

Physician Distribution by Concentrations

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Abstract:

Introduction: Current categorizations of physician workforce location do not facilitate the understanding of physician distribution. More direct methods are needed. **Methods:** Physicians locations were divided into super center locations with 200 physicians at a zip code, major center locations with 75 – 199 physicians, served areas, and underserved locations. **Results:** Over 40% of physicians were in super center zip codes with 200 or more physicians in less than 1% of the land area of the United States. Over 70% of physicians were found in zip codes of 75 or more physicians associated with 34% of the population and less than 4% of the land area. The family medicine specialty had very different distribution compared to all other types of physicians with only half of physicians in major medical centers. Family physicians were 2 – 4 times as likely to be found in urban underserved, rural, rural underserved, and isolated locations. Non-family physicians had over 3 times the probability of major medical center concentration. Distribution outside of major medical centers was more likely for those with birth origins outside and with family medicine career choice. Physicians with geographically or socially different or distant origins were more likely to be found outside of major medical centers in practice, to choose family medicine, to be older medical students, and to attend medical schools with average or below average MCAT scores. Combinations of these distributional characteristics were often found in the same students. Physicians born or raised in the concentrations of income, education, professionals, people, and facilities tended to attend top ranking medical schools, were more likely to subspecialize, were younger as medical students, and remained in major medical center careers and locations at the highest levels. **Discussion:** Extremes of physician concentration complicate physician distribution. Major medical center concentrations may suppress physician levels in nearby underserved and served locations. Distribution is much more than the narrow combination of family medicine plus rural or underserved origin. Less than average levels of distribution are seen only for the students, schools, and health policy periods associated with concentrations of income, professionals, and physicians.

Introduction

The nation has attempted to resolve physician distribution throughout the past century. During the same period physicians, concentrations of population, income, and health care have become more common. Physician distribution seems to evade understanding while concentration proceeds at a rapid rate. In addition, subspecialization rates have also progressed rapidly. Only brief periods of health policy in the 1970s and 1990s have been associated with redistribution of health resources in favor of lower and middle income populations and primary care.

In the past decade, concentration patterns have accelerated in admitted medical students. After decades of 60% levels, nearly 70% now arise from the top quintile in income in the United States. Medical student origins are more and more likely to involve Asian, foreign born, and other types of students with the closest geographic and social proximity to medical schools and

concentrations of physicians and professionals. Medical students are more likely to arise from families with not only higher levels, but the highest levels of income and professionals.¹⁻⁴ This is not likely to change even with expansion. Additional medical students will come from the top colleges. Over 74% of college students from the top 146 colleges arise from the top quartile in income.⁵ Those with national expertise in the path to college admission have already expressed major concerns regarding higher education outcomes and distributions.⁶ Their voices are joined by medical education experts expressing the same concerns about narrowing admissions.⁴

Expansions of medical students are not likely to change the patterns of increasing concentration. The nation has not funded the massive changes in the 1960s and 1970s that prepared a broader range of medical students for admission prior to the doubling of medical students during the 1970s. The nation also has not provided a health policy environment that will encourage choice of primary care, primary care retention in existing forms, or distribution beyond the current concentrations of physicians that thrive under current policy.

Increased admission for medical students associated with concentrations has been matched by declines in admission for the types of physicians associated with distribution. Rural population levels continue to decline steadily. More rapid declines are seen in rural physicians and rural born medical students to levels less than 10% or less than the 20% of the population found in rural areas. The greatest declines are found in the lowest income areas. Medical students are less likely to have origins outside of concentrations of people, professionals, and physicians. Progress in admission of disadvantaged students has also stagnated.⁷ Those gained have the lowest awareness and those lost have the highest levels of awareness of the needs of populations outside of major medical centers.²

Steady decreases in generalists, and family practice or general practice (FPGP) physicians extend back for nearly a century.⁸ Only a few interruptions in these patterns have been seen. One involved the 1970s with a quadrupling of primary care annual production led by the restoration of family medicine and health policy supportive of primary care. Rural health systems were renewed and rebuilt during this massive redistribution from 1965 to 1978. Urban underserved locations received new support from specific health policy changes. Thousands of physicians were distributed to the most rural and the most underserved locations with the National Health Service Corps. Support also involved new modes of community based health care. During the 1980s, declines in primary care again were the rule. Redistributions again interrupted decreases in generalists and primary care during the 1990s. This was a much shorter period of reform and a more rapid decline has followed.

Physician origins, physician training, accreditation, funding, career choices, and health policy involving concentrations are likely to make physician distribution a most difficult process.

The nation has tools to measure concentrations of income, population, and economics. A major problem is the nation does not have tools to measure physician concentration.

Physician locations have been compared to concentrations of income, poverty, economics, and people; however, physicians do not always respond consistently to these variables. Higher income areas often have physicians, but some higher income areas have fewer physicians.

Higher poverty is associated with lower levels of physicians, but concentrations of income, poverty, and physicians can share the same locations. Rural locations can have medical centers with hundreds of physicians. One common sense constant appears to be at work. Physicians appear to concentrate within concentrations of physicians. There has been little progress toward workforce methods that capture physician concentrations, a more direct measure of physician location. Decisions that result in physician concentrations may even make it difficult for some populations to access health care.

