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LOCATIONAL ANALYSIS OF NORTH CAROLINA PHYSICIANS' PRIMARY, SECONDARY, AND TERTIARY PRACTICES

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Introduction

As physicians reorient toward a changing health care system, they increasingly establish secondary and tertiary practice locations. Sixteen percent of North Carolina's physicians had multiple locations during 1992. The expansion into multiple sites has clear implications for the geographic distribution of physicians and therefore for the availability of and access to physicians. One can view multiple-site practices as a two-edged sword; they might increase or decrease physician-to-population ratios in an area, depending on the geographic distribution of physicians' primary, secondary, and tertiary practices.

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Studies that only consider physicians anchored to a single location are rapidly becoming out-of-date. To deal adequately with current realities, locational analyses of physician practices must recognize more complex patterns that include primary, secondary, or tertiary practices. Further complicating analysis are the linkages between financing and service delivery (i.e., managed care) that are revolutionizing the health care industry. In this paper our focus is on describing spatial patterns of practices with multiple sites. This is done using the standard locational concepts of low vs. high order goods and services, threshold, range, population size and central function relationship, and trade areas to compare multiple practice sites. Such an approach demonstrates the usefulness of geographic concepts in "real-world" applications.

The authors deal with the increasing tendency of individual primary health physicians to open offices in different locations and the resulting complexities of patient access to medical services

Background

Why do physicians have multiple locations? The expansion of physician services into secondary and tertiary practices, additional locations to where they commute to provide services, is primarily a function of economics. The goal of course is to maintain and increase profits to insure a stable and secure practice or health care organization. Some measures to maintain and increase profits include increasing the geographic patient (population) base, increasing the referral volume from other collaborating physicians, and discouraging competition from other physicians. However, if physicians (or organizations which employ them) cannot increase their medical service or population base/demand to reach a profitable threshold in only one location, their options are either to relocate to larger markets or branch out with secondary and tertiary practices.

In spite of the importance of economic considerations, there may be other motivating factors which spur the establishment of multiple practices. Is it just a matter of branching out to acquire additional patients or is there a conscious effort to provide care to particular population subgroups with "preferable" (e.g., underserved) characteristics? Other motives directing physicians to secondary and tertiary practices include contract obligations (e.g., managed care) and historic precedent (Albert and Gesler, forthcoming).

Studies of multiple-site practices, especially those with a geographic orientation, are rare.One recent exception is a study which found that multiple-site.practices for urologists (n=35) were common in the Hartford Medical Service Area. Inclusion of secondary practices increased appointment capacity 23 percent and the number of towns with urologists from 6 to 19 of the 38 towns within region. Interestingly, secondary practices were "in communities with higher than average elderly populations and incomes and lower than average minority populations" (Cromley and Albertsen, 1993). This seminal research affirms the importance of multiple-site practices within physician location analyses and concludes by recommending "further research to document the functioning of multiple-site practices across other specialties and geographic areas" (Cromley and Albertsen, 1993).

Data Source

Our physician data originate from a self-report questionnaire subsumed within a registration application for a medical license that is accessible through the North Carolina Board of Medical Examiners (NCBME, 1992) via the North Carolina Health Professions Data System (Sheps Center for Health Services Research, 1992). This statewide database consists of 18,253 records with twenty-two fields that include one field each for gender, race, specialty, and an in-/out-of state code and three fields each for the city, state, county, ZIP Code, hours per week in medicine, and employment setting for the primary, secondary, and tertiary practices.While gender, race, specialty, in-/out-of state code, city, state, and county fields were 98 to 100% complete, the Zip Code fields were far less complete with 97, 66 and 54% respectively for primary, secondary, and tertiary practices. Some of the other fields such as hours/week in medicine and location setting suffer from missing observations. These fields ranged from a low of 70% for tertiary practice setting to a high of 86% for secondary hours/week in medicine. Dealing with missing observations attenuates the power of interpretation for some of the analyses; however, 11 of the 22 fields were over 90% complete (most 98 or 99%). It is important here to recognize data concerns (e.g., self-reported data, completeness, accuracy) up front so that analyses are evaluated in terms of data limitations.

General Description

There were 11,632 primary practices during 1992 which tended to cluster within counties having medical schools, regional hospital complexes, and large urban populations (Figure 1). Supplementing these primary practices were 2,221 second-

ary and tertiary practices with similar spatial patterns (Figure 2); however, without factoring in a denominator (population) the contribution of secondary and tertiary practices to a health care system is difficult to assess (Albert, 1995).

