THE COMPOSITION OF RURAL HOSPITAL MEDICAL STAFFS: THE INFLUENCE OF HOSPITAL NEIGHBORS

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EXECUTIVE SUMMARY

The local supply of physicians has a strong influence on the availability and the quality of services provided by rural hospitals. Nevertheless, there are no published studies that describe the composition of rural hospital medical staffs and, in particular, the availability of specialists on these staffs. Moreover, there are no studies that address whether rural hospitals exhibit cooperative or competitive behavior in the composition of their medical staffs. This study uses 1991 and 1994 survey data from rural hospitals located in eight states to describe the specialty composition and factors that influence the presence of specialists on rural hospital medical staffs. In addition, we examine how the medical staff specialty composition of neighboring hospitals influences the composition of rural hospital medical staffs.

The data are analyzed using multiple regression techniques (ordinary least squares and logistic regression). The dependent variables include an assigned scale score representing the hospital's level of medical staff specialization (1-14) and binary (0/1) variables that indicate whether the hospital has a particular type of specialist on its active medical staff (e.g., general surgeon, internist). Construction of the medical staff scale score involved the use of Guttman scaling techniques.

The results show a strong positive association between the level of medical staff specialization in rural hospitals and the level of specialization of the closest rural neighbor, which suggests there is competition among rural hospitals based on the composition of the hospital medical staff. Analysis by specialty type, however, indicates that the degree of competition may differ for different types of specialists. Some of the specialty types that demonstrate consistently strong competitive effects are internists, obstetricians, general surgeons and urologists. Other factors that demonstrate a consistent relationship with both the level of medical staff specialization in rural hospitals and the presence of different types of specialists are the number of beds in the hospital and the percentage change in county population between 1980 and 1990.

INTRODUCTION

The relationship between rural health professionals, particularly physicians, and rural hospitals is often described as symbiotic (Moscovice and Rosenblatt, 1985; Phelps, 1992; Feldstein, 1988). Rural physicians need rural hospitals in order to deliver a comprehensive set of health care services to their patients. The local supply of physicians, on the other hand, determines the availability and the quality of services provided by the rural hospital and eventually affects the viability of these facilities (Moscovice and Rosenblatt, 1985).

Despite these considerations, there are no published studies that describe the composition of rural hospital medical staffs and, especially, the availability of specialists on these staffs. Moreover, there are no studies that specifically address whether rural hospitals exhibit cooperative or competitive behavior in the composition of their medical staffs. In this paper, we use survey data from rural hospitals located in eight states to examine factors that influence the presence of specialists of different types on rural hospital medical staffs. In particular, we focus on how the specialty composition of a rural hospital medical staff is influenced by the presence of specialists in neighboring hospitals.

BACKGROUND

Maintaining adequate access to health care services for residents in rural areas is an important policy issue (Weisgrau, 1995). A key component of the rural health care delivery system is the rural hospital. As with urban hospitals, to attract patients the rural hospital must attract health professionals, who supply patients and the specialized labor a hospital needs to produce services (Feldstein, 1988). Smith and Piland (1991) found a strong association between the size of the hospital medical staff and hospital utilization. A larger medical staff was related to higher occupancy, a greater number of discharges and more patient days served.

Despite the importance of the hospital medical staff, there are few studies that examine what factors affect the composition, as opposed to the size, of a hospital's medical staff. Morrisey (1984) reported descriptive characteristics of community hospital medical staffs, Shortell and colleagues examined the organizational structure of hospital medical staffs (Shortell and Getzen, 1979; Shortell and Evashwick, 1981) and other studies have analyzed the role of medical staff characteristics on hospital output or cost (Jensen amd Morrisey, 1986; Pauly, 1978).

Morrisey and Jensen (1990) were among the first to estimate the derived demand for physicians on hospital medical staffs and investigate how various factors, including physician stock and the supply of hospital beds, affect both the size and the composition of the medical staff. The demand models used by Morrisey and Jensen included measures of labor input prices and capital inputs, factors expected to affect the marginal cost of a medical staff member (e.g., an application fee for medical staff membership), hospital demand factors (e.g., insurance coverage and socioeconomic status of local residents) and characteristics of the local hospital and physician markets. Demand functions were estimated for seven specialty groupings (family practice, internal medicine, pediatrics, surgery, obstetrics/gynecology, hospital-based physicians and others) and for the total medical staff.

Morrisey and Jensen (1990) concluded that "In general . . . the pattern of results is consistent with a model of derived demand for an input of production" (p. 33). Study findings revealed that an increase in physician supply did not result in proportionate increases in medical staff appointments and, in some cases, increases in one specialty reduced the number of positions for other types of practitioners. The results also showed that the number of other non-teaching hospital beds in the county had a small substitution effect with respect to medical staff privileges for physicians, but this result varied by specialty group. Likewise, the number of teaching hospital beds slightly decreased medical staff size (substitution) and the decrease was consistent across all specialties.

Hospital Competition

Considering the sparsity of literature related to hospital medical staffs it is not surprising that little attention has been paid to how competition among hospitals might affect the composition of the hospital medical staff. Nevertheless, as the health care market becomes increasingly competitive one strategist suggests that "determining and recruiting needed physician specialists is the key to strengthening the short stay acute care hospital's competitive position" (Martinetto, 1989, p. 16). The nature of competition in rural areas and whether competition is an appropriate strategy for the delivery of health services in rural areas, while topics of great interest, have been the subjects of relatively few empirical analyses (Ludke, 1991; Vogel and Miller, 1995). However, whenever more than one facility serves the same general market area, there is bound to be some competition for patients and practitioners (Luke, 1991). In addition, it appears that many urban facilities are becoming more aggressive in their efforts to draw rural patients, thus leaving rural hospitals with fewer patients and a less desirable case-mix (Moscovice, 1989; Bateman, 1991; Boeder, 1991; Adams and Wright, 1991; McDaniel, Gates and Lamb, 1992; Hogan, 1988; Bronstein and Morrisey, 1991).

Physicians have the primary authority to admit patients to the hospital and supervise the care the patient receives while hospitalized. A physician's decision to affiliate with a hospital is believed to be determined by quality and the scope of services offered by a particular institution and not by income opportunities alone (Bigelow and Mahon, 1989; Smith and Piland, 1991). Competition among hospitals is often described in terms of non-price competition involving the acquisition of new technologies and facilities, which are assumed to be desirable because they can help the hospital attract or retain medical staff (Russell, 1979; Romeo, Wagner and Lee, 1984; Farley, 1985; Luft et al., 1986; Robinson and Luft, 1985; Robinson and Luft, 1987; Robinson, Garnick and McPhee, 1987; Fournier and Mitchell, 1992).

In one example of this type of study, Luft et al. (1986) analyzed how the number of neighboring hospitals (hospitals within a five and 15 mile radius) and the availability of specialized services (e.g., mammography, heart surgery, cobalt therapy) in those hospitals affected the availability of similar services in hospitals serving the same general service area. According to Luft et al. (1986), if the presence of a service in nearby hospitals increases the likelihood of a hospital having that clinical service this is an indication of competitive behavior. But, if greater service availability decreases the likelihood that a hospital has the service, the behavior among hospitals is complementary. After controlling for the characteristics of the hospital and the local population, they found that local market characteristics had a significant effect on the likelihood of a hospital having a particular clinical service for 28 of the 29 services that were studied. Furthermore, for 19 of the services, the percentage of neighboring hospitals with the service increased the probability of a hospital also having the service, which suggests that hospitals behave competitively.

We could identify no published studies that investigated the role of competition in influencing the affiliation of specialty physicians with rural hospitals. The study by Morrisey and Jensen (1990) was restricted to urban, community, nonteaching hospitals and the specialty groupings used in the analysis resulted in a large number of specialty types being grouped into an 'other' category. In this study, we expand the work of Morrisey and Jensen by analyzing the medical staff configuration of rural hospitals. We also follow the research of Luft et al. (1986) by focusing on whether rural hospitals exhibit complementary (cooperative) or competitive behavior in the composition of their medical staffs.

