

Chapter 9

Do International Medical Graduates (IMGs) Improve Spatial Access to Physicians? Rushton's Locational Analysis Framework in Practice

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9.1 Internationally-trained Primary Care Physicians and Access to Primary Care

Primary care physicians (PCPs) are critically important components of health care systems, providing preventive, diagnostic and routine care, and serving as gateways to more specialized health services. Wide disparities exist in the geographical availability of PCPs in the United States, as they are less available in rural areas than in urban areas – and within cities, they are in short supply in certain low-income and minority neighborhoods [1] [2]. To redress these rural-urban and intra-urban inequalities in primary care, the U.S. admits to its medical residency programs, significant numbers of international medical graduates (IMGs) who boost the overall supply of physicians. Currently more than 200,000 IMGs practice in the U.S., representing one-quarter of the physician workforce. International medical graduates completed their training at medical schools outside the U.S. Even though the majority of IMGs who practice in the U.S. are immigrants, a growing proportion (currently 38.5% of the IMG applicant pool) consists of American citizens who obtained their medical training overseas [3].

IMGs may impact the uneven geographical distribution of physicians if they enter the country under a visa program that incentivizes them to practice in under-served areas [4]. Immigration programs like the Conrad 30 Waiver Program attempt to assign IMGs to underserved areas. These programs, for example, offer waivers of medical residency requirements for IMGs who agree to practice for a certain length of time in areas designated as Health Professional Shortage Areas (HPSAs) and Medically Underserved Areas (MUAs). In addition, states have their own medical licensure requirements for IMGs that may influence IMGs' location decisions [5].

Many studies have investigated the impacts of IMGs on geographic inequalities in availability of primary care physicians. Research with respect to rural-urban inequalities shows that IMGs are more likely than US-trained physicians to practice in high-need and under-served regions [6]-[9]. At the same time, studies show that IMGs are more likely than US-trained physicians to locate in areas of high physician supply [8], a seemingly contradictory finding. The channeling of IMGs to both high- and low-physician supply areas suggests not only the presence of cohorts of IMGs with distinct location decisions, but also the occurrence of time-dependent IMG migration flows from shortage areas to surplus areas.

Most existing work on IMG locations emphasizes regional and national variations: Less attention has been paid to the locations of IMGs within cities and the implications for inequalities in spatial access to services. One of the few urban studies [10] found that IMGs in cities were disproportionately located in high-poverty areas, although there was considerable variation among cities. In general, research on IMG locations has been limited by its focus on the geographic patterns of IMGs while neglecting the processes of location

and migration that give rise to those patterns. Mutual dependencies between providers' and consumers' spatial behaviors, and the resulting effects on service location and access are central themes in Dr. Gerard Rushton's research. We revisit these themes in our study of IMG locations and locational change in Chicago.

9.2 Rushton's Contributions to Locational Analysis

Effects of the spatial organization of economic and social activities on individuals' decision-making and well-being have been a key focus of Rushton's research. He examined in his early work how the locations of retail and service facilities influenced the use of those facilities, demonstrating the interdependencies between behavior and locational context [11]. He also spearheaded advances in location-allocation modeling that were used to evaluate inequalities in access, and to identify more effective locational arrangements that may reduce the distances and times for traveling to reach essential service facilities [12] [13]. Underpinning this work was the recognition that location matters: People's ability to use services depends critically on where services are located. Hence, location planning and analysis are essential for reducing the disparities in access that exist among populations and places.

In his writings on central place theory, Rushton modelled the spatial organization of retail and service firms as the outcome of firms' and consumers' interlocking spatial decisions [14]. The location decisions made by providers reflected their assessments of local population and market potential, while consumer decisions about where to obtain services considered the spatial accessibility of service outlets and the interplay of personal, household, and service constraints. Similarly, Rushton's locational models for

publicly-provided services hypothesized providers' and consumers' decision-making as interdependent, even while providers' locational decisions might also result from administrative rules embedded in political structures [15]. For example, in analyzing regional planning of health services in rural India, he demonstrated that the planning process relied on administrative assumptions about the allocation of services among districts that often produced suboptimal location decisions [16].

