
A Simplified Method for Approximation of Shortages of Rural Physicians

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MALDISTRIBUTION of primary care physicians clearly exists in the United States. There are shortages in both rural and inner-city areas (1-3). On the other hand, programs have been started and health professionals have been placed in areas that mistakenly were thought to be in need of them or where physician shortages were overestimated. For example, some communities without a primary care practitioner tend to claim need of one regardless of nearby resources. The need is seldom evaluated before a practitioner is brought to an area, and often the result is a wasting of resources in both human and economic terms.

Because of the renewed interest in regional health planning and development, data are required on which to base decisions about allocation of resources. Such data should be provided to the health planners by regional or State agencies.

Other studies of physician distribution have been reviewed (4). Many of the proposed methods are sophisticated and theoretical. Many require data that are more difficult to collect and more expensive to analyze than those we describe. Our study documents the capacity of existing primary care physicians to provide care for a volume of patients, and it maps quantitatively the physician distribution in a region. The method is simple, relatively inexpensive, and easy to interpret by those engaged in local planning.

The Rochester, N.Y., region is a 10-county area of 1.3 million people. Our study deals with the nine rural and semi-rural counties outside the Rochester area (Monroe County) and includes the small city of Elmira in Chemung County. Table 1 shows three clear trends in total physician to population ratios in the region—a continuing decrease since 1905 in the rural counties, a plateauing in Chemung County, and an increase in Monroe County.

Method

The methodology includes five steps: (a) analysis of the population, broken down into small geographic units—enumeration districts (EDs), and of the projected population growth, (b) analysis of the physi-

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cian population and calculation of their capacity to provide care for a volume of patients, (c) geographic mapping of the physician capacity for major population centers, (d) analysis of the potentially underserved areas not covered by such capacity and, after addition of isolated physicians, an estimate of the shortage of physicians in each underserved area, and (e) further analysis of each undeserved area.

These steps were carried out by use of two sets of assumptions or conditions, as follows:

<i>Analysis of—</i>	<i>Condition 1</i>	<i>Condition 2</i>
Population demand rate (average visits per year per capita)	3	4
Physician productivity rate (average total annual patient visits)	6,000	5,000
Corresponding primary physician to population ratio	1/2,000	1/1,250

Current patient demand (not patient need) for primary care is reported to be 3.49 physician visits per year in the rural areas of the United States (5). Current physician productivity in primary care is reported to be 5,197 patient visits per year per physician (6). The figures of 5,000 to 6,000 annual visits per physician correspond to a daily load of 16 to 24 patient visits. Condition 1, as shown, assumes a lower patient demand and greater physician productivity; thus, it leads to a more conservative estimate of underserved areas. Condition 2 leads to the designation of more areas as underserved.

Population and projections. Population figures were obtained for each of the smallest units measured by the first count of the 1970 census, that is, EDs consisting of approximately 800 persons each. Population figures projected for 1975 were obtained from the regional health boards (A-95 agencies).

Physician capacity. Primary care physicians are those in general and family practice, pediatrics, internal medicine, and obstetrics-gynecology. An active physician inventory is maintained. The Rochester region has 14 population centers with 4 or more primary physicians. Each center has an aggregate physician capacity to deliver primary services. The number of persons that can be served by those physicians is defined as follows:

Physician capacity equals the number of primary physicians (P) times the physician productivity rate (R , patients visits per year) divided by the annual per capita rate of demand (V , visits per person per year). For example, if a population center has 10 primary physicians (P) and, under condition 1, the average patient makes 3 visits per year (V) and the average physician manages 6,000 visits per year (R), the capacity of that center is: $P \times R \div V = 10 \times 6,000 \div 3 = 20,000$ persons.

Table 1. Number of non-Federal physicians per 100,000 population, Rochester region, by county and year

<i>County</i>	<i>1905</i>	<i>1920</i>	<i>1940</i>	<i>1960</i>	<i>1970</i>
Metropolitan-urban					
Chemung	175	129	117	120	121
Monroe	112	120	131	185	235
Rural					
Livingston	160	111	117	64	47
Ontario	177	151	137	132	119
Orleans	142	125	126	53	54
Schuyler	214	130	92	80	55
Seneca	145	110	89	53	66
Steuben	145	125	105	93	89
Wayne	135	121	117	74	65
Yates	116	169	171	76	77

Mapping physician capacity. Since the number of people is known for each ED, one can easily shade in the areas covered by the physician capacity of each population center on a map of the region (see map). This is necessarily a subjective exercise; it is accomplished by working outward from each center and adding more EDs until one contiguous service area surrounds each center and the population included in each equals its aggregate physician capacity.

