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Examining the Issue of Maldistribution of Physicians through GIS: A Case Study of Retina Specialists in the United States

Abstract

The United States is afflicted with a physician maldistribution problem. Certain areas of the country have excess numbers of physicians, while others struggle to serve a population that greatly exceeds the healthcare system's capacity. This puts forward concerns regarding healthcare cost, quality, and access. This paper presents a brief overview of the problem, concerns related to maldistribution, causes, and solutions currently being proposed to alleviate the problem. It then uses an in depth case study of retina specialists in the United States, conducted using Environmental Systems Research Institute's ArcGIS 9.0, to demonstrate the problem in real world dimensions. Issues of cost, quality, and access, as they relate to physician maldistribution, must be addressed for all Americans. It will take an amalgamation of creative solutions for the United States to correct the problem. The answer is not to force physicians to redistribute to traditionally undesirable areas, but to make these areas more attractive so physicians voluntarily choose to serve there. Only when the United States' healthcare system can encourage physicians to freely locate in underserved areas can it hope to fix its maldistribution problem.

Introduction

The location decisions of physicians in the United States have significant impacts on healthcare costs, quality, and access. Many parts of the country remain largely underserved, while other areas have an overabundance of doctors. Shi and Singh define maldistribution as, "either a surplus or a shortage of the type of physicians needed to maintain the health status of a given population at an optimum level" (2004: 128). A large majority of new physicians choose to locate their practices in metropolitan areas (counties with populations greater than 50,000 people). From 1980 to 2000, while physician populations grew in metropolitan areas by 260,000 doctors, the rural physician populace grew by only 30,000 doctors. Another problem is that more and more doctors are leaving medical school as specialists. Rural communities have physician to population ratios for generalists of 5:10,000 (Shi and Singh 2004). This leaves a large percentage of the United States' citizens, many of whom are elderly, underserved in terms of medical care. Additionally, as can be seen from the case study on retina specialists, maldistribution, while a more pressing problem for generalists, is also of concern in certain specialties.

The purpose of this study is to look at the problem of maldistribution in the physician population of the United States using the example of retina specialists. It reviews a series of analyses conducted with geographic information systems on a population of ophthalmologists who are members of the American Society of Retina Specialists (ASRS). Before looking at the case

study, there is a brief discussion of concerns related to maldistribution, causes of maldistribution, and a variety of solutions being utilized to alleviate maldistribution. The case study is then presented as an example of this problem in the United States.

Concerns Related to Maldistribution

Concerns related to the maldistribution of physicians are the cornerstones of any discussion of healthcare: access, cost, and quality. Access is the most obvious matter. In underserved areas, the population tends to be sicker and seeks a remedy later in illness. This impacts healthcare costs. The longer a patient delays treatment of an illness, generally, the higher the costs are. In these circumstances, quality and the number of successful outcomes are diminished. Moreover, more physicians, particularly specialists, lead to more surgeries and higher cost of care. Fisher et al. found that increased treatment and higher spending did nothing to improve quality of care, health outcomes, or patient satisfaction among Medicare beneficiaries (2003a, b). Baicker and Chandra, in fact, found that the states with the highest levels of Medicare spending have lower quality of care (2004). So, as the underserved suffer with higher costs for delayed treatment and poorer health outcomes and quality, the over served are no better off; also experiencing more costly and invasive care with lower quality and worse health outcomes.

Causes of Maldistribution

There are a number of probable causes of the maldistribution problem that the United States' medical community faces. They can be divided into three key groups: the stigma of rural/inner city practice, the impacts of health management organization (HMO) penetration, and the influences of malpractice premiums and threat of litigation.

Perhaps the most commonly cited reason why physicians locate in metropolitan areas is the stigma of rural or inner city practice. According to Shi and Singh, "Physicians are more likely to be attracted to rural practice if they have a rural background or exposure to rural practice settings in their clinical training" (2004: 129). These are the physicians who are able to rise above the stigma. A survey of doctors practicing in rural parts of New South Wales, Australia found a preference for the professional autonomy and lifestyle, but opposition to the isolation, long hours, lack of relief, and difficulty of accessing technology and other resources (Alexander and Fraser 2001). Rural communities, plagued by limited medical services, cannot provide doctors with necessary infrastructure or even a service area large enough to pool resources for expensive equipment. Doctors in rural areas usually feel isolated from colleagues and other trained professionals (Cossman 2004). They work long hours with little or no assistance. It is small wonder why it is difficult to attract physicians away from metropolitan areas into underserved rural communities. The case is similar for inner city areas, where the service population is uninsured and physicians lack access to necessary technology and resources to practice effectively.