Methods

The author obtained IRB approval for studies of physician career and location decision using secondary data.

The Process of Categorization

The number of total active physicians at each zip code was determined using the American Medical Association Masterfile and a single practice zip code for each active physician. If there was no practice zip code given, the alternative practice zip codes were used, then the home zip code, then any zip code listed for the physician. Physicians had to be listed as alive and active to be included in the zip code counts. Retired physicians had distributions that were atypical, including greater levels location in urban underserved and rural underserved locations (likely lower cost of living). Listings for each zip code included the total number of active physicians (total minus retired) from all medical school types graduating from 1971 to 2000. The physician zip code distributions were grafted into an existing zip code database with year 2000 census data.

The initial coding methods considered levels of 50, 75, or 100 physicians at a zip code as defining points for concentrations of physicians into a “major medical center” location. After a review of the types of physician careers at each of the locations, the facilities at such locations, and the demographics of the locations, the 75 physician level was selected as the definition for major medical center. Family medicine remained separated from all other types of physicians by a consistent 20 percentage points regardless of the 50, 75, or 100 physician zip coding level. With the 75 physician zip code level, family physicians from different types of medical schools, different geographic origins, and different birth county levels also remained grouped in the 35 – 52% range found in zip codes with 75 or more physicians.

The process of categorization often begins with definitions of opposites. Major medical center concentrations were contrasted with the underserved locations. The middle ground locations were considered served locations although served locations had physician concentrations much closer to underserved locations and quite distant from major medical center locations. The major center, served, and underserved categories were divided into urban and rural components. Military and international locations completed the location coding. Consideration was given for a separate academic or medical school location category as compared to typical major medical centers. The isolated rural, rural, urban, military, and medical school major medical center locations were found to be much the same regardless of geography. A better description of physician concentration and a more consistent coding was developed by using the 200 physician

level as a dividing point. Major medical center zip codes with 75 – 199 physicians became Typical Centers and those with 200 or more became Super Centers. For simplicity all military locations were kept in the military category.

Super centers and typical centers as used in the categorization are not representations of existing corporate entities. These major medical center terms represent concentrations of physicians.

Since the focus was on physician distribution, the Masterfile was constantly used to verify the categorizations in an iterative process using all possible data fields. Zip codes with concentrations of physicians with medical teaching, research, and resident (primary practice activity fields in the Masterfile) duties were used to identify locations likely to be academic forms of major medical centers. The top ten physician specialty types found most commonly in major medical center locations were also used to identify zip codes likely to represent physician concentrations. Type of practice fields also identified other locations likely to represent concentrations of physicians.

The Underserved Category

The development of the underserved category began with a simple zip code plot of ratios of primary care physicians to population. With poverty approaching 19% and beyond, levels of primary care physicians declined. The exceptions involved Community Health Center zip codes and residency training locations. A convenience listing of family medicine residency training zip codes was used for this latter comparison,⁹ but other training programs are likely to contribute. Some form of additional federal, state, or local funding was often required to support even the broadest scope physicians when poverty levels dipped below 19%. Census data for 2000 was used to divide zip codes into locations with at least 19% of the population in poverty to compare this method of underserved coding to existing categorization systems.

Zip code listings of Community and Migrant Health Center (CHC) sites, National Health Service Corps (NHSC) sites, and whole county primary care (PC) shortage areas were obtained from federal web sites from 2001 – 2003, again with reference to the 2005 version of the Masterfile. Newer federal designations since this time were not inputted. There were other federal designations considered (partial county, township, Medicaid, prison designation), but examinations did not reveal the same consistency with the designated subgroup or with poverty levels. The underserved category could be divided into rural, urban, designated, and poverty subgroups.

In the process of setting the standards, there was not a predetermined level of underserved physicians based on standard deviations or a specific level of 5% or 10%. The consistency was set by the process involved in selecting the 3 types of designated sites and also by the 19% poverty level. Even some zip codes with federal designations had to be excluded from the underserved category due to high concentrations of physicians (over 75 at a zip) or poverty levels no different than national averages (12 – 13%).

The unique zip codes presented a challenge. These zip codes often had no population or population levels insufficient to support a single physician. Adjacent zip codes were used to determine patient populations, physician concentrations, and poverty concentrations. The 4 zip code grouping represents the catchment area of a typical primary care physician location. The use of adjacency for unique zip codes was also applied to all zip codes for consistency, grouping up to 4 adjacent zip codes together for comparison.

Consistent coding of underserved zip codes was also a goal. Adjacent zip code comparisons using zip code poverty levels smoothed the underserved location designation. In rural counties, lower levels of county income could be used to facilitate this process. Zip codes in rural counties with income below \$37,000 in median family income in 1999 were also included as underserved. These counties represented the bottom 6 – 8% of the population. Nearly all of these zip codes were already included as underserved. This method used in rural areas could not be used with urban counties with multiple zip codes and a variety of location types in the same county.