DATA

The data for this study were collected through 1991 and 1994 telephone surveys of rural hospital administrators located in eight midwestern and northwestern states (Minnesota, North Dakota, South Dakota, Iowa, Montana, Idaho, Oregon, and Washington). All the rural hospitals in the eight state region, as identified for the 1991 baseline survey (Hartley, 1993), were included in both surveys. A rural hospital is defined as any hospital not located in a Metropolitan Statistical Area (MSA). An MSA, as defined by the Office of Management and Budget, is a county that contains a city with 50,000 or more residents; or an urbanized area with a population of at least 50,000 that is part of a county or counties that have at least 100,000 people (Hewitt, 1989).

Thirty hospitals in 1991 and 27 hospitals in 1994 that are located in MSA counties were also surveyed either because they were in sparsely populated areas, despite being in an MSA, or because of changes in MSA designations between 1991 and 1994. Both the 1991 and 1994 surveys had response rates of greater than 90 percent; the analyses presented in this paper are based on data from 464 rural hospitals that responded in 1991 and 434 hospitals that responded in 1994.

The hospital administrators were asked to report the total number of physicians on the hospital's active medical staff as well as the number of physicians on the active, courtesy and consulting staffs, by specialty, for 17 different types of specialties and an "other" category. For this study, data from the 1990 and 1993 AHA Survey of Hospitals are used to supplement the survey data and provide information about the characteristics of the hospitals, such as the number of beds in the hospital and hospital ownership. The Area Resource File, compiled by the Office of Research and Planning, Bureau of Health Professions, is also used to provide measures of various community and market characteristics. Straight line distance measures were calculated using a data file containing hospital latitudes and longitudes.

Tables 1-4 show the composition of the rural hospital's medical staffs (1991 and 1994) arranged by size. Tables 1 and 2 display the percentage of hospitals with each type of specialist on the active staff. The most commonly reported specialists on rural hospital active medical staffs are family or general practice physicians. Regardless of the size of the active staff, almost all rural hospitals had these types of practitioners. The next most frequently reported specialties are general surgery and internal medicine. While the proportion of hospitals with fewer than five physicians on the active medical staff that had a general surgeon decreased between 1991 and 1994 (24.6 percent vs. 14.7 percent) the proportion with an internist increased (8.8 percent vs. 13.5 percent). As the size of the active medical staff increases to a range from 10 to 20, there is a sharp increase in the proportion of hospitals with orthopedic surgeons, obstetrician-gynecologists (OB-GYN), urologists, ophthalmologists and pediatricians, which is consistent in both 1991 and 1994. All the rural hospitals with more than 50 members on their active medical staff had at least one family or general practitioner, internist, OB-GYN, general surgeon, orthopedic surgeon, ophthalmologist, radiologist and pathologist in 1991 and 1994.

Table 1

Percent of Rural Hospitals with Physician Specialty on Active Staff in 1991

Specialties	Number of Active Members of Medical Staff						
	0-2 (70)	3-4 (101)	5-9 (109)	10-20 (80)	21-50 (71)	>50 (33)	ALL (464)
FP or GP	87.1	99.0	100.0	100.0	98.6	100.0	97.6
Internal Medicine	10.0	7.9	26.6	67.5	95.8	100.0	42.9
Pediatrics	1.4	0.0	5.5	18.8	64.8	100.0	21.8
OB-GYN	2.9	4.0	4.6	30.0	85.9	100.0	27.8
General Surgery	12.9	32.7	61.5	92.5	100.0	100.0	61.9
Orthopedic Surgery	1.4	3.0	1.8	32.5	94.4	100.0	28.4
ENT	0.0	1.0	1.0	5.0	57.7	93.9	16.8
Opthalmology	0.0	3.0	1.8	18.8	81.7	100.0	23.9
Urology	1.4	3.0	5.5	20.0	73.2	100.0	23.9
Cardiology	0.0	1.0	1.0	3.8	14.1	75.8	8.6
Oncology	0.0	0.0	0.0	1.3	16.9	93.9	9.5
Gastro-enterology	0.0	0.0	0.0	2.5	14.1	78.8	8.2
Psychiatry	0.0	0.0	1.8	11.3	47.9	81.8	15.5
Neurology	0.0	0.0	0.0	0.0	18.3	90.9	9.3
Anesthesiology	0.0	2.0	3.7	8.8	60.6	100.0	19.2
Radiology	0.0	5.9	36.7	75.0	90.1	100.0	43.8
Pathology	1.4	4.0	19.3	37.5	74.6	100.0	30.6
Other Surgery[1]	0.0	0.0	0.0	1.3	5.6	45.5	4.3
Other Specialties[2]	0.0	3.0	2.8	16.3	22.5	63.6	12.1

[1] Includes such specialties as plastic surgery, oral surgery, thoracic surgery, vascular surgery and neuro-surgery.

[2] Includes such specialties as dermatology, podiatry, allergy, hematology, nuclear medicine, geriatrics, infectious disease and emergency medicine.

Table 2

Percent of Rural Hospitals with Physician Specialty on Active Staff in 1994

	Number of Active Members of Medical Staff						
Specialties	0-2 (63)	3-4 (93)	5-9 (100)	10-20 (76)	21-50 (62)	>50 (40)	ALL (434)
FP or GP	98.4	98.9	100.0	100.0	98.4	100.0	99.3
Internal Medicine	9.5	16.1	30.0	65.8	95.2	100.0	46.1
Pediatrics	0.0	2.2	6.0	23.7	59.7	95.0	23.3
OB-GYN	0.0	0.0	5.0	26.3	79.0	100.0	26.3
General Surgery	6.3	20.4	66.0	88.2	100.0	100.0	59.4
Orthopedic Surgery	0.0	1.1	4.0	42.1	88.7	100.0	30.4
ENT	0.0	0.0	1.0	9.2	46.8	92.5	17.1
Opthalmology	0.0	0.0	1.0	22.4	74.2	100.0	24.0
Urology	0.0	0.0	0.0	14.5	66.1	95.0	20.7
Cardiology	0.0	0.0	0.0	3.9	4.8	72.5	8.1
Oncology	0.0	0.0	1.0	1.3	12.9	75.0	9.2
Gastro-enterology	0.0	0.0	1.0	3.9	14.5	77.5	10.1
Psychiatry	0.0	0.0	4.0	9.2	43.5	82.5	16.4
Neurology	0.0	0.0	0.0	2.6	9.7	87.5	9.9
Anesthesiology	0.0	0.0	2.0	10.5	56.5	95.0	19.1
Radiology	0.0	4.3	17.0	61.8	90.3	100.0	37.8
Pathology	0.0	6.5	8.0	28.9	66.1	100.0	27.0
Other Surgery[1]	0.0	0.0	0.0	0.0	8.1	47.5	5.5
Other Specialties[2]	0.0	4.3	4.0	28.9	67.7	100.0	25.8

[1] Includes such specialties as plastic surgery, oral surgery, thoracic surgery, vascular surgery and neuro-surgery.

[2] Includes such specialties as dermatology, podiatry, allergy, hematology, nuclear medicine, geriatrics, infectious disease and emergency medicine.

Table 3

Average Number of Active Medical Staff per Hospital in 1991

	Number of Active Members of Medical Staff						
Specialties	0-2 (70)	3-4 (101)	5-9 (109)	10-20 (80)	21-50 (71)	>50 (33)	ALL (464)
FP or GP	1.36	2.76	4.65	7.21	9.65	14.52	5.65
Internal Medicine	.10	.09	.33	1.38	3.66	9.82	1.61
Pediatrics	.01	.00	.06	.23	1.27	5.27	.62
OB-GYN	.03	.04	.05	.43	1.79	5.55	.77
General Surgery	.14	.35	.71	1.51	2.99	5.45	1.37
Orthopedic Surgery	.01	.03	.02	.39	2.21	5.48	.81
ENT	.00	.01	.01	.05	.76	2.18	.28
Opthalmology	.00	.03	.02	.24	1.48	4.24	.58
Urology	.01	.03	.06	.21	.97	2.45	.38
Cardiology	.00	.01	.01	.04	.18	2.72	.20
Oncology	.00	.00	.00	.01	.20	2.09	.18
Gastro-enterology	.00	.00	.00	.03	.15	1.42	.13
Psychiatry	.00	.00	.03	.13	.73	2.70	.33
Neurology	.00	.00	.00	.00	.18	2.00	.17
Anesthesiology	.00	.02	.04	.10	1.04	5.24	.56
Radiology	.00	.06	.50	1.20	1.96	4.61	.96
Pathology	.01	.04	.20	.50	1.11	2.64	.50
Other Surgery[1]	.00	.00	.00	.01	.06	1.15	.09
Other Specialties[2]	.00	.04	.03	.36	.58	4.94	.52
Overall	1.69	3.50	6.69	14.01	30.97	84.03	15.72

[1] Includes such specialties as plastic surgery, oral surgery, thoracic surgery, vascular surgery and neuro-surgery.