One of the most highly studied causes of maldistribution is HMO penetration (see Jiang and Begun 2002, Polsky et al. 2002, Escarce et al. 2000, Polsky and Escarce 2000, Polsky et al. 2000, and Escarce et al. 1998). Over time, studies have found that both generalists and specialists prefer markets with lower than average levels of HMO penetration (Polsky and

Escarce 2000). Escarce et al. found that a .10 increase in HMO penetration in a market reduced specialist population growth by 10 percent and total physician population growth by 7 percent (2000). While this factor is slowly becoming unimportant, due to the increasing uniformity of HMO penetration in markets across the United States, there still are places, even in metropolitan areas, that are classified by low penetration, especially in the Deep South (Cossman 2004). Therefore, it is crucial to understand how HMO penetration continues to contribute to the problem of maldistribution in the physician population of the United States.

Another cause of maldistribution is the spatial variation in malpractice premiums and threat of litigation. A study of the location decisions of future physicians, preparing to leave training in Pennsylvania, looked specifically at that impact, as Pennsylvania is among the many states experiencing a malpractice crisis. The study found that over one-third of them planned to move outside the Commonwealth due to the lack of affordable malpractice insurance (Mello and Kelly 2005). Other states confront similar problems in attracting physicians. In 2001, the *New York Times* called Mississippi "… lawsuit mecca." The state ranks as one of the worst for high malpractice premiums and extraordinary numbers of lawsuits. In fact, in a recent year, Jefferson County, Mississippi had more plaintiffs than residents (Cossman 2004). It is likely that a map of malpractice rates and/or the number of malpractice cases would have a direct inverse relationship with a map of physician location; showing a picture of maldistribution.

The Possible Solutions

The three key groups of causes lead to four fundamental areas for possible solutions. These are telemedicine, graduate medical education (GME) opportunities, government intervention, and monetary incentives.

Telemedicine, a technology where doctors in underserved areas can network with doctors at large institutions for consultation and assistance with diagnosis, is becoming a more common way for the health industry to deal with maldistribution. It is also being used as a method in which patients can talk to a doctor at a distance while receiving that doctor's treatment from a nurse practitioner in local facilities. Since 1995, the Commonwealth of Virginia has been attempting to alleviate much of its maldistribution problem through the Office of Telemedicine of the University of Virginia Health System. Not only does it provide patients access to distant specialists, but also removes some of the isolation that rural physicians feel by giving them a network of colleagues to talk to and remote access to technology (Rheuban and Sullivan 2004). Through the Office of Telemedicine, the Commonwealth of Virginia has been able to provide not only specialist services to rural communities, but also remove some of the stigma related to rural practice.

One of the leading reasons why there is a stigma about rural and inner city practice is because GME programs provide little training to prepare new doctors for it. If the GME programs in the United States could provide opportunities for future physicians to train in rural or inner city settings, these trainees may be more willing, upon graduation, to practice in areas that suffer from maldistribution. Once they have had some exposure to an underserved community, during GME, the stigma may be alleviated (Shi and Singh 2004). Studies have found that physicians

who freely choose to work in underserved areas, as opposed to being placed there involuntarily, are more likely to stay (Cossman, 2004).

Another possible solution, albeit one that has been limited in its effect, is government intervention. The government has a few alternatives at its disposal. One option is the use of the National Health Service Corps to place physicians in underserved areas. The federal government has been using this, in areas such as Mississippi, to alleviate the maldistribution problem. As previously noted, however, programs which force doctors into certain positions have been linked to higher rates of physician relocation at the end of the program contract (Cossman 2004). The federal government has also subsidized the formation of rural health clinics. These, however, need to be linked to telemedicine resources to be most effective. As the Office of Telemedicine of the University of Virginia Health System discovered, federal reimbursements and grants for telemedicine services are limited at best (Rheuban and Sullivan 2004). Government intervention needs to focus on more long-term redistribution of the physician population. This includes more reimbursement by Medicare and Medicaid for services provided by telemedicine and incentives for GME programs to provide rural and inner city training opportunities. Only with this type of government intervention can the United States hope to alleviate its physician maldistribution problem.