Reasonable traveling distance (20–30 minutes) and available roads are taken into account. Overlaps with the mapped capacity of adjacent population centers are avoided where possible. The shaded areas on the map, however, reveal some overlapping areas as well as areas not “covered” by physician capacity; these not-covered areas are designated as “potentially underserved” and are numbered. Obviously, there are more underserved areas under condition 1 than under condition 2.

Analysis of potentially underserved areas. Each underserved area has, by definition, no physicians from the population centers, but it may have isolated physicians. With the raw data for physician numbers and population in the EDs in each underserved area, the physician shortage is readily calculated for each area, and a shortage-intensity ratio is determined for each area; it is now possible to construct a table (table 2), as follows:

Physician shortage equals $P \times V \div R$ minus the number of local physicians and then divided by the population (p) to obtain a “shortage-intensity ratio”; that is, $V \div R$ less the ratio of the number of local physicians to population (in thousands). For example, when the number of local physicians is zero, the shortage intensity ratio is identical to $V \div R$ (a constant 0.500 for condition 1 and 0.800 for condition 2).

Refinements were applied to this procedure—the application of age-specific visit rates and the physician productivity of the different primary care specialties and of physicians over age 65—and the estimates of physician shortage were recalculated. When compared to the results obtained from the procedure as outlined, the use of these refinements failed to significantly affect the relative differences between area physician shortages. Thus, the more-involved procedure in calculating the measures of shortage proved to be unnecessary.

Further analysis of each underserved area. With use of the 1970 census data and the 1975 population projections, the EDs of each underserved area are broken down according to the age, sex, and growth rate of the population. From the physician inven-

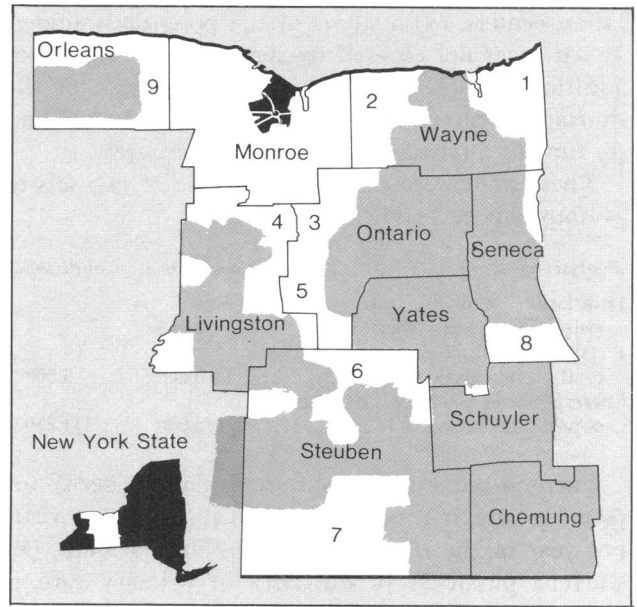
Table 2. Potentially underserved areas in Rochester region as determined under 2 sets of assumptions, condition 1 and condition 2¹

Area	Physician shortage		Population	Shortage intensity	
	Number	Rank		Number	Rank
<i>Condition 1</i>					
1	1.65	6	9,295	0.178	6
2	3.70	3	21,403	0.173	7
3	0.47	9	8,938	0.053	9
4	1.77	5	13,538	0.131	8
5	2.87	4	9,733	0.295	3
6	1.65	7	7,300	0.226	4
7	4.04	2	8,081	0.500	1
8	0.69	1	3,384	0.204	5
9	6.41	1	14,820	0.432	2
<i>Condition 2</i>					
1	5.64	11	15,795	0.357	15
2	16.45	3	31,823	0.516	13
3	2.89	17	13,776	0.210	16
4	7.23	7	16,539	0.437	14
5	7.46	6	11,834	0.630	7
6	6.54	9	10,673	0.613	9
7	6.46	10	8,081	0.800	1
8a	8.46	5	11,831	0.715	5
8b	3.56	15	5,694	0.625	8
9	17.49	2	23,111	0.757	3
10	2.95	16	15,900	0.185	17
11	5.28	14	9,106	0.579	11
12	6.66	8	12,071	0.552	12
13	5.54	12	6,932	0.799	2
14	5.33	13	9,167	0.581	10
15	9.30	4	14,132	0.658	6
16	26.11	1	35,135	0.743	4

¹ See text for explanation of conditions 1 and 2.