[2] Includes such specialties as dermatology, podiatry, allergy, hematology, nuclear medicine, geriatrics, infectious disease and emergency medicine.

Table 4

Average Number of Active Medical Staff per Hospital in 1994

Specialties	0-2 (63)	3-4 (93)	5-9 (100)	10-20 (76)	21-50 (62)	>50 (40)	ALL (434)
	Number of Active Members of Medical Staff						
FP or GP	1.57	2.87	4.76	6.72	10.08	16.68	6.09
Internal Medicine	.10	.17	.36	1.42	3.58	9.45	1.76
Pediatrics	.00	.02	.06	.32	1.05	4.83	.67
OB-GYN	.00	.00	.05	.41	1.60	4.95	.77
General Surgery	.08	.22	.79	1.49	2.40	5.08	1.31
Orthopedic Surgery	.00	.01	.04	.47	1.94	5.68	.89
ENT	.00	.00	.01	.11	.66	2.30	.33
Opthalmology	.00	.00	.01	.26	1.52	3.50	.59
Urology	.00	.00	.00	.16	.87	2.38	.37
Cardiology	.00	.00	.00	.07	.10	1.83	.19
Oncology	.00	.00	.01	.01	.16	1.55	.17
Gastro-enterology	.00	.00	.01	.07	.21	1.35	.17
Psychiatry	.00	.00	.04	.17	.74	2.53	.38
Neurology	.00	.00	.00	.03	.11	1.78	.18
Anesthesiology	.00	.00	.02	.12	1.06	5.08	.65
Radiology	.00	.04	.17	.83	1.77	4.35	.85
Pathology	.00	.06	.09	.42	.90	2.58	.47
Other Surgery[1]	.00	.00	.00	.00	.08	1.33	.13
Other Specialties[2]	.00	.04	.05	.58	2.66	9.95	1.42
Overall	1.75	3.44	6.47	13.64	31.50	87.13	17.40

[1] Includes such specialties as plastic surgery, oral surgery, thoracic surgery, vascular surgery and neuro-surgery.

[2] Includes such specialties as dermatology, podiatry, allergy, hematology, nuclear medicine, geriatrics, infectious disease and emergency medicine.

Tables 3 and 4 show the average number of active staff members per hospital by specialty. In general, the proportion of the active staff comprised of family or general practice physicians decreases as the size of the staff increases. Whereas approximately seventy percent of an average medical staff with five to nine members are family or general practitioners, only 30 percent of an average staff with 21 to 50 members are family or general practice physicians. General surgeons and internists comprise the next greatest proportions of specialists on the active medical staffs of rural hospitals. When the average size of the staff reaches 31 (the category of medical staff with 21-50 members) it appears that the importance of internists on the active staff begins to exceed that of general surgeons with approximately 11 to 12 percent of the staff being composed of internists versus 8 to 10 percent for general surgeons. As average staff size increases from 14 to 31 there are fairly dramatic increases in the average number of several types of specialists including OB-GYNs, orthopedic surgeons, ophthalmologists, pediatricians and anesthesiologists.

To decrease the possibility that the results observed in Tables 1-4 are driven by a few highly specialized rural hospitals, the table entries were also generated after excluding hospitals that are classified by Medicare as Rural Referral Centers. Although the percentage of hospitals with some of the less commonly observed specialists, such as gastroenterologists, oncologists and neurologists declined, the general patterns remained the same.

METHODS

We analyzed the factors that affect the composition of rural hospital medical staffs using multiple regression techniques (ordinary least squares and logistic regression). The dependent variables included an assigned scale score representing the hospital's level of medical staff specialization (1-14) and binary (0/1) variables indicating whether the hospital has a particular type of specialist on its active medical staff (e.g., general surgeon, internist). Construction of the medical staff scale score involved the use of Guttman scaling techniques.

Guttman Scaling

Tables 1-4 suggest that as the size of the rural hospital medical staff increases, new types of specialists appear on the active staff in a systematic pattern. Guttman scaling techniques were used to test whether this apparent hierarchical pattern could be used to produce an acceptable unidimensional continuum or scale to describe the configuration of the hospital medical staff. Previous health services applications of Guttman scaling techniques include Edwards, Miller and Schumacher (1971) and Adams et al. (1991) who tested for hierarchical patterns in the provision of services in rural hospitals and a study by Lawlor and Reid (1981) that examined the location patterns of specialists in U.S. counties.

The principle behind the Guttman scale is that each item in a series of items (e.g., types of specialists on the medical staff) is actually part of a single underlying dimension (McIver and Carmines, 1981). For this application, the presence of each type of specialist on the medical staff is considered a positive response to an item on a scale that represents the level of medical staff specialization. The apparent hierarchical pattern suggests that a positive response for a certain type of specialist results only if there are positive responses for the specialists that are observed more frequently. For example, the presence of an internist on a hospital medical staff suggests that the medical staff also has the more frequently reported specialties of family/general practice and general surgery. If all the specialties followed this pattern, without deviation, there would be a perfect hierarchy of specialization. Moreover, a single scale could be used to provide a measure of the level of specialization of hospital medical staffs.

Most applications of Guttman scaling do not produce a perfect scale, however, and the practical issue is how much deviation to allow before rejecting a Guttman scale as an adequate representation of the data. Tables 5 and 6 show each hospital ranked according to the number of specialists, out of a total of 14, on the hospital's active medical staff. Hospital-based specialties such as pathology, radiology and anesthesiology were excluded from this analysis because they have a somewhat different relationship with hospitals and do not, in general, admit patients to the hospital. The body of the table contains the percentage of hospitals with a certain specialty ranking that have a given type of specialist on their active medical staff. For example, in 1991 23 hospitals had four types of specialists on their active medical staff, and among those hospitals 82.6 percent had an internist on the active staff.

Table 5

Percent of Hospitals with Physician Specialty on Active Staff in 1991

Number of Specialties (number of hospitals)	1 (144)	2 (117)	3 (43)	4 (23)	5 (21)	6 (16)	7 (15)	8 (10)	9 (19)	10 (12)	11 (10)	12 (8)	13 (8)	14 (18)	ALL (464)
FP or GP	95.1	97.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	91.7	100.0	100.0	100.0	100.0	97.6
General Surgery	2.8	75.2	83.7	95.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	61.9
Internal Medicine	2.1	14.5	58.1	82.6	95.2	100.0	100.0	100.0	94.7	100.0	100.0	100.0	100.0	100.0	42.9
Orthopedic Surgery	0.0	1.7	14.0	39.1	33.3	62.5	86.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	28.4
OB/GYN	0.0	3.4	11.6	13.0	52.4	81.3	86.7	80.0	84.2	100.0	100.0	100.0	100.0	100.0	27.8
Urology	0.0	2.6	14.0	26.1	19.0	37.5	46.7	90.0	73.7	100.0	100.0	100.0	100.0	100.0	23.9
Opthalmology	0.0	1.7	2.3	13.0	28.6	62.5	60.0	80.0	84.2	100.0	100.0	100.0	100.0	100.0	23.9
Pediatrics	0.0	1.7	2.3	17.4	33.3	37.5	26.7	60.0	84.2	75.0	100.0	100.0	100.0	100.0	21.8
ENT	0.0	1.0	0.0	0.0	14.3	12.5	26.7	40.0	63.2	83.3	90.0	100.0	87.5	100.0	16.8
Psychiatry	0.0	1.0	7.0	8.7	19.0	6.3	26.7	20.0	73.7	58.3	80.0	50.0	50.0	100.0	15.5
Oncology	0.0	0.0	0.0	0.0	4.8	0.0	0.0	10.0	0.0	33.3	60.0	75.0	100.0	100.0	9.5
Neurology	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	21.1	8.3	40.0	87.5	100.0	100.0	9.3
Cardiology	0.0	0.0	7.0	4.3	0.0	0.0	13.3	0.0	10.5	16.7	10.0	62.5	75.0	100.0	8.6
Gastro-enterology	0.0	0.0	0.0	0.0	0.0	0.0	6.7	20.0	10.5	33.3	20.0	25.0	87.5	100.0	8.2