The author reviewed over 43,000 zip codes across geographic categories, latitude, longitude, poverty, adjacency, income levels, types of physicians, and physician concentrations to assure consistency in coding.

The coding was maintained for 36 different types of locations with internal consistency for each type across concentrations of people, poverty, income, and physicians as well as shortage designations.

Geographic Coding

The major medical center, served, and underserved physician locations were also categorized into urban and rural segments using RUCA 2.0 coding. Urban zip codes typically are codes of 1 – 3 with rural codes 4 – 10. The urban codes break down into urban and urban-focused zip codes in Hart's Categorization A. Rural locations with 30% of the population commuting for work to adjacent urban areas are considered urban focused (4.1, 5.1, 7.1, 8.1, and 10.1). The “.1” or urban focused codes join the urban codes (1 – 3) for the urban totals. Categorization A divides rural locations into large rural (4 – 6), small rural (7 – 9), and isolated rural (10 – 10.6) locations, again with the exception of urban focused codes.¹⁰ Initially a rural major medical center category was developed but it involved only about 3% - 4% of total physicians and was merged with other major medical center categories.

Geographic coding was also extended to birth origins. City and state were converted to RUCA urban, large rural, small rural, and isolated rural locations in addition to birth in a foreign nation, a military base, or Puerto Rico. Birth origins were also converted to county to link per capita income and population density to a county of origin. County birth variables are a proxy for parent income. It should be remembered that children of professionals with higher income levels are still the most likely to gain admission, even with rural or lower income county birth. Across the nation, life experiences involving the dimension of income are likely to be different in lower income counties just as social organization levels are different in various populations or rural populations.

Birth in a city or county with a medical school also was determined. This included physicians born in the United States or in other nations. Geographic proximity to a medical school impacted physician career and location choice. Those born in a city or county with a medical school were twice as likely to gain medical school admission and 50% less likely to choose family medicine or primary care. They also were born and raised in the highest income, most urban counties with the highest concentrations of professionals. Birth in a city or county with a medical school is a useful proxy for major medical center origin.

There are other issues important to understand regarding the new coding system.

- Single Zip Location Assumption - Many have more than one practice location. This categorization uses only one location per physician. A single zip location can also be problematic for certain specialists, nurse practitioners, and physician assistants that may have more than one location.
- Secondary Data Assumptions - An underserved categorization using secondary data such as the Masterfile does not mean that a physician working at an underserved zip code serves lower income patients. This is not a new problem, the geographic location coding may be urban, but many from rural locations are served. Urban locations in close proximity to rural areas also draw many rural patients. Some international medical graduates are known to live in urban locations and commute to rural practice locations. These inconsistencies do not prevent the development of a coding system. Across a national population the primary care physicians found closely associated with adjacent practice zip codes are most likely to be serving similar populations.
- National Versus State and Local – Physician distributions across the nation are important to understand for health policy and workforce design. National distributions are often different from local and state distributions. The national data can be used to help understand national distributions, but may need more sophisticated analysis for state or local use. New zip codes and increasing concentrations of physicians seem to be more and more common. Also few understand that physician databases take years to update. This limits the use of the most recent graduates, especially international graduates who are delayed in entry, are more likely to be found in training, are more likely to be found outside the country, or are unemployed. The current method has limitations for state and local applications. Areas with concentrations of poverty or rural people will have more underserved or rural physicians. National studies have fewer limitations.
- Home Location Zip Codes - Physicians also concentrate to reside in exclusive neighborhoods. This remains a problem when physicians fail to list practice zip codes.

Major Medical Center Versus Underserved and Served Locations

Zip codes not uncommonly had over 75 physicians and also a federal shortage designation. This presented a coding challenge. A major principle of physician distribution was involved in the decision to exclude major medical centers from the underserved category. Getting physicians to go to major medical center locations was much easier than getting physicians to locate away from concentrations of physicians and health care resources. Locations sharing both the major

medical center (over 75 physicians) and the underserved location criteria (poverty or designation site) were considered major medical centers.

The remaining locations that were not major medical center or underserved locations were coded as served locations. The served locations did not represent a middle ground in concentrations as physician levels were not much different than underserved locations. The major division remains major medical center versus all other location types.

Definitions of Specialties

Specialty designations in the Masterfile are self-designated. The various primary care specialties of family medicine, general practice, internal medicine, pediatrics, and medicine pediatrics were combined together as the physician form of primary care. The office based response in the primary practice activity field combined with a primary care self-designation in the specialty field is consistently the best indicator of actual direct primary care contributions. The level of office base primary care increases with the schools (lower MCAT), the birth origins (lower and middle income and rural), the practice locations (rural), the physicians (generalists), and the health policies (1970s and early 1990s) most likely to be associated with a greater focus on primary care,

In these categorization studies, the family medicine and general practice specialties are combined for a number of reasons. The first reason involves historical comparisons with past graduates. The major reason for the FPGP combination is coding differences in allopathic, osteopathic, and international graduates. Regardless of allopathic, osteopathic, or international graduates, the family practice or general practice physicians share the highest levels of distribution. For these reasons the two specialties were combined into the FPGP combination. The division is becoming a moot point. By and large the general practice numbers have substantially declined in physicians in recent decades due to credentialing requirements. For the most recent 1987 – 2000 US MD Grads 24,888 of 25,207 or 98.7% of the FPGP physicians were family physicians and only 1.3% were general practice physicians. In osteopathic and international graduates, the general practice levels were 6% of the FPGP total, largely due to delays and differences in Masterfile data entry from osteopathic sources. When researchers select cohorts with a few years of delay (2000 – 2005), osteopathic and some international data approximates allopathic US graduates.