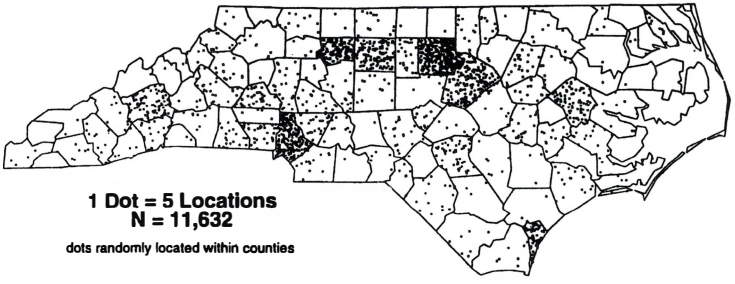

Figure 1: Primary practices, 1992.

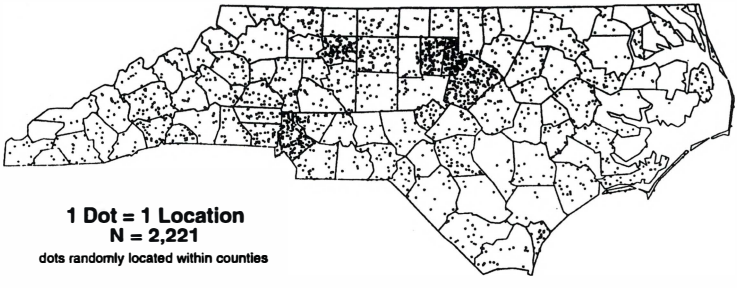

Figure 2: Secondary and tertiary practices, 1992.

The effect of physicians crossing state lines to establish secondary and tertiary practices is minimal with 41 more practices entering North Carolina than leaving the state. In other words, the North Carolina multiple-site system is almost entirely a closed one. The ratios of secondary and tertiary to primary practices provide insight into counties benefiting dramatically from multiple practices. There were 15 counties having ratios of ≥ 1 (i.e., more secondary and tertiary practices than primary practices), including Martin, Washington, Hyde, Dare, Currituck, and Camden which formed a cluster of adjacent counties in northeastern North Carolina. Simple examination found these counties to be nonmetropolitan and health professional shortage areas. Designation as a health professional shortage areas

(HPSA) is dependent on population-to-primary care physician ratios and other criteria such as poverty status, infant mortality, and birth rates for females aged 15-44 (NC Office of Rural Health and Resource Development, 1993). These factors, nonmetropolitan status and HPSA status, were significant in a multiple regression analysis using the ratio of secondary and tertiary to primary practices as a dependent variable (Albert, 1996). Such findings suggest that some physicians were locating with respect to underserved populations.

Physicians with multiple practices work on average 45 hours per week at primary practices, 11 hours at secondary practices, and six hours at tertiary practices. These physicians' secondary practices tend to be much less office based (35% vs. 55%), more hospital based (34% vs. 24%), less university based (6% vs. 9%), and more based in other settings such as clinics or nursing homes (24% vs. 13%) than their primary practices. Tertiary practices of multiple-site physicians were less office based (35% vs. 55%), less university based (6% vs. 9%), and more other based (34% vs. 13%) than their primary practices. Second practices tend to mirror the county type of the primary practice (e.g., if primary practice is metropolitan then secondary practice is apt to be metropolitan). Eighty-two and sixty-two percent, respectively, of physicians cross municipal and county limits to secondary and tertiary practices, indicating a movement out of the immediate area to serve other markets. Secondary and tertiary practices were in smaller sized settlements than primary practices. Forty percent of secondary and 50% of tertiary practices were in settlements under 10,000 as compared with 20% of primary practices. The average distance between primary and secondary practices is 24 miles with 90% under 50 miles (Albert and Gesler, 1997).

Multiple locations of a physician's office are especially concentrated in counties that have a shortage of primary health services to begin with

Locational Analysis

There are a number of geographic concepts that can provide structure to an analysis of physician practice locations; these are the central place elements of 1) low and high order goods and services, 2) threshold, 3) range 4) population size and central function (specialties) relationship, and 5) trade area (deSouza and Stutz, 1994). These concepts will highlight locational differences existing between primary, secondary, and tertiary practices of multiple-site physicians.