Table 6

Percent of Hospitals with Physician Specialty on Active Staff in 1994

Number of Specialties (number of hospitals)	1 (142)	2 (92)	3 (48)	4 (21)	5 (16)	6 (21)	7 (16)	8 (13)	9 (14)	10 (9)	11 (6)	12 (7)	13 (11)	14 (18)	ALL (434)
FP or GP	98.6	100.0	100.0	100.0	100.0	100.0	100.0	100.0	92.9	100.0	100.0	100.0	100.0	100.0	99.3
General Surgery	1.4	71.7	91.7	76.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	59.4
Internal Medicine	0.0	22.8	75.0	76.2	93.8	95.2	87.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	46.1
Orthopedic Surgery	0.0	3.3	4.2	52.4	68.8	71.4	81.3	100.0	92.9	100.0	100.0	100.0	100.0	100.0	30.4
OB/GYN	0.0	1.1	4.2	23.8	31.3	66.7	62.5	92.3	100.0	100.0	100.0	100.0	100.0	100.0	26.3
Urology	0.0	0.0	2.1	9.5	12.5	33.3	56.3	69.2	78.6	88.9	100.0	100.0	90.9	100.0	20.7
Opthalmology	0.0	0.0	2.1	4.8	25.0	47.6	93.8	76.9	92.9	88.9	100.0	100.0	100.0	100.0	24.0
Pediatrics	0.0	0.0	12.5	23.8	37.5	33.3	37.5	69.2	92.9	100.0	100.0	85.7	90.9	100.0	23.3
ENT	0.0	0.0	0.0	4.8	6.3	14.3	43.8	38.5	50.0	88.9	100.0	100.0	100.0	100.0	17.1
Psychiatry	0.0	1.1	6.3	14.3	6.3	19.0	18.8	30.8	71.4	55.6	83.3	71.4	81.8	100.0	16.4
Oncology	0.0	0.0	0.0	4.8	6.3	0.0	6.3	7.7	14.3	0.0	50.0	57.1	81.8	100.0	9.2
Neurology	0.0	1.1	0.0	0.0	0.0	4.8	6.3	0.0	7.1	11.1	33.3	100.0	100.0	100.0	9.9
Cardiology	0.0	0.0	0.0	4.8	6.3	4.8	0.0	0.0	7.1	11.1	0.0	57.1	72.7	100.0	8.1
Gastro-enterology	0.0	0.0	2.1	4.8	6.3	9.5	6.3	15.4	0.0	55.6	33.3	28.6	81.8	100.0	10.1

While there is an obvious hierarchical pattern displayed in both Tables 5 and 6, it is not a perfect hierarchy. Nevertheless, several criteria for assessing the scalability of a set of items suggest that the Guttman scale scores do provide an adequate representation of the level of specialization of rural hospital medical staffs. Two measures that reflect how well the medical staff data fit a hierarchical structure are the "coefficient of reproducibility" (CR), as suggested by Guttman and the "coefficient of scalability" (CS), as designed by Menzel (McIver and Carmines, 1981). The CR, which measures the goodness of fit between the observed response pattern and the ideal predicted response pattern, is calculated by dividing the ratio of errors (observed responses that do not agree with the ideal scale pattern) by the number of total responses and subtracting the result from one (McIver and Carmines, 1981). A CR of .9 or greater indicates that the items should be considered scalable. The CR for the 14 point scale of active members in both 1991 and 1994 was .94. This suggests that the level of specialization of rural hospital active medical staffs can be ordered, using Guttman scaling techniques, to produce a single specialization scale score.

The CS measures the improvement in fit from using scale predictions relative to predictions based on marginal frequencies, and is calculated as one minus the ratio of the number scale errors to the number of marginal errors (McIver and Carmines, 1981). A scale with perfect predictive ability would produce a CS of one, while a scale with no predictive power would result in a CS of zero (i.e. no improvement over the predictions based on marginal probabilities). In general, a CS of .60 is arbitrarily accepted as an indication of scalability (McIver and Carmines 1981). The CS for the 14 point scale of active medical staff members in 1991 was .68 and in 1994 .70, which supports the hypothesis that the level of specialization of rural hospital active medical staffs can be scaled.

Other Dependent Variables

Because of the low prevalence of certain types of specialists on rural hospital medical staffs, a five point scale that collapsed several of the categories also was constructed. For the five point scale, a scale value of one was assigned if the hospital medical staff consisted of family or general practitioners only. A hospital received a value of two if there was a general surgeon on the active medical staff and a value of three if there was an internist. A value of four on the five point scale indicated the presence of at least one of the following types of specialists: ENT, pediatrician, ophthalmologist, urologist, obstetrician-gynecologist or orthopedic surgeon. If the hospital's active medical staff had a gastro-enterologist or cardiologist or neurologist or oncologist or psychiatrist, then the hospital was assigned a value of five. Analyses using the five point scale produced essentially the same results as those based on the 14 point scale score. So, for ease of presentation, from this point on any reference to scale scores will refer to the 14 point scale only.

The scale variables discussed above provide a single measure to describe the configuration of a hospital's medical staff. However, previous studies have shown that different factors may also influence the distribution of different types of specialized services as well as the demand for different types of hospital medical staff (Luft et al., 1986; Morrisey and Jensen, 1990). To examine whether this is true with respect to the presence of specific types of specialists (e.g., general surgeons) on the medical staffs of rural hospitals, we constructed binary variables that take a value of one if the hospital has a certain type of specialist on its active staff and zero if it does not.

Independent Variables/Empirical Specification

Following Luft et al. (1986), we hypothesize that the location and medical staff composition of neighboring hospitals will affect any given rural hospital's medical staff composition. To investigate these potential "competitive" effects we included as independent variables the level of medical staff specialization at the two nearest rural hospitals, the presence of certain types of specialists on the active medical staff of the two nearest hospitals, the distance to the two nearest rural hospitals and the distance to the nearest urban hospital. If the level of medical staff specialization in the closest rural hospitals is positively associated with a rural hospital's level of staff specialization, then hospital behavior is considered competitive. That is, rural hospitals compete based on the availability of various specialists and the level of specialization of the hospital medical staff. Likewise, if there is a positive relationship between the presence of a certain type of specialist (e.g., orthopedic surgeon, OB-GYN, internist) on a rural hospital's active medical staff and the presence of the same type of specialist on the staffs of either of its nearest neighbors, this is also considered competitive behavior.

If, on the other hand, the level of medical staff specialization or the presence of a certain type of specialist on the staffs of the closest rural hospitals is negatively related to a rural hospital's level of specialization or the presence of a particular specialist, then hospital behavior is regarded as cooperative. Behavior of this sort could indicate that hospitals avoid duplication of specialty services available in other rural hospitals located in the same region (Luft et al., 1986; Luke, 1991).

The distances to the two nearest rural hospitals were entered into the equations as interactions with the specialty scale scores of those hospitals and dummy variables that indicate whether a certain type of specialist is on the hospital's active staff. The distance measures are proxies for travel time, which is considered a cost factor for both patients and physicians (Luft et al., 1986; Morrisey, Sloan and Valvona, 1989). Interacting distance with the specialization measures allows one to assess whether potential competitive effects are enhanced as distance increases or decreases.

The distance to the nearest urban hospital was included because urban providers are also potential competitors for rural patients and health professionals. Time and travel considerations suggest that the closer rural hospitals are located to urban areas, which are assumed to possess a full complement of medical specialists, the greater the competitive pressure and possible patient "leakage" to the urban area. Thus, rural hospitals located closer to urban facilities may be more likely to expand their service capability (i.e., level of medical staff specialization) as a competitive strategy.