One final possible solution is the use of monetary incentives. This includes making it more profitable for physicians to practice in underserved areas. Currently, Medicare provides an incentive per recipient that a physician sees in an identified area of medical shortage. These incentives need to be expanded to include not just Medicare recipients, but all patients that a physician attends to in an underserved area. The State of Mississippi has also attempted to provide assistance in paying malpractice premiums, which could make an area more attractive for a physician (Cossman 2004). One other monetary incentive is assistance with relocation costs. Polsky and Escarce found that only 2 to 3 percent of established physicians relocate in a given year, despite the fact that more may wish to. They believe this is largely due to high costs of relocation (2000). If relocation was not cost prohibitive, physicians may choose to move to underserved areas for professional autonomy and less market competition.

Case Study: Retina Specialists in the United States

The problem of maldistribution has been identified. Concerns related to it and causes and possible solutions have been discussed. But how does maldistribution look in real terms? To discover that, it is necessary to map the distribution of a specific specialty within the United States. The population considered is those ophthalmologists who are members of the ASRS. These physicians specialize in diseases and conditions that impact the retina, or the thin layer of cells at the back of the eyeball where images are projected. Retina specialists treat not only age-related macular degeneration, the number one cause of blindness in the elderly of the United States, but also retinal tears, which can impact people of any age. For that reason, it is important for Americans to have good access to these physicians. However, as can be seen from the following analyses, it is not always the case.

Using geographic information systems technology allows one to look more closely at the distribution of retina specialists (defined as physicians who are listed as members of the ASRS

by the organization's website). Environmental Systems Research Institute's (ESRI), ArcGIS 9.0 was used to conduct analyses of the data. Simple mapping of the locations of physicians and their practices, which were identified using the addresses provided on the website, shows a preliminary picture of the distribution discrepancies. When examining the number of retina specialists and retina practices, by state, according to 2006 membership, New York, Florida, and California have the largest populations (Figure 1). They also represent the areas with the highest need, however. By normalizing the physician population by the total resident population, the picture changes slightly (Figure 2). The population of physicians in individual cities is represented by proportional circles. Physician numbers are normalized by the 2001 population

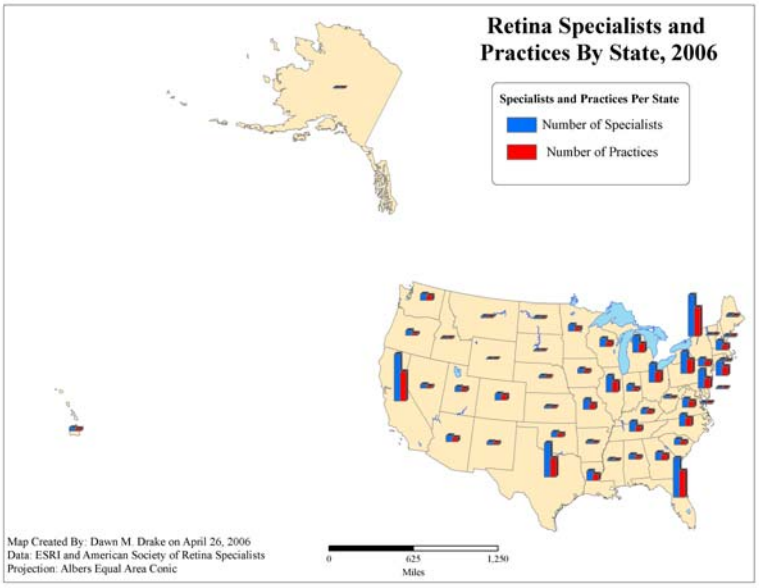

Figure 1: The bar graphs depict the number of retina specialists and practices per state in 2006.