Four sets of MCAT scores for each medical school were collected for the 2000 – 2003 class years from medical school web sites. In each class year set of MCAT scores, about 10% of the scores were missing and were interpolated from the surrounding class year values. The 4 year set of score average was ranked and used to categorized allopathic United States medical school graduates (US MD Grads) into five groups MCAT 10.5-12, MCAT 10-10.5, MCAT 9.5-10, MCAT 9.25-9.5, and MCAT 8.5-9.25. Outlier medical school types were not included in this categorization. Special categories were provided for Puerto Rican schools, Historically Black medical schools, Uniformed Services, early admission schools (University of Missouri in Kansas City and Northeast Ohio) and the West Coast Distributional medical schools (University of Washington, UCLA, UC Irvine, and UC Davis). The West Coast Distributional schools had

increased family medicine and primary care choice, increased distribution, older graduates, and more diverse graduates but also managed relatively higher MCAT scores. Some of this trend can also be seen in Wisconsin, Iowa, Minnesota, Utah, and Nebraska, states with broader distributions of income and education.

The development of the birth origins Masterfile, the zip code data base, the county and state databases, the medical school database, specialty databases, and the family medicine databases with ethnicity, race, and gender involved comprehensive reviews of the literature relevant to sociology, economics, education, geography, census data, and history as related to physician workforce and distributions. The studies were greatly facilitated by continued advances in internet search capabilities.

Results

Physician Distribution by Concentrations (PDC) categories can be compared to demographic variables.

Physician Distribution by Concentrations

	Major Medical Center		Served		Underserved		Military	Total
	Super (200+)	Typical (75-199)	Urban	Rural	Urban	Rural		
Practice Zip Codes	1,117	2,231	16,020	9,312	3,955	9,391	1,816	43,842
% of Land Area using Total US Land Area	0.51%	2.52%	11.55%	22.03%	4.24%	37.51%	0.47%	78.3%
% Land Area Using Zips with physicians or pop	0.65%	3.19%	14.65%	27.94%	5.38%	47.58%	0.60%	100.0%
US Pop 2000 (millions)	32.021	61.434	96.230	23.887	34.556	23.705	1.949	273.8
% By Location	11.7%	22.4%	35.1%	8.7%	12.6%	8.7%	0.7%	1
Per Square Mile	1769.83	689.56	239.20	30.87	232.77	18.31	122.99	99.8
US Pop Poverty (millions)	3.895	6.508	7.738	2.485	8.425	4.636	0.195	33.88
% By Location	11.5%	19.2%	22.8%	7.3%	24.9%	13.7%	0.6%	100%
Per Square Mile	215.28	73.05	19.23	3.21	56.75	3.58	12.301	12.36
Poverty Concentration	12.2%	10.6%	8.0%	10.4%	24.4%	19.6%	10.0%	12.4%
Poverty to Pop Index	0.983	0.856	0.650	0.841	1.970	1.581	0.808	1
Physician to Pop Index	3.643	1.295	0.489	0.428	0.290	0.347	1.029	1
Physicians Per Sq Mile	19.145	2.651	0.348	0.039	0.200	0.019	0.376	0.297
Active Physicians Per 100,000 Population	1081.76	384.45	145.28	127.07	86.12	103.19	305.50	296.97
All Active Physicians (Total Minus Retired)	346,389	236,186	139,807	30,354	29,760	24,460	5,954	813,099
	42.6%	29.0%	17.2%	3.7%	3.7%	3.0%	0.7%	100.00%
1987 – 2005 Physicians Including Residents	49.6%	25.2%	13.4%	3.0%	4.1%	2.7%	1.6%	417,110
All Grads of 1987-2000	46.1%	26.5%	14.5%	3.6%	4.2%	3.3%	1.7%	316,511
Recent Grads 1987-2000, Classified, Not Residents	41.4%	28.6%	15.5%	4.3%	4.5%	3.7%	1.9%	246,573

% FPGP at Location	7.7%	15.2%	25.9%	38.6%	23.8%	36.9%	21.6%	16.1%
FPGP	19.8%	27.1%	25.0%	10.2%	6.6%	8.6%	2.6%	100.0%
Not FPGP	45.6%	28.9%	13.7%	3.1%	4.1%	2.8%	1.8%	100.0%
FPGP / Not FPGP Ratio	0.43	0.94	1.83	3.29	1.63	3.05	1.44	1.00

Major medical center locations represent the highest concentrations of physicians, people, and specialty physicians. About 41% of all graduates and 46% of recent graduate physicians were found in super center zip code locations with 200 or more physicians. This increases to half of physicians when including residents in training. The super center location with less than 1% of the land area of the United States had a concentration of 1100 physicians per 100,000 population or over 3 times the national average of 300.