Other factors that are also expected to influence the composition of a rural hospital's medical staff are of two general types: 1) hospital characteristics that are related to the mission, resources and capacity of the hospital, and 2) market characteristics, both those related to the demand for services and those related to practitioner supply.

The number of beds in the hospital is an indication of the size or operating capacity of the facility (Romeo, Wagner, and Lee, 1984). Hospital ownership is a proxy for the mission or objectives of the hospital, which could influence the service mix and the strategic behavior of the hospital (Luft et al., 1986; Russell, 1979; Morrisey, 1984). Whether the hospital is part of a multi-hospital system is a measure of both hospital resources and the philosophy or objectives of the institution. Other hospital level variables, which are often included in studies of hospital behavior or demand models, such as the number of discharges, occupancy rate, case-mix index or operating margin were not included in this analysis because they are considered endogenous variables and could introduce bias into the estimation results.

Community-level economic and social characteristics are used as indicators of consumer demand for hospital services and are measured at the county level. The total population and change in total population measure the hospital's 'potential' patient-base and whether the potential patient population is growing or shrinking. A growing potential patient-base suggests the hospital is located in an environment that is able to support practice growth and therefore maintain certain types of specialists (Renshaw, Kimberly and Schwartz, 1990; Martinetto, 1989). Per capita income is used as a measure of the level of consumer demand and the demand for various specialized services. Higher per capita income is generally associated with an increased demand for hospital care and for specialized services and a greater ability to pay for services, whereas lower per capita income may indicate less ability to purchase services and more limited insurance coverage. The number of physicians per capita, which is measured at the state level, is a proxy measure of the supply of physicians. County-level physician supply is not included because of potential endogeneity. A dummy variable is also included in the analysis to control for whether the hospital is located in a county that is part of a metropolitan area.

Table 7 displays the mean values and standard deviations for the dependent and independent variables used in the multivariate analyses. Determining the scale values (assigned level of specialization), whether the closest rural hospitals have a certain type of specialist on their active medical staffs and the straight line distances to the two nearest rural hospitals involved a two step process, which is explained in further detail in the Appendix.

Statistical Methods

Data from the 464 rural hospitals surveyed in 1991 and the 434 surveyed in 1994 were analyzed separately. In the first set of analyses, we used Ordinary Least Squares (OLS) regression with the 14 point assigned scale score as the dependent

Table 7

Mean Values and Standard Deviations for Dependent and Independent Variables

Variables	1991 (N = 464)	1994 (N = 434)
Scale - assigned level of medical staff specialization	4.97 (4.5)	4.99 (4.6)
Acim - have an Internist on active staff	0.43 (.50)	0.46 (.50)
Acped - have a Pediatrician on active staff	0.22 (.41)	0.23 (.42)
Acob - have an Obstetrician on active staff	0.28 (.45)	0.26 (.44)
Acgsg - have a General Surgeon on active staff	0.62 (.49)	0.59 (.49)
Acosg - have an Orthopedic Surgeon on active staff	0.28 (.45)	0.30 (.46)
Acopth - have an Ophthalmologist on active staff	0.24 (.43)	0.24 (.43)
Acur - have a Urologist on active staff	0.24 (.43)	0.21 (.41)
Independent Variables		
ScaleR1 - assigned level of medical staff specialization for the nearest rural hospital	4.96 (4.6)	5.06 (4.7)
ScaleR2 - assigned level of medical staff specialization for the second nearest rural hospital	4.84 (4.5)	5.02 (4.6)
DistR1 - distance to nearest rural hospital	21.49 (11.8)	21.78 (11.6)
DistR2 - distance to second nearest rural hospital	29.82 (14.3)	30.17 (14.5)
ScaleR - highest assigned level of medical staff specialization among the two nearest rural hospitals	7.05 (4.7)	7.12 (4.9)
DistR - distance to the rural hospital with the highest assigned level of medical staff specialization	25.16 (14.3)	25.38 (13.9)
Xscdist - ScaleR x DistR	173.8 (163.7)	178.5 (169.0)
Imc - one of the two nearest rural hospitals has an internist on its active staff	0.62 (.49)	0.65 (.48)
Ximdist - first or second nearest rural hospital has an internist x the distance to that hospital	15.28 (16.7)	16.17 (16.7)
Pedc - one of the two nearest rural hospitals has a pediatrician on its active staff	0.37 (.48)	0.40 (.49)
Xpeddist - first or second nearest rural hospital has a pediatrician x the distance to that hospital	9.04 (15.0)	9.74 (14.3)

Table 7 (continued)

Variables	1991 (N = 464)	1994 (N = 434)
Obc - one of the two nearest rural hospitals has an obstetrician on its active staff	0.45 (.50)	0.44 (.50)
Xobdist - first or second nearest rural hospital has an obstetrician x the distance to that hospital	11.03 (15.8)	10.77 (15.7)
Gsgc - one of the two nearest rural hospitals has a general surgeon on active staff	0.83 (.38)	0.80 (.40)
Xgsgdist - first or second nearest rural hospital has a general surgeon x the distance to that hospital	19.06 (15.2)	18.89 (15.6)
Orsgc - one of the two nearest rural hospitals has an orthopedic surgeon on active staff	0.45 (.50)	0.48 (.50)
Xosgdist - first or second nearest rural hospital has an orthopedic surgeon x the distance to that hospital	10.69 (15.5)	11.61 (15.9)
Opthc - one of the two nearest rural hospitals has an ophthalmologist on active staff	0.41 (.49)	0.42 (.49)
Xopthdist - first or second nearest rural hospital has an ophthalmologist x the distance to that hospital	9.67 (14.7)	9.74 (14.3)
Urc - one of the two nearest rural hospitals has a urologist on active staff	0.41 (.49)	0.35 (.48)
Xurdist - first or second nearest rural hospital has a urologist x the distance to that hospital	9.78 (15.1)	7.76 (13.4)
DistU1 - distance to nearest urban hospital	69.75 (43.8)	69.21 (44.2)
Public - public ownership (1990/1993)	0.45 (.50)	0.45 (.50)
System - member of a multi-hospital system (1990/1993)	0.21 (.41)	0.21 (.40)
Hbed - number of hospital beds (1990/1993)	47.75 (41.7)	45.76 (39.4)
Pop - county population in 100s (1990/1992)	300.34 (420.4)	303.02 (427.7)
Pctpopch - percent change in county population between 1980 and 1990	-3.00 (10.6)	-2.80 (10.8)
Pci - per capita income (1990/1992)	15634.73 (1828.9)	16600.39 (1916.1)
Doc_pop - physicians per 1000 state population	1.72 (.26)	2.19 (.37)

variable, to examine factors related to the level of medical staff specialization in both 1991 and 1994. The same model was estimated using the 5 point scale. All of the scale measures, whether used as dependent and independent variables, are quite skewed. To determine how sensitive the results might be to this skewness, the data were analyzed using both an untransformed model and a model where the natural logarithmic transformation was applied to the scale measures. In addition, the inference statistics were corrected using the Huber/White consistent estimator (Huber, 1967; White, 1980). This procedure was applied to correct for heteroscedasticity as well as intracluster correlation, with the state as the clustering variable. The state was selected as the clustering variable to account for the possible effect of state-level factors not captured by the other variables in the model.

In the second set of analyses, we examined factors associated with the presence of different types of specialists on a rural hospital's active medical staff, using logistic regression. The dependent variable for these analyses was a binary variable with a value of one if the hospital has a specialist of that type on its active staff and a value of zero if it does not. The logistic model expresses the log odds of an event (e.g., having a general surgeon on the active medical staff) as a linear function of a set of explanatory variables (Hosmer and Lemeshow, 1989). Once again, the inference statistics were corrected using the Huber/White consistent estimator (Huber, 1967; White, 1980) to correct for intracluster correlation, with the state as the clustering variable. Equations were estimated only for specialists present in greater than twenty percent of the rural hospitals.