Rushton's approach to locational analysis relied critically on geospatial data. In the 1970s and early 1980s at a time when the term geographic information system (GIS) was not widely known, he constructed large spatial databases on populations, towns, transportation networks, service centers, and other place characteristics in the state of Iowa and rural India. With limited computing resources, he created rudimentary geographic information systems for analyzing spatial accessibility and locational efficiency. Teams of his students (including two of this study's authors) collected and managed geospatial data; created distance matrices to represent spatial relationships; and coded computer programs to perform spatial analyses and location-allocation modeling. These were among the first steps towards Rushton's vision of developing spatial decision support systems for regional development and public health planning.

The two themes of spatial access to services, and geospatial data and methods provide the framework for the research presented here. Our investigation focuses on geographic inequalities in access to primary care physicians (PCPs) in the Chicago metropolitan area, and it utilizes geospatial data and spatial analysis methods popularized by Rushton in addressing the research problem. Our specific research question is whether internationally-trained primary care physicians locate in neighborhoods where PCPs are in

short supply and thus reduce disparities in access to primary care.

9.3 Data and Methods

Our dynamic approach to analyzing the uneven locations of primary care physicians involves tracking movements of IMGs and U.S.-trained PCPs over time in Cook County, Illinois. We rely on data from the American Medical Association's Physician Masterfile for 2000 and 2008 to evaluate PCP locations. Our database includes information about all physicians who are members of the AMA, and it represents a near-complete sample of all physicians. Physicians who were retired or not actively practicing were removed from the database for each year. Only office-based physicians were retained. Physicians whose specialties include general practice, family medicine, and internal medicine were identified as PCPs.

This study uses a geocoding process for physician practice locations. Note the benefits and pitfalls of geocoding health data are discussed in detail in Rushton's work on geocoding of cancer data [17]. Each physician record in the database includes two types of locational information, namely, the physician's office address and mailing address. More than 90 percent of the PCPs had an office address and were geocoded to that location. For remaining physicians, the mailing address was geocoded even though this may introduce bias if a mailing address is not an actual office location [18].

The database also includes basic demographic information about the physician and the name of his or her medical school. We used the latter to identify international medical graduates as physicians trained at a medical school outside the U.S. In 2008, 2,615 of the 5,900 PCPs in Cook

County (42.3%) were IMGs. Each physician in the database has a unique code number for tracking if he or she moves from one office to another through time. We used these codes to study and compare shifts in office locations from 2000 to 2008 for IMGs and US-trained PCPs.

First and foremost, a measure of spatial access to service is required for inferring the impact of IMG locations on overall spatial inequalities in access to PCPs. To create the spatial access measure, we used kernel estimation, a widely used spatial filtering method, wherein spatial access is assumed to vary continuously over space rather than being based on geographic zones, such as zip codes or census tracts. Rushton pioneered the implementation of spatial filtering methods in research on health disparities [19] [20]. Our method creates a smooth, continuous surface map of spatial access to PCPs, as measured by the physician-to-population ratio. Peaks on the map indicate areas of high spatial access (high physician-to-population ratio) and valleys show areas of poor spatial access.

A key component of spatial filtering is the bandwidth, and this is the geographic extent or radius of the spatial filter for determining the local density of events. Populations with car access were assigned an 8 km bandwidth, while those without car access were assigned a 3 km bandwidth to represent their more limited geographic mobility. These values are derived from empirical studies of travel patterns within cities in North America [21], although we acknowledge that people's actual travel patterns may be more complex and variable than can be depicted by fixed radii. Population counts for the car and non-car subpopulations were extracted by census block from the American Community Survey, and kernel estimation was used to determine local population density based on the respective bandwidth. An overall index of local spatial access to PCP

services was obtained by computing the weighted average of the respective physician-to-population ratios for car and non-car populations at each location. We computed this index for each study year of 2000 and 2008, based on PCP data for that year. We refer to this smoothed physician-to-population ratio as the ‘spatial access index’, and use it for assessing variations in local spatial accessibility of PCPs across Cook County.