Low and High Order Goods and Services

One of the fundamental concepts of central place locational analysis is order of goods and services. There are lower order (small cost and more frequent purchase) and higher order (large cost and less frequent purchase) goods and services. Physicians, according to their individual specialties, were aggregated into a four group classification that included general practitioners and family practitioners (GP&FP), medical specialties (MS), surgical specialties (SS), and other specialties (OS). The GP&FP, MS, and SS groups were considered low order and the

OS group high order. This dichotomy is based on the hours per week each group spends in the office versus a hospital setting. More hours per week are spent in an office setting than hospital setting for lower order specialties; the reverse is true for higher order specialists (Gonzalez, 1993). From among the physicians (N=2,000) with multiple practices, 68% offered lower order specialties (GP&FP = 16%, MS = 27%, SS = 25%), and 32% offered high order specialties (OS).

Threshold

Threshold is the minimum population base (or demand) that supports primary, secondary, and tertiary practices. Notice that 57% of secondary and 65% of tertiary practices were in settlements under 20,000 compared to just 35% of primary practices (Table 1). This means that secondary and tertiary practices operate at lower population thresholds (smaller-sized settlements) than do primary locations. Greatest threshold differences were among the specialties at primary locations with the lowest order specialties, GP&FP, standing apart from the other physician groups with lower thresholds (Figure 3). Threshold differences among the specialties (GP&FP, MS, SS, OS) at secondary and tertiary practices were minimal.

Secondary and tertiary office locations are in the smaller towns and more rural counties which therefore see their physician(s) less frequently

Settlement Size	Primary	Secondary (cumulative percentage)	Tertiary
< 2,500	8	13	15
2,500 - 4,999	15	24	35
5,000 - 9,999	22	38	52
10,000 - 19,999	35	57	65
20,000 - 49,999	54	72	80
50,000 - 124,999	65	79	84
125,000 - 199,999	82	90	94
200,000+	100	100	100

Notes: significant using K-S test at $p < 0.001$; primary locations (N=1,984), secondary locations (N=1,934), tertiary locations (N=342); includes out-of-state locations when physicians have at least one in-state location; data sources, NCBME, 1992 and U.S. Bureau of the Census, 1994.

Table 1: Primary, secondary, and tertiary practices and settlement size.

Range

Range is defined here as the maximum distance physicians traveled between their primary, secondary and tertiary practices. The average distances were least from primary to secondary (24 miles) and greatest from secondary to tertiary practices (35 miles) (Table 2). General practitioners and family practitioners, medical

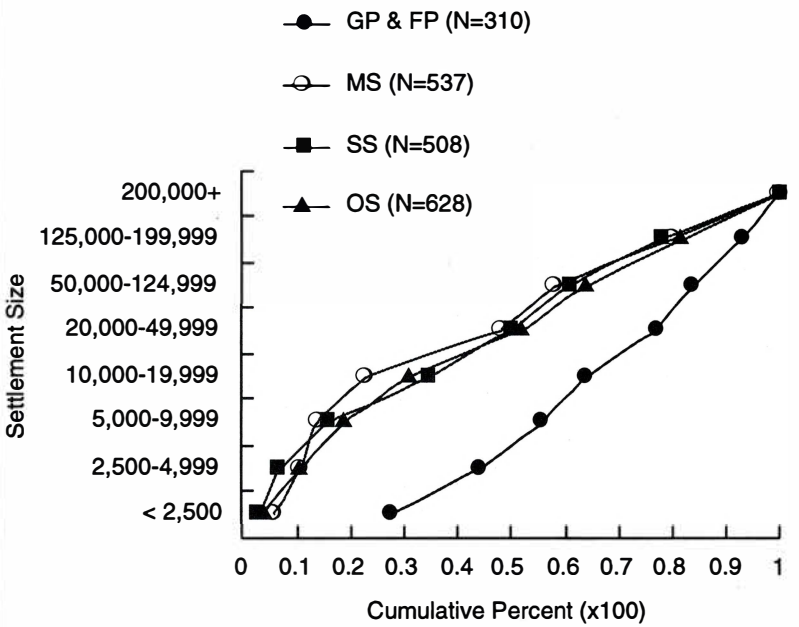

Figure 3: Primary Practices of GP & FP,MS, SS, and OS.

specialties, and surgical specialties (lower order specialties) travel on average less distance than the other specialties (higher order specialties) between primary, secondary, and tertiary practices.

	P to S	P to T	S to T
GP&FP	23	30	32
MS	22	26	34
SS	21	26	30
OS	27	36	40
Total	24	30	35

Data Source: NCBME, 1992; out-of-state locations excluded.
Note: P = Primary, S = Secondary. and T = Tertiary; P to S (N = 1,741), P to T (N = 292), and S to T (N = 286).