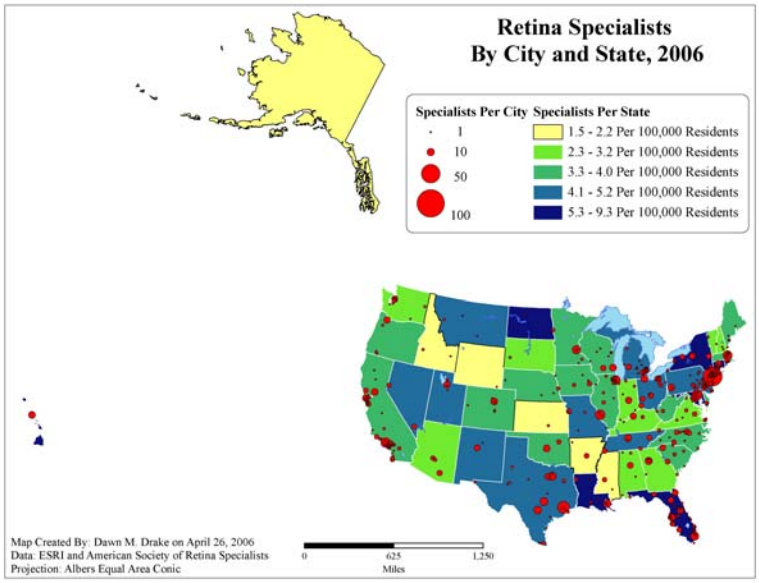

Figure 2: Proportional circles represent the number of retina specialists per city while the states are symbolized according to the number of retina specialist per 100,000 residents.

of the state. In this analysis, New York and Florida remain well served and other states, such as Louisiana and North Dakota also demonstrate many retina specialists per 100,000 residents. California, despite its large number of physicians, has an intermediate value per 100,000 residents. States such as Mississippi and Idaho, alternatively, are experiencing shortages of retina specialists. By looking at specific sections of the United States, such as the Boston, Massachusetts to Washington, DC corridor and California and its surrounding states, a clearer picture emerges (Figure 3 and 4). These analyses again use simple symbology and categorization techniques to display the maldistribution of retina specialists. In figure 3, it is apparent that while many residents in this region are well served on the state level, the

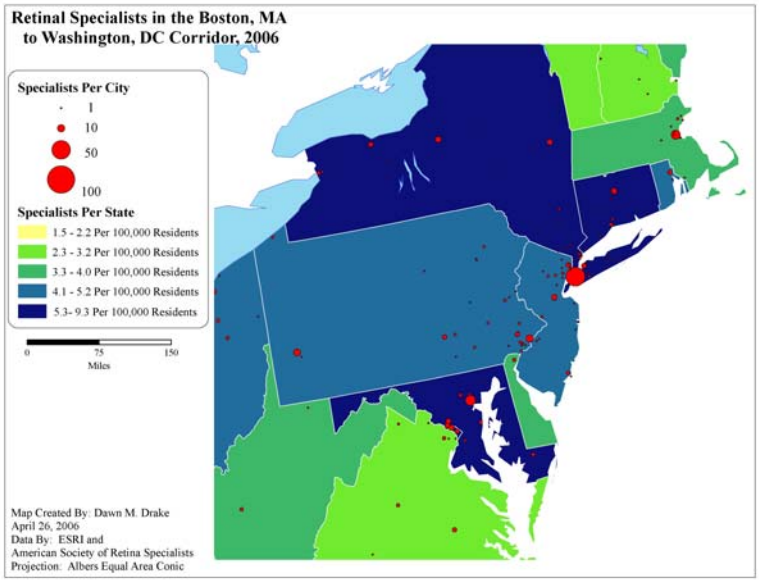

Figure 3: A closer look at the retina specialist population of Megalopolis in 2006.

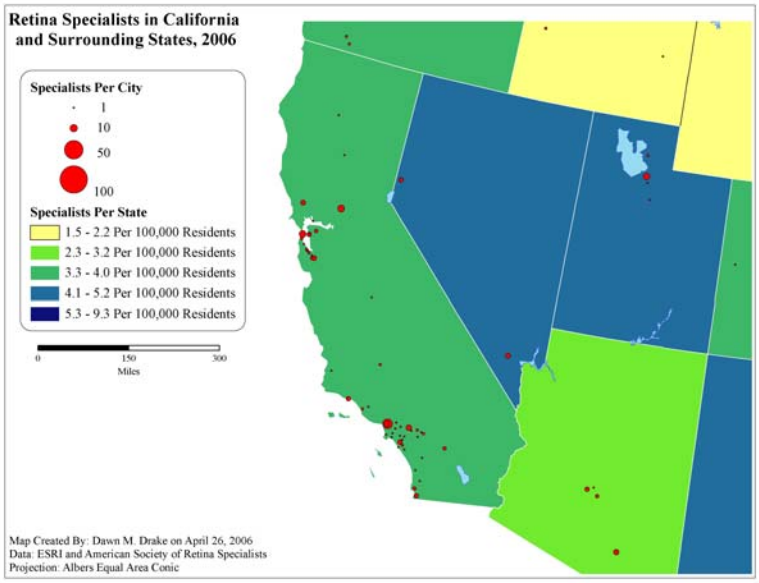

Figure 4: California and its neighbors suffer from severe maldistribution of retina specialists.