In the rural underserved and urban underserved areas, physician concentrations were one third the national average at 80 (urban) and 100 (rural) physicians per 100,000. Underserved areas had concentrations of poverty as well. Physician concentrations and populations did not improve much moving from urban underserved to urban served locations and despite half the level of poverty. Some improvement would have been expected as poverty decreased and income levels improved. This suggests that urban served and urban underserved physician levels may be suppressed by major medical center concentrations of physicians. Rural underserved locations had slightly higher concentrations of physicians compared to urban underserved locations despite greater isolation, the national lowest levels of income, similar concentrations of poverty, and lower concentrations of population. This again suggests suppression of urban served and urban underserved physician levels by nearby major medical center concentrations.

Rural served locations did have greater concentrations of physicians, greater concentrations of population, and lower concentrations of poverty compared to rural underserved locations.

In the super center locations population concentrations were 1700 or 17 times greater than the 100 people per square mile average but super center physician concentrations (19.1) were 64 times greater than the national average for physicians (0.297) in physicians per square mile. The total difference between super center and rural underserved physician concentrations in physicians per square mile was 1000 times greater.

Super centers had more physicians per square mile (19) than the rural underserved areas had people per square mile (18).

The entire major medical center location grouping included concentrations of 75 or more physicians by combining super and typical center locations. This grouping involved 71% of total US physicians, 34% of the population, less than 4% of the land area, and less than national average concentrations of poverty.

The national standards for underserved location are best seen in recent graduates of 1987 – 2000 without including residents. About 4.5% of physicians were in urban underserved locations and 3.7% were in rural underserved locations. Underserved physician levels were one-third of the 21% of the US population found in zip codes that were coded as underserved.

The United States population is about 20% rural. Rural physician levels were 10 - 11% of the total but were evenly divided between major medical center, served, and underserved locations at 3 – 4% each. The real challenge in rural distribution involves rural served and rural underserved locations. Rural studies that focus on distribution outside of major medical centers are likely to best represent needed distribution.

Physician types (including other forms of primary care) other than family medicine concentrated 70% or more into major medical centers. Over 50% of family physicians were found outside of major medical centers, the major factor in enhanced family medicine distribution. Super center locations had significantly lower concentrations of family physicians at only 6%. Zip codes with 75 – 199 physicians had average family physician concentrations at 13 – 14%. For all other locations family physicians had above average concentrations at 20 – 40%. Concentrations of family physicians consistently improved with lower levels of income, population, education, physicians, health facilities, and professionals.

Logistic regression equations can be loaded with controls such as birth origin factors (rural birth, lower county income), older age at graduation, and lower medical school MCAT levels that represent the major factors in physician distribution outside of major medical centers. In equations loaded with these factors, choice of family medicine multiplied distributions at 1.8 times for urban underserved, 3 times for rural and rural underserved, and 4 times for isolated rural or whole county primary care shortage areas. Non-family physicians had 3 times the probability of major medical center concentration.

Does the PDC coding represent actual concentrations of physicians?

In the following, the physicians at each zip code were multiplied by 100,000 and divided by the zip code population in 2000. Zip codes with greater than 4 standard deviations of difference were combined into the extremes of -4 or +4 S.D.

Divisions by Physician Concentration: Standard Deviations for Physicians Per 100,000 at a zip code	Total	Super Center	Major Center	Urban Served	Urban Under-Served	Rural Under-Served	Rural Served	All Under-Served
-4 Standard Deviations	3165	0.0%	0.0%	40.8%	46.4%	7.7%	4.7%	54.2%
-3 Standard Deviations	3749	0.0%	2.0%	53.5%	23.0%	11.3%	8.9%	34.4%
-2 Standard Deviations	5533	0.0%	0.8%	50.0%	23.6%	12.9%	10.8%	36.5%
-1 Standard Deviations	8897	0.0%	6.6%	52.3%	13.8%	13.7%	12.4%	27.5%
0 Standard Deviations	12492	0.6%	14.8%	43.6%	11.0%	12.9%	15.3%	23.8%
1 Standard Deviations	19075	2.3%	33.7%	34.4%	6.8%	9.3%	11.8%	16.1%
2 Standard Deviations	29244	6.8%	59.5%	18.2%	3.3%	4.6%	6.8%	7.9%
3 Standard Deviations	44638	28.3%	58.3%	7.4%	1.5%	1.2%	1.9%	2.7%
4 Standard Deviations	88800	78.8%	18.1%	1.4%	0.5%	0.1%	0.3%	0.5%
Unique zip codes	30980	55.0%	6.7%	18.5%	4.7%	4.2%	3.3%	8.9%
	246573	41.4%	28.6%	15.5%	4.5%	3.7%	4.3%	8.2%

The super center and major center codes do represent the top concentrations of physicians as measured in physicians per 100,000 population. The underserved locations coded by the PDC do involve the lowest physician density locations.