In addition to the smoothed physician-to-population ratio, we employed two government-defined measures of physician underservice: Health Professional Shortage Areas (HPSAs) and Medically-Underserved Areas. (MUAs). The federal government defines these areas from multiple criteria including socioeconomic indicators of population need for health services, and the availability of physicians compared to population within the census tracts comprising a HPSA or MUA. Criteria differ between the two types of designated shortage areas [22]. It is important to note that shortage area boundaries are infrequently updated, and so, the districts do not necessarily reflect current population characteristics and physician supply.

The map of smoothed physician-to-population ratio for 2008 (Figure 9.1) shows wide inequalities in overall spatial access to primary care physicians in Cook County. Areas of high physician supply are located in and near downtown Chicago and in urban and suburban areas north and west of downtown. In contrast, Chicago’s South Side and southeastern suburbs are areas of low physician supply and thus have poor spatial access to PCPs. These disparities closely follow patterns of socioeconomic and racial segregation, with low-income areas and areas of high African-American concentration experiencing low spatial access. As in many other U.S. cities, primary care physician shortages are closely aligned with racial and socioeconomic disadvantage [23].

9.4 Results

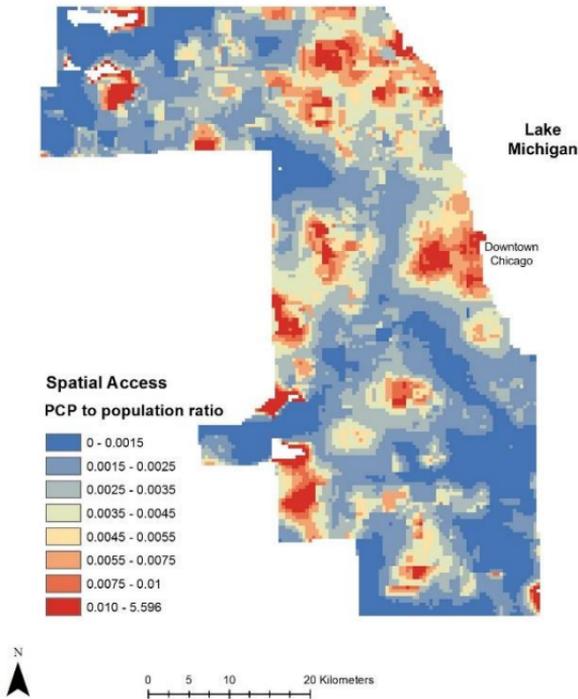


Figure 9.1 Spatial access to primary care physicians in Cook County, IL in 2008. Values represent physician-to-population ratios (PCPs per 100,000 population) determined via kernel estimation and incorporating access to automobile transportation. (Color copy online.)

In 2008, internationally-trained medical graduates accounted for almost one-half (42%) of Cook County's primary care physicians, indicating their overall importance for local physician supply. Similarly to their US-trained counterparts, IMG PCPs were unevenly distributed across the county, with high concentrations in and around downtown Chicago and in neighborhoods north and west of downtown.

However, based upon the calculated 2008 spatial access index in Figure 9.1 at each PCP office location, IMGs practiced in locations with a lower average spatial access index value (103.17 physicians to 100,000 population) than did US-trained PCPs (141.83), indicating that IMGs tend to work in areas of lower PCP supply. IMGs were also more likely than US-trained PCPs (20% vs 11%) to practice in federally-designated Health Professional Shortage Areas. These results offer preliminary support for the hypothesis that IMGs fill in the gaps by practicing in areas where PCPs are in short supply; and this result is based on both our index of spatial access and federally-defined health care shortage areas.

