was significant in 1978 in the West.

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