Table 2: Mean miles between practices.

Population Size and Central Function Relationship

There is a positive relationship between a settlement's population size and the number of different central functions (goods and services). Here we compare the

number of different specialties offered among aggregates of large, moderate, and small settlements for physicians having just a single practice (N = 9,754) and for physicians having multiple practice locations. The number of individual specialties offered by physicians decrease from primary, secondary, and tertiary practices at the large (I), moderate (II), and small (III) settlement sizes (Table 3)[1]. One should note, however, that the ratio of the specialties between small (III) and large (I) settlements increase from 1.1 among primary, to 1.6 among secondary, and then to 2.5 among tertiary practices. This is a positive indication that a wide spectrum of specialties, rather than just a select group of specialties such as GP&FP that customarily favor smaller sized settlements, were located in smaller sized settlements.

	Specialties (Number)		
Settlement Size (I. large, II. medium, III. small)	Primary Practices	Secondary Practices	Tertiary Practices
I. ≥ 125,000	78	47	22
II. 20,000 - 124,999	75	46	19
III. ≤ 19,999	86	74	56
Ratio III/I	1.1	1.6	2.5

Table 3: Number of specialties and settlement size.

Trade Areas

Mean distances between primary and secondary and primary and tertiary practices for GP&FP, MS, SS, and OS delimit surrogate trade or market areas for those physicians with three practice locations. Trade areas are depicted graphically in Figure 4. The x-axis is the mean distance from primary to secondary and the y-axis is the mean distance from primary to tertiary practices. For low-order specialties' (GP&FP, MS, SS) the trade area is less than or equal to 690 square miles; whereas, the higher order specialties' (OS) trade area is 972 square miles.

Health Care Policy Implications

There are five potential health care policy implications of multiple locations. These include implications related to data quality, monitoring health care providers, geographic access to and availability of physicians, calculating health professional shortage indices, and physician recruitment. For example (Albert and Gesler, 1997):

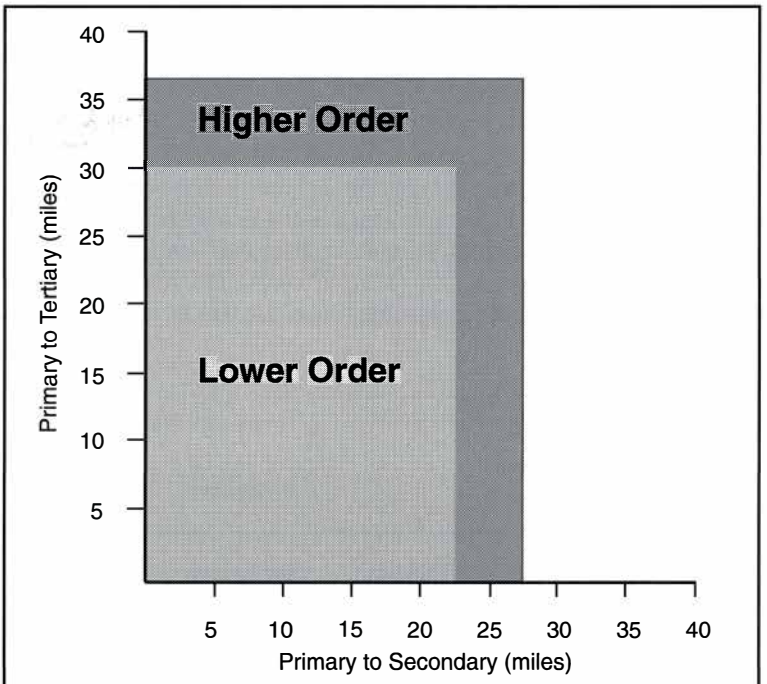

Figure 4: Trade Areas of Higher and Lower Order Specialties.

•missing observations, inaccuracies, and poor definition of terms taint the usefulness of the physician database;

•ignoring second and tertiary locations might cause an under or over estimation of physician-to-population ratios;

•multiple practice patterns redistribute physicians within and between counties to alter access for or against certain population groups;

•precise accounting of physicians' hours spent in secondary and tertiary locations might cause counties to gain, lose, or maintain federal shortage designation (i.e., health professional shortage areas and medically underserved areas) and change potential to compete for various program funding; and

•data on secondary and tertiary locations might be useful to target physicians within some specified radius (e.g., 30 to 60 miles) of shortage communities for full-time recruitment.