For both sets of analyses the rural hospital competition measures (i.e., the assigned scale values for the two nearest hospitals, specialist dummy variables and the distance interaction terms) were first examined separately and then as a set. We decided to consider the two nearest rural hospitals as a set since there appears to be little difference in the level of specialization among the two nearest rural hospitals and the difference in the straight line distances to those hospitals is less than 10 miles (see Table 7). When defined as a set, only the highest level of specialization among the two nearest rural hospitals and that hospital's scale value interacted with the distance to the hospital were included in the specialty scale models. In the analyses of the different specialists by type, if either the nearest or second nearest rural hospital had a specialist of that type on its active staff the competition variable received a value of one and was zero otherwise. Distance was again entered as an interaction term, with its value being the distance to the 'nearest' hospital in the set that had a specialist of that type. The results were essentially the same, irrespective of whether the competition measures were specified separately or as a set. In the models where the two nearest rural hospitals were considered separately, the coefficients for variables that related to the second nearest hospital tended not to be significantly different from zero and the estimates for other variables were generally less precise. Because of the similarity in results, only those from the models that regard the two nearest rural hospitals as a set are presented.

RESULTS

Descriptive Results

In general there are few substantive changes in measures of medical staff composition or in the independent variables between 1991 and 1994 (see Table 7). Some of the more notable changes, such as a decrease in the percentage of rural hospitals with general surgeons on their active medical staff and an increase in the percentage of hospitals with internists on staff, have already been discussed. There is also a slight increase, between 1991 and 1994, in the level of medical staff specialization as well as the distances to the first and second closest rural hospitals. There is a greater distance between hospitals for specialists such as internists and general surgeons, which are found in a higher percentage of rural hospitals, and a noticeably smaller distance between hospitals where there are less prevalent specialists such as urologists. This pattern is likely due in part to various geographic and situational factors (e.g., the availability of orthopedic surgeons in hospitals near ski resorts) as well as smaller hospitals that provide a more basic set of services being located in more remote areas.

The average number of hospital beds has decreased, which is expected as more and more rural hospitals decrease their acute care inpatient capacity (AHA, 1991), while the number of physicians per capita has increased, which is also expected since the number of medical graduates per capita has been increasing over the past several years (Jolly and Hudley, 1995). There was a six percent increase in average per capita income between 1990 and 1992. This increase is consistent with national figures that show an increase in per capita income of almost seven percent over the same period ($15,199 in 1990 and $16,262 in 1992, Area Resource File, 1995).

Multivariate Results

Results from the OLS regressions using the 14 point assigned specialization scale score are shown in Table 8. Using both the untransformed and transformed scale scores, there is clearly a strong positive association between the level of medical staff specialization in rural hospitals and the level of specialization of the closest rural neighbors. This relationship is presented in both the 1991 and 1994 data. Other factors that are consistently related to the level of medical staff specialization in rural hospitals are the number of beds in the hospital and the percentage change in population between 1980 and 1990. While the percentage change in population is positively related to the level of medical staff specialization, the number of hospital beds demonstrates a positive but non-linear association with the medical staff scale score, which was captured by adding a quadratic term to the regression.

Public ownership (i.e. non-federal government including state, county, city, and hospital districts) and being located in an MSA appear to be related to the level of medical staff specialization in rural hospitals in 1991 but not in 1994. However, public ownership shows a negative association with the level of medical staff

Table 8

Medical Staff Model with 14 Point Scale Regression Coefficients and Standard Errors[1]

	1991 (N = 464)		1994 (N = 434)	
Variables	Base Model Coef (std err)	Ln Model[2] Coef (std err)	Base Model Coef (std err)	Ln Model Coef (std err)
ScaleR/LnScaleR	.1357 (.0494)**	.1593 (.0535)**	.1587 (.0505)**	.1579 (.0470)**
Xscdist[3]	-.0009 (.0010)	-.0006 (.0008)	-.0014 (.0007)	-.0012 (.0006)
DistU1	-.0006 (.0043)	-6.9e-06 (.0008)	.0074 (.0047)	.0016 (.0009)
Public90/93	-.6979 (.1752)**	-.1396 (.0591)*	-.3104 (.2871)	-.0238 (.0746)
System90/93	.3366 (.3339)	.1161 (.0820)	.1544 (.2274)	.1032 (.0502)*
Hbed90/93	.1184 (.0073)**	.0266 (.0020)**	.1208 (.0149)**	.0292 (.0024)**
Hbed2	-.0003 (.0000)**	-.0001 (.0000)**	-.0003 (.0001)**	-.0001 (.0000)**
Bflag	.0416 (.3342)	.0096 (.0851)	.0810 (.3459)	-.0087 (.0846)
Pop90/92	.0019 (.0006)**	.0003 (.0001)**	.0017 (.0013)	.0003 (.0002)*
Pctpopch	.1162 (.0170)**	.0241 (.0036)**	.1036 (.0131)**	.0230 (.0031)**
Pci90/92	.0001 (.0001)	.00002 (.00004)	1.6e-06 (.0001)	-9.2e-06 (.0000)
Msacat	-2.623 (.5786)**	-.3768 (.0992)**	-1.549 (1.507)	-.2550 (.2063)
Doc pop	-1.053 (.7675)	-.3084 (.1820)	-.3366 (.5844)	-.0853 (.1139)
Adj. R^2	.5952	.4918	.5461	.4619

[1] Huber standard errors with group option to correct for intracluster correlation, the state is the clustering variable

[2] The LN models use the natural log of the scale values for both the dependent and independent variables

[3] Interaction term: Xscdist = ScaleR*DistR, highest scale value among the two nearest rural hospitals times the distance to that hospital

* Statistically significant at the 0.05 level ** Statistically significant at the 0.01 level

specialization in both 1991 and 1994, while being located in an MSA is negatively related to specialization in both years. Although the distance and scale score interaction terms are not statistically significant, the negative coefficients indicate that distance may have some moderating effects on medical staff competition between rural hospitals.

The strong positive association between the level of medical staff specialization in rural hospitals and the level of specialization of the closest rural hospitals suggests there is competitive rather than cooperative behavior amongst rural hospitals based on the composition of the rural hospital medical staff. In addition, hospital size and demand factors, most notably the percentage change in population, appear to influence the degree of specialization of rural hospital medical staffs. This assessment is based on a global measure that describes the overall composition of the active medical staff and does not assess what factors affect the availability of different types of specialists on rural hospital medical staffs.

Tables 9 and 10 present coefficient estimates and standard errors from logistic regression models for seven different types of specialists. The same basic set of variables used to examine the level of medical staff specialization is used in these regressions. Overall, after controlling for hospital and community characteristics, whether a rural hospital has a specialist on its active staff is positively related to the presence of the same type of specialist on the active staff of either of its two closest rural neighbors in both 1991 and 1994. Moreover, this relationship is statistically significant for five of the seven specialty types in 1991 (internists, obstetricians, general surgeons, orthopedic surgeons and urologists) and six of the seven types in