Nevertheless, the geographical distribution of PCPs in any year is the product of dynamic processes of settlement and mobility as physicians decide not only where to practice but also whether or not to shift their practice's location over time. Based on location data for 2000 and 2008, we categorized PCPs into four groups: 1) Stable – physicians whose office locations did not change over time; 2) Movers – physicians whose office location shifted within the study area from 2000-2008; 3) Entrants – PCPs who entered the study area between 2000 and 2008; 4) Exits – PCPs who left the study area between 2000 and 2008.

In the case of entrants, odds ratios reveal that IMGs have higher odds than do US-trained PCPs of locating in an area where PCPs are undersupplied as defined by our spatial access index (IMG: 0.15 vs. US-trained: 0.12) or by the federal government's designated physician shortage areas, HPSAs (0.251 vs. 0.140) and MUAs (0.93 vs. 0.63) in 2000. Thus, IMGs who enter the region are more likely than their US-trained counterparts to locate in an underserved area.

Even so, the odds ratios for both groups are well-below unity, indicating an overall tendency towards not locating in

poorly served areas. In fact, both IMGs and US-trained PCPs are more likely to locate outside a HPSA than inside one, and similarly for MUAs. In addition, both groups are significantly less likely to choose a location characterized by the poorest spatial access – defined here as having a spatially-smoothed ratio of fewer than 50 PCPs per 100,000 population [22] – than a more well-supplied location. Our demonstration of locational avoidance of underserved areas by entering PCPs suggests their initial location decisions reinforce spatial inequalities in access.

In the case of movers, we compared the spatial access index values at the origin and destination office locations to assess trends in PCP migration. Results show that both IMGs and US-trained PCPs tend to relocate within areas of moderate or high spatial access; or to move from areas with lower spatial access to those with higher spatial access. For both groups, a majority of PCPs who were located in a high spatial access area in 2000 moved to another high access location in 2008 (53% IMGs and 64% US-trained). Similarly, the vast majority of PCPs who relocated from a medium spatial access area, moved to an area with similar or higher spatial access (94% IMGs and 98% US-trained). Only a handful of PCPs relocated into areas of low spatial access, and most of them moved from one low access neighborhood to another. Only 2.1% of US-trained physicians and 3.8% of IMGs who relocated from a high access area moved to a low access area. Thus, relocation processes of both domestically- and internationally-trained PCPs tend to reinforce inequalities in spatial access when physicians move into areas that are already well-endowed with primary care doctors.

9.5 Conclusion

Our findings show that in Cook County, internationally-trained PCPs fill in the gaps in basic health care for potential patients to a modest degree, especially in their initial location choices. Over time, however, their location decisions mirror those of their domestically-trained counterparts, maintaining wide gaps in spatial access to PCP services. Even though IMGs are slightly more likely than domestically-trained PCPs to locate in areas of physician shortage, there is a persistent migration of both groups from areas of low supply to areas with relatively more PCPs. These results are consistently similar for three indicators of local physician supply, namely, HPSAs, MUAs and our spatially-smoothed physician to population ratios. These results therefore raise questions about the long-term effectiveness of policies that encourage PCPs to locate in physician shortage areas.

Several decades ago, Rushton put forth a vision for locational analysis that emphasized using geospatial data and methods to map and understand geographical inequalities in access to essential services. In his view, locational decisions by service providers and consumers resulted in an uneven landscape characterized by both spatial and social disparities in service supply and access. Our research on primary care physicians in Cook County illustrates and builds on these themes. Geospatial data and methods were critically important in generating our findings, confirming Rushton's observation that locational analysis research rests on a strong geospatial data foundation. Today, vast computing resources coupled with GIS and 'big' geospatial data enable sophisticated locational analyses of access to essential health and social services over time and space. Our work on primary care physicians just scratches the surface of this dynamic research field.

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