The urban served and urban underserved locations are consistently within a few miles of the concentrations of physicians in nearby major medical center and super center locations. Urban served and underserved concentrations were suppressed to the lowest concentration levels of all. Counties and zip codes adjacent to concentrations of physicians have long been known to have fewer physicians and have often been granted federal and state shortage designations on this basis. Concentrations of physicians deserve more individual study and now would be a good time since major revisions of shortage designations are planned.

Rural served and rural underserved physicians are more likely to be found in the lower ranking physician concentration divisions, but rural physicians and rural populations are broadly spread across the average and lower concentration divisions rather than suppressed to the lowest divisions as in urban locations. Rural health access is complicated by geographic distances and a variety of factors related to lower concentrations of physicians, including specialists who are geographically distant. This is another consequence of concentration of specialists in a few major medical center locations.

Medical School Type, Concentrations, and Physician Origins

Medical schools vary across a continuum that can be ranked by scores, rural origins, birth in a city or county with a medical school (proxy for major medical center origin), birth county income (1969 per capita), and career choice. Urban and rural served locations are not shown. Super Center, Typical Center, Urban Underserved, and Rural Underserved Zip Code columns

Table III. Medical School Type and Distributions of Graduates

Most Recent Graduates 1987 – 2000 with a Classification, Not Residents in Training

Type or Location of School and Percent Found in Office Primary Care	Career Choice and FPGP %	Total	Urban Underserved	Rural Underserved	Typical Center	Super Center	Bottom Quart Income Birth in US	Rural Birth	Birth in MS City/County
Puerto Rican 30.9%	Not FPGP	2,121	14.2%	5.0%	33.2%	35.5%	0.9%	0.3%	75.4%
	FPGP 13.6%	335	22.4%	10.1%	33.1%	18.2%	1.2%	0.8%	72.2%
Historically Black 44.2%	Not FPGP	1,761	8.0%	3.4%	29.1%	39.9%	11.8%	6.6%	73.1%
	FPGP 19.7%	433	15.9%	7.9%	28.2%	17.8%	19.0%	11.4%	68.6%
Early Admission 32.6%	Not FPGP	1,957	3.4%	1.5%	30.0%	45.7%	21.6%	13.1%	65.2%
	FPGP 14.7%	336	4.5%	8.3%	28.9%	17.6%	20.5%	20.5%	56.0%
West Coast Distributional 42.1%	Not FPGP	4,887	4.5%	1.6%	30.6%	49.7%	5.6%	7.5%	73.4%
	FPGP 21.6%	1,343	8.0%	6.0%	33.1%	26.8%	7.9%	11.1%	64.8%
MCAT 10.5-12 27.4%	Not FPGP	32,153	2.8%	1.1%	24.4%	58.8%	8.2%	6.7%	77.2%
	FPGP 7.6%	2,626	7.8%	5.6%	28.0%	27.0%	12.6%	11.7%	68.1%
MCAT 10-10.5 33.9%	Not FPGP	34,001	2.9%	1.3%	29.2%	49.1%	9.1%	9.5%	71.3%
	FPGP 14.2%	5,622	5.5%	5.4%	26.8%	20.9%	14.4%	18.7%	59.7%
MCAT 9.5-10	Not FPGP	47,512	3.5%	2.0%	29.8%	45.8%	9.8%	9.3%	71.4%