locations of the physicians are intensely clustered. For example, Pennsylvania appears to have a sufficient amount of retina specialists to treat its residents. This is largely due, however, to the presence of Wills Eye Hospital in Philadelphia and University of Pittsburgh Medical Center to the west. Residents living in the interior portions of the Commonwealth may have to travel several hours to receive treatment from a retina specialist. A similar situation is presented in figure 4, where huge portions of California and its neighboring states lack a retina specialist within a reasonable driving distance. By looking at these maps, it becomes apparent that maldistribution exists in the retina specialist population of the United States.

An even more disturbing picture develops when looking at the distribution of retina specialist practices (Figure 5). The practice numbers were determined by aggregating physicians who listed the same address as other physicians on the ASRS website. It is desirable to have multiple practices within a reasonable distance of each other. This allows patients to seek a second opinion outside the practice they regularly obtain care from. In figure 5, however, only the District of Columbia provides more than five practices for every 100,000 residents. Looking at the Boston, Massachusetts to Washington, DC corridor (Figure 6), Massachusetts, a Commonwealth known for its physician population, has approximately two practices for every 100,000 residents. The Commonwealth of Virginia exhibits a similar problem.

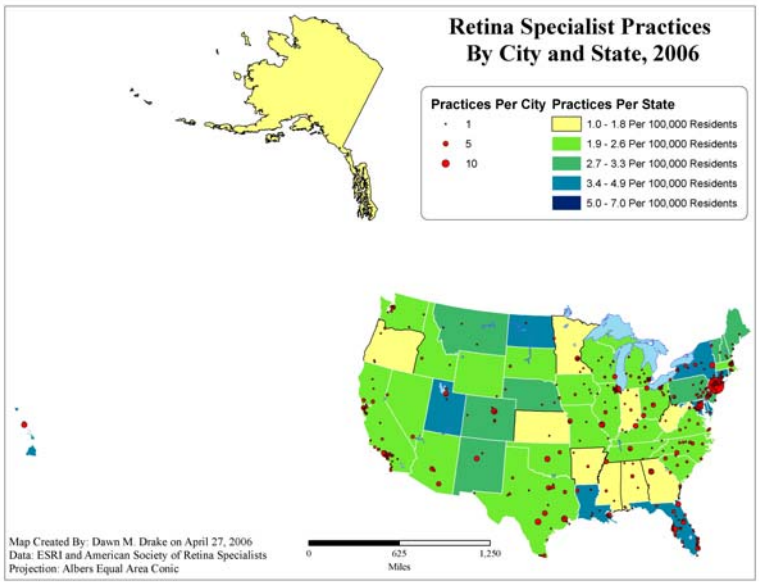

Figure 5: Proportional circles represent the number of ophthalmology practices with retina specialists in United States' cities while the states are shaded according to the number of practices with retina specialist practices per 100,000 residents.

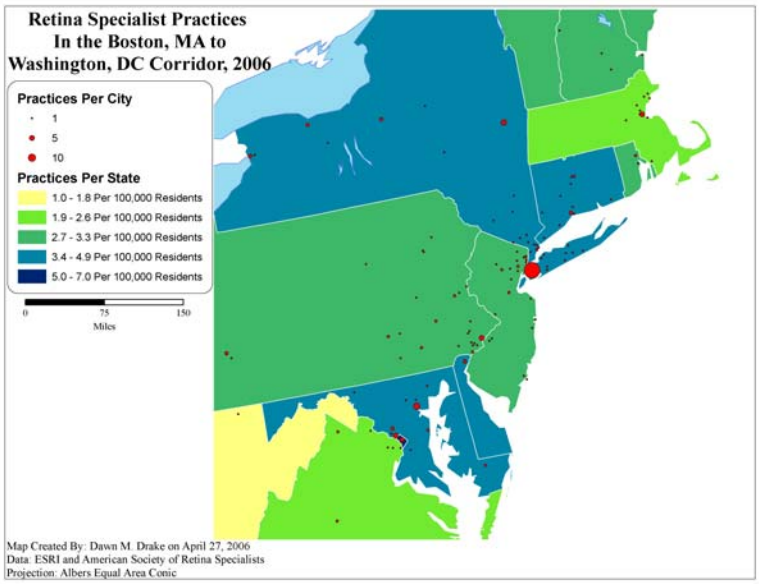

Figure 6: Looking more closely at the dispersal of retina specialist practices in Megalopolis, in 2006, presents a snapshot of maldistribution.