Table 9

1991 Coefficients and Standard Errors[1] from Logistic Regression Models with Different Specialty Types

Variables	Internist	Pediatrician	Obstetrician	General Surgeon	Orthopedic Surgeon	Ophthalmologist	Urologist
First or second nearest hospital has a specialist of that type	.9953** (.1578)	.1413 (.3491)	1.752** (.4937)	1.694** (.3151)	1.518** (.5099)	.9766 (.5650)	2.211** (.6970)
XDist[2]	-.0078 (.0085)	.0385* (.0163)	-.0138 (.0173)	-.0326** (.0076)	.0021 (.0233)	-.0207 (.0261)	-.0385 (.0292)
DistU1	.0039 (.0036)	-.0001 (.0054)	.0083* (.0037)	.0048** (.0018)	.0036 (.0036)	-.0018 (.0052)	-.0012 (.0040)
Public90	-.5080 (.3728)	-.0030 (.2131)	-.7350** (.2225)	-.2672* (.1349)	-.6627* (.2933)	-.8339** (.3162)	-.0654 (.2004)
System90	.1996 (.3723)	.3684 (.4264)	1.281** (.3934)	.2145 (.3622)	.4281 (.2746)	.3229 (.5733)	.2806 (.4005)
Hbed90	.0785** (.0137)	.0999** (.0099)	.1017** (.0172)	.0871** (.0101)	.0892** (.0150)	.1149** (.0122)	.0734** (.0132)
Hbed2	-.0002** (.0001)	-.0003** (.0000)	-.0003** (.0001)	-.0003** (.0000)	-.0002** (.0001)	-.0003** (.0000)	-.0001* (.0001)
Bflag	.0099 (.2724)	.4645 (.3261)	.0265 (.2932)	.0640 (.2402)	-.0884 (.3371)	-.1906 (.4204)	.0948 (.2693)
Pop90	.0009** (.0003)	.0005 (.0003)	.0011** (.0004)	.0008 (.0005)	.0013** (.0002)	.0013 (.0009)	.0001 (.0013)
Pctpopch	.0787** (.0135)	.0853** (.0232)	.0684** (.0172)	.0299** (.0102)	.0981** (.0186)	.0777** (.0101)	.0702** (.0112)
Pci90	.0001 (.0001)	.0001 (.0001)	.0001 (.0001)	.0001 (.0001)	.00002 (.0001)	-.0001 (.0001)	.0001 (.0001)
Msacat	-.6841 (.3735)	-.7383 (.6572)	-.6790 (.3928)	-.6338 (.4842)	-1.415** (.2648)	-2.036 (1.072)	-.4580 (1.492)
Constant	-5.003* (2.196)	-8.129** (2.023)	-7.931** (2.169)	-4.7974** (1.575)	-5.892** (1.520)	-4.846* (2.303)	-6.620** (1.302)
Pseudo R^2	.3650	.5316	.5231	.2689	.5133	.5571	.4563

[1] Huber standard error with group option to correct for intracluster correlation, the state is the clustering variable
[2] Whether the first or second nearest rural hospital has a specialist of that type times the distance to that hospital

* Statistically significant at the 0.05 level

** Statistically significant at the 0.01 level

Table 10

1994 Coefficients and Standard Errors[1] from Logistic Regression Models with Different Specialty Types

Variables	Internist	Pediatrician	Obstetrician	General Surgeon	Orthopedic Surgeon	Ophthalmologist	Urologist
First or second nearest hospital has a specialist of that type	.9944** (.2421)	-.1374 (.4513)	1.642** (.5697)	1.119** (.2194)	1.052** (.3488)	.9436* (.4265)	3.517** (.7204)
XDist[2]	-.0154** (.0051)	.0243* (.0100)	-.0089 (.0137)	-.0198** (.0034)	-.0107 (.0180)	-.0247 (.0231)	-.0807** (.0293)
DistU1	.0048 (.0027)	.0075 (.0050)	.0084 (.0046)	.0018 (.0011)	.0058 (.0040)	-.0011 (.0066)	.0021 (.0060)
Public93	-.4407* (.2009)	-.0458 (.2196)	-.6036** (.2296)	-.1633 (.1535)	-.5758 (.3061)	-.2589 (.3646)	-.3706 (.4179)
System93	.7006* (.3181)	-.0218 (.4987)	.6649* (.2855)	.1640 (.2419)	.2501 (.2817)	.1775 (.2654)	-.2611 (.5336)
Hbed93	.0657** (.0114)	.0909** (.0141)	.1115** (.0177)	.0916** (.0142)	.0926** (.0111)	.1085** (.0096)	.0892** (.0122)
Hbed2	-.0002** (.0001)	-.0003** (.0001)	-.0004** (.0001)	-.0003** (.0001)	-.0003** (.0000)	-.0003** (.0000)	-.0003** (.0001)
Bflag	-.0474 (.2761)	.3528 (.2827)	-.2296 (.3001)	-.1089 (.2265)	-.3274 (.4234)	-.4437 (.4899)	-.3398 (.4646)
Pop92	.0007** (.0001)	.0003 (.0005)	.0007** (.0003)	.0006* (.0003)	.0009 (.0007)	.0015 (.0011)	-.0003 (.0010)
Pctpopch	.0698** (.0127)	.0869** (.0107)	.0830** (.0257)	.0429** (.0124)	.1021** (.0126)	.0668** (.0103)	.0844** (.0191)
Pci92	-.00003 (.0001)	.0000 (.0001)	.00005 (.0001)	-.00004 (.0001)	-.0001 (.0001)	-.0002 (.0001)	-.0001 (.0001)
Msacat	-.8292** (.2759)	.1726 (.6221)	-.5665 (.3307)	-1.051 (.5914)	-.8676 (.8683)	-2.232 (1.703)	.3827 (1.168)
Constant	-2.429** (.7721)	-5.941** (1.344)	-7.238** (1.811)	-2.232** (.7659)	-2.924 (1.510)	-2.988 (2.596)	-4.428* (1.816)
Pseudo R^2	.2921	.4346	.5049	.2548	.4482	.5133	.5043

[1] Huber standard error with group option to correct for intracluster correlation, the state is the clustering variable
[2] Whether the first or second nearest rural hospital has a specialist of that type times the distance to that hospital

* Statistically significant at the 0.05 level ** Statistically significant at the 0.01 level

1994 (internists, obstetricians, general surgeons, orthopedic surgeons, ophthalmologists and urologists). Only the pediatrician model in 1994 shows a negative association between the presence of a specialist on the active staff of a rural hospital and whether either of the two nearest rural hospitals has a specialist on staff. However, this association is not statistically significant. As with the analysis of the medical staff scale score, the number of beds in the hospital and percentage change in population are also strongly associated with the presence of all types of specialists in both years.

The effect of distance on the competition measures tends to be negative, which suggests the competitive effect is tempered as distance increases, but this effect is not entirely consistent nor always statistically significant. Public ownership is negatively associated with the presence of all types of specialists while membership in a healthcare system shows a positive relationship across most specialty types. Ownership seems to have the strongest relationship with the presence of obstetricians on the active medical staff of rural hospitals, with the public hospitals less likely to have obstetricians on their staffs.

DISCUSSION

The rural hospital medical staff is an integral part of the delivery of health care services in rural areas as well as an instrumental force in maintaining rural hospitals. Family or general practice physicians are the most commonly reported specialists on the active medical staffs of rural hospitals followed by general surgeons and internists. As the size of the medical staff increases, however, other types of specialists appear in a relatively consistent manner, which allows for the use of a single scale to describe the level of specialization on the hospital medical staff.

The primary findings of this study suggest there is competition among rural hospitals based on the composition of the hospital medical staff, after controlling for demand factors and hospital capacity. The degree of competition appears to differ, however, for different types of specialists. Some of the specialty types that demonstrate consistently strong competitive effects in these data are internists, obstetricians, general surgeons and urologists. For example, the presence of an internist in either of the two closest rural hospitals is associated with a nearly three-fold (odds ratio = 2.7) increase in the odds that a rural hospital will have an internist on its active medical staff relative to hospitals whose nearest neighbors do not have internists. It also appears that distance may moderate this effect, since interacting the specialist binary variable with distance results in a negative coefficient. A 10 mile increase in the distance to the nearest rural hospital with an internist is associated with a decrease in the odds ratio from 2.7 to 2.5 in 1991 and from 2.7 to 2.3 in 1994; a 30 mile increase results in a decrease in the odds ratios from 2.7 to 2.1 in 1991 and from 2.7 to 1.7 in 1994.

In the case of general surgeons, a rural hospital with a neighbor that has a general surgeon on its active medical staff is also significantly more likely to have a general surgeon on its active medical staff than a hospital whose neighbors do not have a general surgeon on the active medical staff. And, once again, this relationship diminishes as the distance to the 'competitor' hospital increases. It is possible, however, that the mobility of general surgeons and higher average number of medical staff affiliations (Miller, Welch and Englert, 1995) could lead to an apparent "competitive effect" in the analysis that was not actually present.

To account for the potential effects of multiple affiliations we used information about the location of the general surgeon's primary practice that was collected in the 1991 survey. A respecified general surgeon model was estimated using only hospitals where the primary location of the active general surgeon was in the same town as the hospital, which included 83 percent of the rural hospitals in the 1991 sample that had a general surgeon on the active medical staff. The results of the new model were quite consistent with those shown in Table 9, indicating that the prior results likely reflect competitive behavior and are not artifacts of cooperative sharing arrangements.