NOTE: A detailed analysis of each shortage area is not included here. However, a profile can be readily constructed for each area by use of the data already described. For example, the age and sex breakdown of the population is known for the enumeration districts of each area and, from the physician inventory, the physicians located there, if any, can be identified by specialty, age, and whatever other information is available.

The Rochester region



NOTE: Shaded areas indicate the physician capacity of the population center (under condition 1, see text). Potentially underserved areas are numbered. Monroe County is excluded.

tory, physicians in the shortage areas can be identified by specialty, age, and other characteristics.

Results

Nine potentially underserved areas were identified in the Rochester region (see map) under the assumptions of condition 1. Under condition 2, which assumes greater patient demand and lower physician productivity, 17 underserved areas were identified.

When the areas were analyzed further, with physicians practicing in the remote areas included, all the potentially underserved areas were, in fact, shortage areas. Table 2 lists (in full-time equivalents) the number of physicians needed in each area, as well as the shortage intensity of each area—a factor that ranks the seriousness of the shortage in various areas.

Discussion

In small rural areas, small changes in statistics on physicians can change the shortage-intensity ranking markedly. The results of this study emphasize the sensitivity of the indicator of primary care need to both per capita demand rate and physician productivity rate.

Limitations of the study methodology are as follows:

- Adjacent areas (the city of Rochester and adjacent regions) were excluded from the study. Depending

on the population's ability to travel to the city or outside the region, the capacity of physicians in the areas excluded might extend to parts of the nine rural areas studied.

- Geographic areas are treated as homogeneous, distinct wholes. However, the allocation of the population center's physician capacity by mapping requires subjective judgments. Moreover, our definitions are based on certain assumptions about physicians and patients. Actually, of course, physician and patient behavior varies. To determine the actual patient loads of each physician's practice and where patients actually go for care would require detailed survey techniques.

- The rates for patient demand and physician productivity are simple aggregate averages. With further refinement, one could consider the differential demand of various segments of the population, such as the young and the aged in each area. Other specialties that may be providing primary care (for example, general surgeons), as well as physician's assistants, may be added.

- In the absence of recognized standards, one cannot assume that the geographic areas appearing to be underserved are indeed so. People might be able to travel outside these areas if, for example, an acceptable standard were that primary care should be available within an hour's drive. Without such standards, therefore, the sites where new physicians might be placed cannot be judged from physician-capacity maps. On the other hand, in our region the generally accepted standard is 20–30 minutes of travel time, and the nine shortage areas identified (under condition 1) have proved appropriate for new practices.

Despite the preceding limitations, however, staffs of health planning and development agencies in the region consider the findings well based. Ten small medical care practices have been established in communities serving shortage areas that were targeted by our methodology. Alternate approaches to primary care—satellite health centers, rural group practices, and physician's assistants or nurse practitioners—have been used. All the practices are small, conservative programs that are organizationally geared to meet the needs and resources of their areas. Two satellite centers are used as offices for part-time physicians. Eight satellite centers use physician's assistants and nurse practitioners, who receive medical backup (frequent consultation and direct supervision) from group practice physicians. Part-time physicians rotate through the satellite centers. The physician's assistants and nurse practitioners repre-

sent a fraction of the estimated required full-time physician equivalents.

The methodology is being used in our region by the recently formed health systems agency (HSA). It forms the basis on which primary health care services are planned, as outlined in the HSA's health systems plan and annual implementation plan.

Conclusions

The distribution of physicians can be mapped and shortage areas and the number of physicians needed in them can be determined by use of the simple, inexpensive method described.

However, the limitations of the methodology must be borne in mind. One should visualize the physician shortage as only a rough indication of the need for primary health care services. More detailed analysis of each area may be required before a new service is actually established, for example, developing a community profile of the planned service area (age-sex mix, income, education, race, occupation, and so on), surveying service-level expectations in the community, or studying patients' use of primary care providers in neighboring areas. Even more important may be the selection among a number of possible choices of service alternatives, such as satellite practices, use of physician's assistants or nurse practitioners, or group practices.

Estimates based on simplified data and approximations are useful in leading planners to areas of probable undersupply and in helping them to avoid the problems of oversupply. These estimates identify target areas that appear to have physician shortages and point out where more refined analysis should be concentrated.

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