When one looks to the west, the picture becomes more alarming (Figure 7). Much of the western United States, with the notable exception of Utah, suffer from shortages of retina specialist practices to serve their populations. This presents not only an issue of access, but also quality of care. A small number of ophthalmology practices with a retina specialist can lead to long waits for patients and overextended staff and physicians. It also could have implications for healthcare costs. If the supply of retina specialists is low and demand for their services is high, these practices may consider not accepting any insurance to maximize their profits. This could keep Medicare recipients and others from seeking care they urgently need. The maldistribution of both doctors and practices can greatly impact healthcare cost, quality, and access.

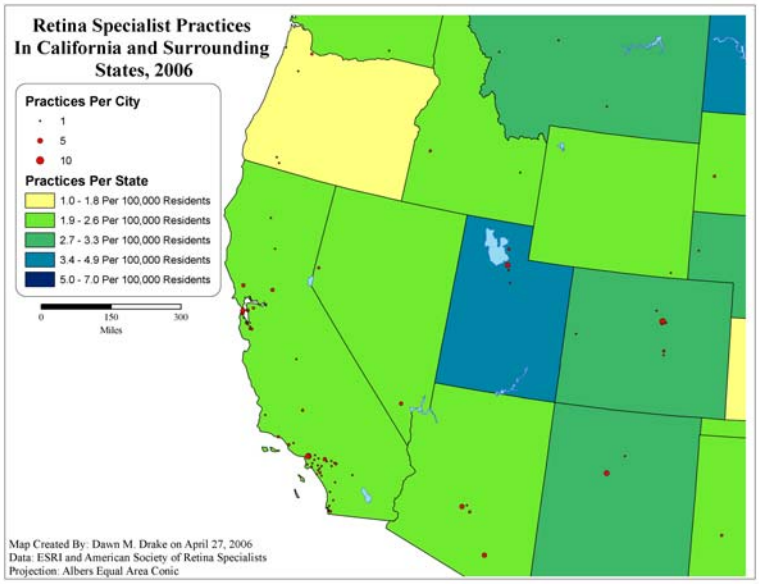

Figure 7: California and its neighbors present a similar image of maldistribution.

Perhaps the most interesting analysis conducted with this data looks for clustering of specialists by city. Using ArcGIS 9.0's hot spot analysis (Getis-Ord GI*), applying an inverse distance function (the farther away physicians in another city are, the less impact they have on the market in the city being examined), and normalizing the results by the population of the cities, one can see assemblages of retina specialists (Figure 8). There are several exceedingly clustered hot spots around the United States, including New York City, Atlanta, and Los Angeles. Because the analysis was normalized by population, these hot spots represent places where the number of retina specialists is outstripping the needs of the people, while cold spots, such as Dallas-Fort Worth, Portland, and Phoenix are areas where population demands exceed the number of retina specialists available.

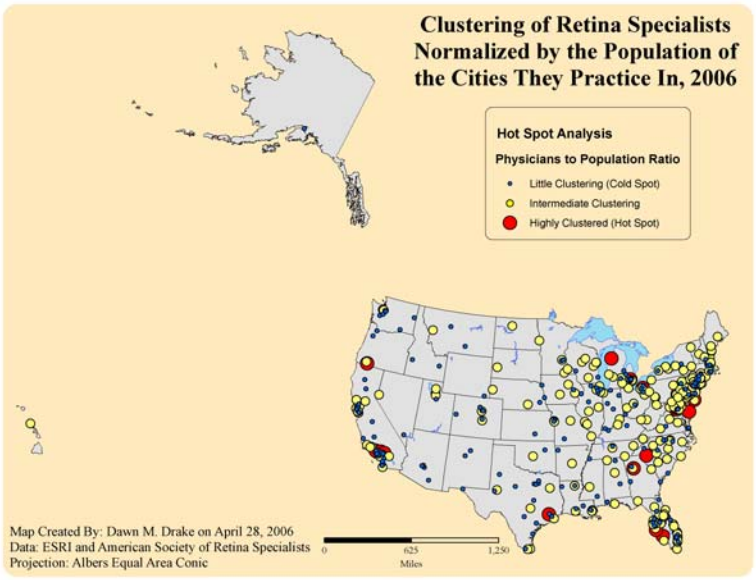

Figure 8: A hot spot analysis of the retina specialist population of the United States very clearly depicts the maldistribution problem.