34.6%	FPGP 14.5%	8,045	5.6%	7.4%	26.5%	20.9%	15.0%	15.9%	59.8%
MCAT 9.25-9.5	Not FPGP	20,577	4.0%	3.5%	29.3%	44.4%	19.0%	14.0%	64.4%
37.3%	FPGP 17.8%	4,471	7.0%	11.6%	26.0%	20.0%	24.5%	19.0%	56.1%
MCAT 8.5-9.25	Not FPGP	14,723	5.3%	5.1%	32.5%	38.5%	28.8%	21.7%	53.6%
41.0%	FPGP 21.9%	4,139	6.8%	14.3%	25.4%	15.0%	36.2%	32.1%	44.6%
Uniformed Services	Not FPGP	1,515	3.2%	2.1%	18.3%	18.9%	12.7%	11.4%	64.0%
14.4%	FPGP 21.2%	408	2.7%	6.4%	15.2%	9.6%	16.7%	14.7%	58.2%
Osteopathic Low	Not FPGP	5,278	4.1%	4.8%	34.9%	28.3%	13.1%	12.5%	65.9%
MCAT 48.2%	FPGP 37.1%	3,111	5.7%	10.3%	29.7%	16.4%	17.5%	17.9%	60.9%
Osteopathic High	Not FPGP	8,454	3.8%	3.3%	32.6%	32.0%	12.4%	12.6%	67.1%
MCAT 46.0%	FPGP 35.0%	4,556	5.4%	8.3%	26.8%	16.9%	16.7%	19.3%	58.1%
Canadian	Not FPGP	2,337	2.1%	3.2%	15.2%	39.3%	1.0%	1.2%	75.8%
26.7%	FPGP 22.9%	693	3.6%	7.6%	22.9%	16.0%	1.1%	1.6%	66.0%
Central American	Not FPGP	2,167	11.2%	4.2%	30.5%	36.2%	4.1%	1.6%	76.6%
53.2%	FPGP 22.6%	631	20.1%	11.4%	26.3%	19.5%	9.3%	5.5%	64.6%
China	Not FPGP	480	6.5%	1.0%	29.0%	46.5%	0.0%	0.0%	86.4%
42.1%	FPGP 7.3%	38	21.1%	0.0%	34.2%	26.3%	0.0%	0.0%	93.3%
India	Not FPGP	7,211	5.6%	5.2%	31.0%	38.2%	0.1%	0.1%	75.7%
53.3%	FPGP 6.8%	522	5.7%	7.3%	27.8%	23.9%	0.0%	0.0%	73.6%
Distant International	Not FPGP	11,283	5.7%	4.7%	25.9%	47.7%	0.4%	0.5%	75.8%
40.0%	FPGP 7.2%	874	9.2%	7.2%	29.5%	27.9%	0.5%	0.9%	71.6%
Nigeria	Not FPGP	685	10.8%	5.3%	27.4%	34.3%	0.0%	0.0%	72.3%
60.3%	FPGP 9.3%	70	18.6%	11.4%	22.9%	24.3%	0.0%	0.0%	60.6%
The Philippines	Not FPGP	2,254	8.4%	11.4%	30.9%	26.3%	0.7%	0.3%	80.1%
58.3%	FPGP 12.7%	329	8.2%	8.5%	25.8%	17.3%	1.3%	0.6%	79.1%
Pakistan	Not FPGP	2,711	6.3%	11.2%	29.5%	32.0%	0.0%	0.1%	89.6%
44.6%	FPGP 5.2%	150	7.3%	8.0%	30.7%	18.0%	0.0%	0.0%	92.5%
Caribbean	Not FPGP	2,924	4.1%	3.5%	32.6%	37.0%	7.1%	7.0%	74.2%
59.5%	FPGP 22.5%	850	5.4%	8.4%	29.9%	19.6%	12.6%	11.8%	64.0%
All	Not FPGP	206991	4.1%	2.8%	28.9%	45.6%	11.3%	9.7%	70.4%
37.2%	FPGP 16.1%	39,582	6.6%	8.6%	27.1%	19.8%	17.9%	17.7%	58.9%

About 70% of osteopathic and 50% of international graduates have birth origins resulting in some missing data and estimates of rural or lower income birth origins. Only those with known birth origins were included in the calculations. Office based listings are unlikely for physicians in military service who list themselves as hospital based rather than office based.

Family physicians are consistently found in rural underserved, rural, and urban underserved locations at greater levels, typically double or triple the levels of other types of graduates from the same types of medical schools (or individual schools). This level of distribution is consistent dating back across 30 years of graduates. Typical medical centers with 75 – 199 physicians represent a balance point. Family medicine and primary care contributions are more likely up to this point. Beyond 200 physicians, super center concentrations result in fewer family physicians and primary care physicians.

Certain medical schools admit more medical students who were born in cities or counties with medical schools. This is the largest group of physicians by birth origins including nearly 70% of those born in the United States or in other nations. Major medical center origin, using the proxy of birth origin, is related to concentration in major medical centers. Family physicians are consistently distant from major medical centers in origins, training, and practice locations.

Medical schools that admit the most exclusive students by score rankings concentrate those with medical school city or county origins. Elite medical schools have the highest concentrations of physicians in super center locations. Elite medical schools are more likely to have younger medical students, more born in higher income counties, more born in the most urban counties, and fewer born in rural or lower income counties. Medical schools selecting the most exclusive students concentrate the most into major medical center locations and graduate the fewest for rural, underserved, family medicine, and primary care careers.

Medical schools admitting a wider distribution of medical student types distribute more physicians. Even the average medical schools distribute physicians above national averages. Exceptional distribution was found in the Historically Black, osteopathic, and lower scoring allopathic medical schools. Historically Black, osteopathic, and lower scoring allopathic medical schools admit more older, urban underserved origin, rural origin, and lower income origin medical students. They distribute physicians outside of major medical centers at the highest levels, graduate the most family physicians and primary care physicians, and distribute the most to underserved locations. Birth origins using city and county cannot divide urban medical student origins into major medical center, urban served, or urban underserved origins. Use of race and ethnicity adds an important dimension to understand inside and outside. Most African American and Hispanic graduates were born in medical school cities and counties, but significant components did not have typical higher income children of professional major medical center origins.

Measurements using parent income, parent profession, and individual MCAT scores would be more revealing than proxy measures involving geography, race, ethnicity, and proximity.

Medical students, medical schools, and career choices can be divided into types that distribute and types that concentrate.

Discussion:

The Physician Distribution by Concentration method brings new perspectives to physician workforce. Decades of efforts focused on shortages have not helped. A focus on physician concentrations may help to understand shortages as well as overall physician distribution.

PDC coding methods do represent physician concentrations. The categories also represent understandable separations that integrate geography, designations, and poverty. The studies also illustrate the importance of birth origins as physicians can be tracked across birth, medical school, graduate training, and practice.

