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The Geographic Distribution of General Surgeons: Comparisons Across Time and Specialties

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Quick Facts

The Gini Index assesses the evenness or equity of a distribution.

50 percent of the U.S. population lives in counties that contain just 30 percent of the general surgeons.

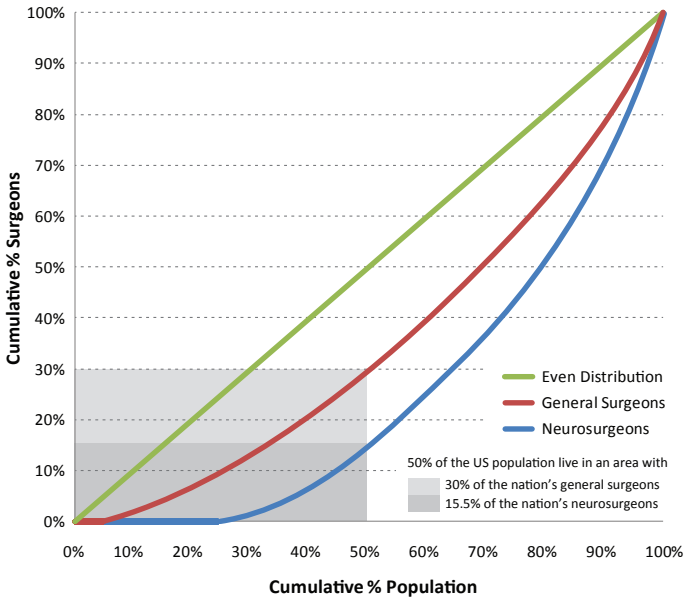
50 percent of the U.S. population lives in counties that contain 15.5 percent of the neurosurgeons.

Mission Statement

The mission of the ACS Health Policy Research Institute is to improve our understanding of surgical patient care from a policy perspective in order to educate the public, federal and state governments, health care consumers, and the policy community to enable advocacy for superior, efficient, and compassionate surgical patient care. The goal of the Institute is to create a data driven, knowledge based program for examining issues related to surgical services, the surgical workforce, and public policies affecting surgery.

Policymakers and researchers continue to debate whether there is an overall shortage of surgeons, a maldistribution, or both. The recurring question, "How many surgeons do we need?" has not been definitively answered. There are specific surgeon-to-population ratios that are considered benchmarks for this issue, but they offer little guidance on what constitutes a shortage.[1,2] In this article, the Gini index—a tool for assessing the overall fairness of the distribution of surgeons—is presented, along with guidance for how it may be useful in monitoring geographic access to surgical services.

Figure 1: Illustration of the Gini Index for General Surgeons and Neurosurgeons (2008)



While we know that growth of the general surgery workforce has not kept pace with U.S. population growth, we do not know whether this has changed the geographic distribution of general surgeons across U.S. counties.[3] Geographic distribution can be measured by the Gini index, a number that characterizes how evenly a resource is spread across a population.* This article employs the Gini index to describe the geographic distribution of general surgeons and selected other groups of physicians over time from 1999 to 2008.

*The Gini Index is usually used to measure income inequality across n-tiles of a population. For example, the top 5 percent of the population may have 40 percent of the total income in a nation resulting in a relatively high Gini index, perhaps 0.40. The Gini index is named after Corrado Gini (1884-1965), an Italian political scientist.

The Gini Index of Inequality

The use of the Gini index to characterize physician supply and distribution in the U.S. started in the 1970s and 1980s, but the measurement tool has not been used widely in recent years to describe issues of access.[4] A Gini index describes whether there is a concentration of resources in some geographic area or some segment of the population. For physician distribution, we calculated the index for counties and weighted them according to the proportion of the population living in each county. The index ranges from 0 to 1, with smaller values representing more equal distribution.