The distance to the nearest urban hospital, which was included as a measure of competition with urban facilities, appears to have little influence on the composition of the rural hospital medical staff. Only the probability of a rural hospital having an obstetrician or general surgeon on its active medical staff shows any association with the distance to the nearest urban hospital, and then only in 1991. Furthermore, the positive coefficients suggest that rural hospitals are more likely to have obstetricians and general surgeons as the distance to an urban facility increases, which is considered cooperative rather than competitive behavior. Thus, it appears that the rural hospitals in this study are not strongly influenced by urban hospitals.

This result could be due in part to the geography of the region in which the study hospitals are located. Several of the states (e.g., Montana, South Dakota, North Dakota) cover large land areas and have few cities, so the distances to a city are generally quite large. Or, it could indicate that the rural hospitals in the study do not regard urban hospitals as their primary competitors.

The lack of statistical significance for the distance to the nearest urban hospital also emphasizes another critical factor that is likely to affect our study results, which is market definition. For this study we simply identified the closest rural and urban hospitals as 'the competition', while using the county to specify measures of demand. There is much discussion about what the best way is to define hospital markets but no clear consensus. Nevertheless, it would seem that the closest hospitals are the most visible sources of competition for a hospital and therefore a direct measure of actual competition. This is consistent with Luke (1991) who observes that "relative distances sort out real from potential competitors" (p.210) and "hospital competitors located near one another in geographic space face the most intense competitive interdependency" (p. 221), which results in increased distrust and rivalry. However, it is also apparent that using distance calculations does not take into account geographic factors such as mountains, which are likely to influence competition with one's apparent neighbors.

An additional limitation of this study is that all the analyses examine the composition of rural hospital medical staffs at one point in time. Since the data were collected in two separate time periods we did attempt to analyze changes in hospital medical staffs but in general there was little change in the specialty composition of rural hospital medical staffs between 1991 and 1994. Among the 418 rural hospitals that responded to both the 1991 and 1994 surveys, a scale difference score was calculated by subtracting the 1991 specialty scale score from the 1994 score. The difference values ranged from minus 12 to plus 12 with a mean value of .02. Approximately 58 percent of the rural hospitals had a difference value of zero and 22 percent had a positive value, indicating an increase in the hospital's level of medical staff specialization between 1991 and 1994. Because of the concentration of observations at zero and the presence of a few extreme values, rather than analyze the difference variable we decided to focus on hospitals that showed an increase in their level of specialization. A binary variable was constructed with hospitals that had a positive difference score given a value of one while hospitals with a zero or negative difference score received a value of zero.

A logistic model of whether a hospital's scale score increased showed that hospitals with a higher scale score in 1991 (i.e., more types of specialists) were less likely to add more types of specialists in 1994. Among the competition variables, both the highest scale value among the two nearest rural hospitals and the distance to the nearest urban hospital were statistically significant and positive. So, the higher the level of specialization of a hospital's neighbors the more likely the hospital was to increase its level of specialization, which is considered competitive. On the other hand, an increase in specialization did not appear to be a competitive strategy with respect to urban hospitals since hospitals located farther from urban hospitals were more likely to increase their level of specialization. System ownership was also positively related to an increase in a hospital's medical staff scale value.

Next, we examined the addition of specialists, by type, as well as changes in the number of specialists of different types on the active medical staffs of the 418 hospitals in both surveys. The biggest changes, among the hospitals that did not have specialists of a certain type on the active medical staff in 1991, were the addition of internists and general surgeons. Internists were added by 24 rural hospitals (10 percent) that did not have an internist in 1991, while 27 rural hospitals (17 percent) without general surgeons in 1991 had a general surgeon in 1994. Changes in the number of specialists on the active staff were a bit more prevalent. Forty percent of the surveyed hospitals showed an increase in the number of family practice physicians on the active medical staff, 21 percent had an increase in the number of internists, 16 percent had more general surgeons and 15 percent more orthopedic surgeons.

Logistic models of an increase in the number of specialists versus no change or a decrease in the number of specialists indicated that the more specialists of a certain type on the active staff in 1991, the less likely a hospital was to increase the number of specialists of that type in 1994. The presence of a specialist of the same type in either of the two nearest rural hospitals was positively related to an increase in the number of specialists for all specialty types, except pediatricians. This relationship was statistically significant for general surgeons, orthopedic surgeons and urologists, which suggests there may be a competitive element to increasing the number of specialists on the active medical staff for some specialty types. The percentage change in population also showed a strong, positive association with an increase in the number of specialists for almost all of the different types of specialists.

One question that arises from the results of this study is whether medical staff competition among rural hospitals increases hospital and hence health care costs. Past research has identified competition based on the acquisition of specialized technology (i.e., the medical arms race) as a primary reason for increasing costs (Robinson and Luft, 1985, 1987; Noether, 1988). Whether competition based on the composition of the hospital medical staff results in higher costs is not readily apparent.

Moreover, the results of this study also support the general conclusion by Dranove, Shanley, and Simon (1992) that the extent of the market matters. Dranove, Shanley, and Simon (1992) showed that local population is an important predictor of the provision of specialized services by hospitals. This study demonstrates that population, and more specifically a growing population, has a clear, positive affect on the level of specialization of rural hospital medical staffs (i.e., a growing population is associated with a more specialized medical staff).

The findings from this study also challenge, in part, the conclusions of a recent study by Vogel and Miller (1995) who found that unlike hospitals located in urban markets, which demonstrated a negative relationship between costs and market concentration, those in rural markets did not exhibit any association between costs and concentration. They suggest that the difference in observed concentration-cost relationships could be because hospitals located in rural areas focus more on their communities than their rivals and therefore engage in less technological rivalry. This study, on the other hand, indicates that rural hospitals do watch their neighbors and do appear to compete with at least their closest rural rivals.

In conclusion, it has been suggested that hospital competition in the post-PPS, cost-control, managed care environment will be based on price rather than status (i.e., specialized services) (MacStravic, 1986; Melnick and Zwanziger, 1988; Melnick et al., 1992). This analysis indicates that may not be entirely true. Rather, the results show there is competition among rural hospitals based on the composition of the hospital medical staff as well as the availability of certain types of medical specialists. There is also little evidence of the regionalization of various specialized physician services, at least among rural hospitals and their nearest neighbors.

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APPENDIX

Determining the specialty composition of the closest and second closest rural hospitals involved a two step process. First, the distance to and identity of the two nearest rural hospitals were ascertained. However, even though both samples include over 90 percent of the rural hospitals within the eight state area there were still some hospitals that were not surveyed and in some cases the nearest rural hospitals were located outside the eight state region. Because we were unable to calculate a scale value for hospitals that are not within our sample groups we decided to select the closest rural hospitals within our sample.

In 1991 there were 47 hospitals where the nearest rural hospital was outside the sample group and, after replacing these values, 87 hospitals where the distance to the second nearest rural hospital was out of sample. The average distance to the nearest rural hospital for the observations requiring replacement values was 21.25 and the average distance to the second nearest was 27.77. Substituting the nearest in sample hospitals increased the average distances to the first and second nearest rural hospitals to 30.46 and 36.47 respectively. However, the average distance to the nearest rural hospital for the entire 1991 sample only increased from 20.56 to 21.49 and the average distance to the second nearest from 28.19 to 29.82.

In 1994, there were 53 observations where the nearest rural hospital was not in the 1994 sample and 103 where the distance to the second nearest was out of sample. Using 1991 scale values for twenty-nine hospitals that responded in 1991, but not 1994, decreased these numbers to 22 and 51. The average distance to the nearest rural hospital for the 22 that needed replacement values was 23.83, which increased to 33.18 after replacement. For the 51 hospitals where the second nearest hospital was out of sample, after replacing the nearest if necessary, the average distance was 29.64 before replacement and 39.11 after. The average distance to the nearest rural hospital for the entire 1994 sample only increased from 21.31 to 21.78 and the average distance to the second nearest from 29.05 to 30.17. When 1991 scale scores were not used the average distance to the nearest rural hospital for the 53 hospitals was 22.30, which increased to 32.06 after replacement; the average distance to the second nearest for the 103 hospitals was 29.63, which increased to 39.08; for the entire sample the average distance to the nearest rural hospital increased from 21.31 to 22.50 and the average distance to the second nearest increased from 29.05 to 31.29.

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