The results are consistent with the literature regarding the types of physicians most likely to distribute and those least likely. Currently the literature appears to be focused on extremes of origins and distribution. More than extremes result in physician distribution.

- Physician origins involving 70 – 80% of the United States population are associated with above average levels of distribution. Only the most elite origins are associated with concentration.
- Medical schools with average levels admission by age, geographic origins, scores, or socioeconomic status also have average or above average levels of physician distribution. Only the most extreme scores are associated with concentration.
- Average health policy support as in the 1980s also allowed choice of primary care, family medicine, and physician distribution.

Physician origins are moving consistently toward the highest income and most urban concentrations. Training has already achieved near 100% major medical center location. Health policy rewards major medical centers and major medical center careers and locations at the highest levels. The nation continues to make it difficult to distribute physicians until it improves child development and education, broadens admissions, disperses training, focuses on the careers most likely to be found outside of major medical centers, and funds health care for lower and middle income populations found outside of major medical centers. For physician distribution the two major impact areas involve funding for lower and middle income children and funding for lower and middle income health care. The same interventions are also likely to improve health care quality 3 ways: improvements in the patient, improvements in nurses, staff, and all who provide health care, and improvements in matching physicians and health professionals that more closely to the populations most in need of health care by language, culture, geography, and status.

Narrow admissions shaped by narrow origins and scores and narrow training and health policy are not going to address health care for a more and more diverse nation in numerous dimensions far beyond the current debates.

Limitations

The major medical center and underserved categories were developed based on a simple model with a single location for each physician. Physician locations are more complex with multiple locations. Some have the ability to provide services associated with two or more different specialties.

Unique zip codes without land area or population represented only 5 – 7% of the physicians in super center, rural served, rural underserved, and urban underserved locations; 2% of the typical major center locations, and 11% of the physicians in urban served zip codes. Adjustments were not provided for the concentration calculations as these represent small differences and relatively consistent differences across location types.

Different states and schools distribute physicians to different environments. Schools in states with greater percentage rural populations are going to have higher percentages of rural born admissions and higher percentages of graduates in rural locations (0.92 correlation). Schools in higher poverty states will have greater underserved location, as will schools who admit more of underserved origin. Some would consider this a form of selection bias. Others would note that physician distribution is all about designing bias in admission, training, and policy. In states that

are completely dependent upon a single medical school, failure to graduate enough physicians of the proper career choices and distributions has already become a major impediment to health care.

The major medical center category should still be considered conservative. Active physicians graduating before 1971 and entering after 2000 (over 150,000) do make workforce contributions. Physician assistants (PAs), nurse practitioners (NPs), nurse anesthetists, nurses, and allied health personnel are also found in major medical centers and contribute more and more to overall workforce and to the specialty workforce focus in major medical centers.

Concentrations Versus Distributions: Inside and Outside of Major Medical Centers

Experiential place is a concept that involves the tendency of physicians to return to practice locations similar to origins or previous life experiences. Medical students born, raised, and trained for 30 years in major medical center locations are likely to have the greatest level of concentration in major medical center careers and locations.

Studies of rural origin consistently demonstrate doubling of rural location but rural life experiences are more limited. Rural experiential place (or underserved experiential place) can only involve a limited number of years. Rural or underserved life experiences are earlier and do not have the intense physician-specific focus of major medical center experiences involving medical school and residency training. Also rural or underserved experiential place means very little to physicians who specialize as they are already greatly limited to major medical center location by their career choice. Without significant health funding distributed to primary care and to lower or middle income populations, even primary care physicians cannot afford to distribute outside of major medical centers. Tail end improvements in graduate medical education mean little without sufficient improvements in state or national health policy or without the front end improvements to admit the types of physicians who will distribute.

The experiential place of major medical center involves lifestyle considerations and also role modeling. Controllable lifestyle may represent a misnomer. The real factor in medical student decisions may be decisions regarding the ability to maintain the major medical center lifestyle or experiential place, including connections to parents, friends, and colleagues. With different health policy a decade ago, those with the same birth location and medical school location had the highest levels of increase in family medicine choice (70% versus average 46%) in the 1990s. This is something that major medical center experiential place can explain, but not controllable lifestyle.

Role modeling theories are also compatible with major medical center experiential place. Generalist ways of life are most common in the geographically and socially isolated locations where 40 – 50% of physicians are family physicians and teachers, nurses, and public servants at the prominent professionals (also all serving professionals). Specialized lifestyles and physicians are found in concentrated urban areas. Very few family physicians are found in super center locations and those found in these locations are less likely to be delivering direct primary care.

Role modeling can involve birth to admission or medical school experiences and role modeling studies should consider both for proper study.

The framework of experiential place appears to be an excellent taxonomy for physician career and location decisions. Themes include origins, training, and policy emphasizing inside versus outside major medical center. Additional themes and theories involve professional parents, lifestyle, role-modeling, standardized test scores, and age at graduation. A framework that can integrate concentrations, geographic and socioeconomic influences, role modeling, medical school training, and lifestyle can be a powerful aid to understanding physician workforce.

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