Summary and Discussion

Basic concepts of locational analysis provide a useful approach to differentiate between the lower (68%) and higher order (32%) specialties and among the primary, secondary, and tertiary practices of physicians (Table 4). In general, the

results confirm the expectations geographers derive from their knowledge of central place locational theory. This analysis, however, is particularly useful because it shows that concepts such as threshold and range differ for different physician groups as well as for multiple- versus single-site practices. Threshold populations decrease with multiple practices; a larger percent of secondary (57%) and tertiary (65%) compared to primary practices (35%) were in settlements under 20,000. Distances (range) separating primary, secondary, and tertiary practices were less for lower order specialties (GP&FP, MS, SS) than higher order specialties (OS). More individual specialties were among the aggregation of small rather than large settlements; however, the ratios (individual specialties at small/individual specialties at large settlements) were greatest for secondary (1.6) and for tertiary (2.5) practices. Trade areas of the lower order specialties (GP&FP, MS, SS) were less than trade areas for higher order specialties (OS). Results such as these indicate that clear geographic differences exist both among specialty groups and among primary, secondary, and tertiary locations.

Results indicate that clear differences exist within North Carolina in service availability provided by specialist as well as primary health physicians

The dynamics of multiple practice locations are fascinating. The phenomenon of multiple practice locations raises concerns over data quality of physician databases, effective geographic monitoring of health care personnel, access and availability of physician services, health professional shortage area determination, and physician recruitment (Albert and Gesler, 1997). Further investigations of secondary and tertiary practices might reinvigorate the languishing topic of physician location analysis. One immediate need is to continue to document the percent of physicians with multiple practices since 1992. Future research must recognize that locational patterns of physicians have become more complex given the phenomenon of multiple practices and overarching changes occurring (i.e., managed care) within the health care sector.

Endnote

[1]**General Practice & Family Practice (N=2):** General Practice; Family Practice; **Medical Specialties (N=33):** Allergy; Cardiovascular Disease; Dermatology; Diabetes; Endocrinology; Gastroenterology; Geriatrics; Hematology; Infectious Disease; Internal Medicine; Neoplastic Disease; Nephrology; Nutrition; Pediatrics; Pediatrics, Allergy; Pediatrics, Cardiology; Pulmonary Disease; Rheumatology; Adolescent Medicine; Allergy and Immunology; Immunology; Neonatal - Perinatal; Pediatric Endocrinology; Pediatric Hematology-Oncology; Pediatric Nephrology; Gynecological Oncology; Maternal and Fetal Medicine; Medicine/ Pedicatrics; Pediatric Gastroenterology; Pediatric Rheumatology; Pediatric Pulmonology; Pediatric Infectious Disease; **Surgical Specialties (N=29):** Bronchoesophagology; Gynecology; Laryngology; Obstetrics; Obstetrics/Gynecology; Opthalmology; Otology; Otorhinolaryngology; Rhinology; Surgery, Abdominal; Surgery, Cardiovascular; Surgery, Colon and Rectal; Surgery, General; Surgery, Hand; Surgery, Head and Neck; Surgery, Neurological; Surgery, Orthopedic; Sur-

gery, Pediatric; Surgery, Plastic; Surgery, Thoracic; Surgery, Traumatic; Surgery, Urological; Maxillofacial Surgery; Reproductive Endocrinology; Vascular Surgery; Facial Plactic Surgery; Hand Surgery, Plastic; Surgery, Oncology; **Other Specialties (N=41):** Aerospace Medicine; Anesthesiology; Emergency Medicine; General Preventive Medicine; Hypnosis; Legal Medicine; Neurology; Neurology, Child; Neuropathology; Nuclear Medicine; Occupational Medicine; Pathology; Pathology, Clinical; Pathology, Forensic; Pharmacology; Physical Medicine & Rehabilitation; Psychiatry; Psychiatry, Child; Psychoanalysis; Psychosomatic Medicine; Public Health; Radiology; Radiology, Diagnostic; Radiology, Pediatric; Radiology, Therapeutic; Roentgenology, Diagnostic; Other Specialty; Blood Banking; Dermatopathology; Nuclear Radiology; Radioisotopic Pathology; Child Development; Addiction/Chemical Dependency; Critical Care Medicine; Epidemiology; Radiation Oncology; Sports Medicine; Anatomic Pathology; Administrative Medicine; Neuro-Radiology; Medical Microbiology/Genetics

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