Even more intriguing than the hot spot analysis normalized by the total population of the city that the physicians practice in, is an analysis, still using the inverse distance function, which is normalized by the population aged 65 or older of the city (Figure 9). This is the main population that seeks out retina specialists on a regular basis, as they are the group most likely to be inflicted with age-related macular degeneration. Only cities such as New York City, Baltimore, and Pueblo are outstripping the demand for retina specialists with their supply. Cities like Richmond, Salt Lake City, and Minneapolis-St. Paul experience a population burden well in excess of the abilities of the available pool of retina specialists within a reasonable driving distance. Even Washington, DC, which was cited earlier as having a good retina specialist distribution, becomes a cold spot when normalized by the elderly population of the district. Clustering analysis clearly demonstrates the problem of retina specialist maldistribution in the United States.

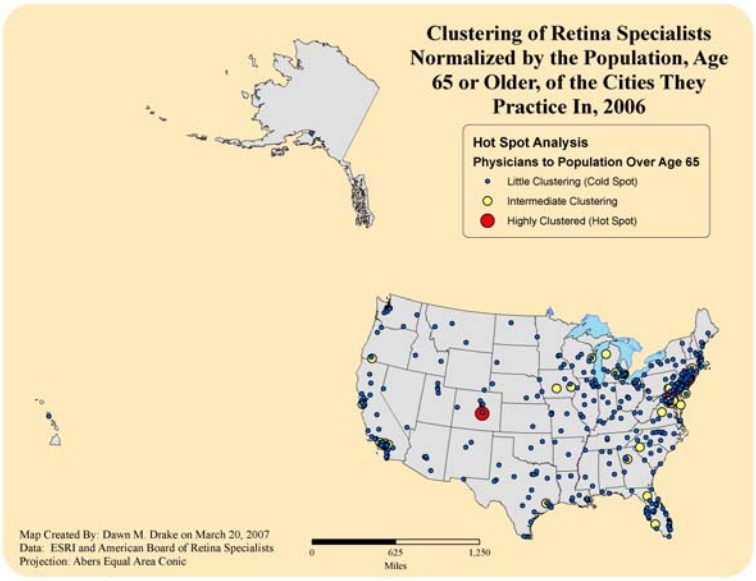

Figure 9: The elderly largely remained underserved in regards to their retina specialist needs.

These maps present a small part of a case study of the maldistribution of retina specialists in the United States. Many additional analyses could be run within ArcGIS 9.0 to study the problem more closely. A more accurate picture of the distribution of retina specialists could be obtained by geocoding the addresses collected from the ASRS and also by verifying which of the members are in active practice. The numbers used in this study most likely overestimate the physician population, as many members of the ASRS, rather than seeing patients on a daily basis, are engaged in teaching or work in private sector companies such as Genentech, which has been actively leading research into treatments for age-related macular degeneration. A more complete analysis may present a slightly different picture of the retina specialist population in the United States, albeit still a maldistributed picture.

Conclusion

From the preceding case study, maldistribution within a specialty in the United States is apparent. From these analyses and ones like it conducted within other specialties and among generalists, as well as the studies of solutions discussed earlier, policy should be developed to help alleviate some of the concerns related to maldistribution in the United States. Issues of cost, quality, and access in healthcare, presented by maldistribution, must be addressed for all Americans. Only through a combination of solutions will the United States be able to correct this problem. It will take an amalgamation of telemedicine programs, which are more actively funded by Medicare and other insurers and the federal government encouraging GME programs to create training opportunities in areas of maldistribution as to alleviate the stigma associated with those locales. The answer is not forcing physicians into underserved areas, but making it more attractive for them to serve there. Only when the healthcare system can get its physicians to freely relocate to underserved regions can the United States hope to see a long-term fix to its maldistribution problem.

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