Calculating the Gini Index for General Surgeons

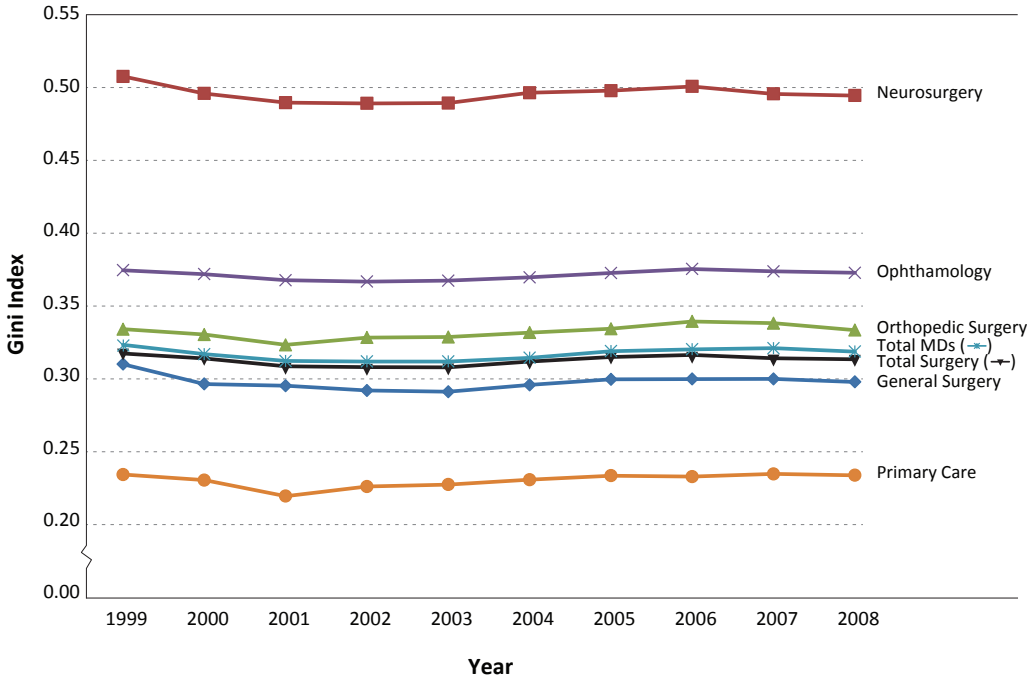
Figure 1, page 1, illustrates the Gini index calculation for general surgeons with neurosurgeons included for comparison. The green diagonal line represents a perfectly even distribution of surgeons per population, or a Gini index of 0.0.[†] For general surgeons, the Gini index is the area bounded by the green line and the red curve, divided by the total area under the green line.

In Figure 1, the lines representing general surgeons (red) and neurosurgeons (blue) do not leave the horizontal axis until they have reached 4.9 percent and 24.6 percent, respectively. This means that nearly 25 percent of the U.S. population lives in a county that doesn't contain a neurosurgeon, and close to 5 percent are without a general surgeon. Similarly, 50 percent of the U.S. population lives in counties that contain just 15.5 percent of the U.S.'s neurosurgeons and 30 percent of the general surgeons.

Generalists Are More Evenly Distributed than Specialists

As physicians become more specialized, the Gini index climbs. The Gini index for primary care physicians in 2008 was 0.232, while the Gini index for general surgeons was higher, at 0.296. This indicates that general surgeons are somewhat less evenly distributed than primary care physicians.

Figure 2: Gini Indices (1999-2008)[††]



Among surgical subspecialists, the Gini index climbs even higher. The Gini indices in 2008 for neurosurgery and ophthalmology were 0.494 and 0.371, respectively. This is not surprising because these surgical subspecialties require a more populous area to sustain the appropriate volume of surgeries and support resources.

[†] The Gini Index is equal to the space between the diagonal and the curve representing the distribution of physicians divided by the total space below the diagonal line. These lines are also called "Lorenz Curves".

[††] In 2001, we found the ARF-reported population data to be inconsistent with the overall trend. This outlier datum was dealt with by estimating the 2001 modified FIPS populations as the midpoint of the 2000 and 2002 data.

Physician Distribution over Time

Figure 2, page 2, traces the changes in the Gini index for six groups of physicians and surgeons. The surgical subspecialty Gini indices reflect a slight move toward greater maldistribution from 2001 through 2006. In 2007 and 2008, this trend appears to be stabilizing (see Table 1, page 1). Primary care physician and general surgeon distribution has been relatively stable since 2005 with a slight downward trend toward a more equal distribution.

The annual percent changes in the Gini indices summarized in Table 1 also show that, overall, the most significant changes occurred between 2001 and 2006. Although the Gini index fluctuations for each specialty (see Figure 2) appear small, the accumulation of these changes represent a substantial shift in the equality of physician distribution when the trend is consistently in one direction. These data show that the distribution of all surgeons and of general surgeons has remained steady. The Gini index should be calculated again in future years to determine if the projected drop in the supply of physicians and surgeons creates greater geographic imbalance than what currently exists.

Due to the fact that the Gini index is sensitive to changes in distribution, it allows researchers to project distribution shifts in the future. For example, if all of the general surgeons from each of the counties with three to six practicing general surgeons were to move to the 22 counties with the most surgeons, the Gini index would shift from 0.296 to 0.324. This shift would further limit access to surgical services for 17% of the U.S. population.

Table 1. Annual Percent Change in the Gini Index

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Primary care	-1.64%	-4.85%	3.07%	0.58%	1.51%	1.19%	-0.27%	0.79%	-0.38%
General surgery	-4.43%	-0.43%	-1.12%	-0.29%	1.62%	1.31%	0.07%	0.03%	-0.70%
Total surgery	-1.09%	-1.76%	-0.15%	-0.08%	1.32%	1.01%	0.44%	-0.71%	-0.23%
Total MDs	-2.00%	-1.50%	-0.10%	0.01%	0.81%	1.47%	0.40%	0.25%	-0.74%
Orthopaedic surgery	-1.12%	-2.18%	1.58%	0.10%	0.95%	0.79%	1.52%	-0.36%	-1.42%
Ophthalmology	-0.72%	-1.13%	-0.26%	0.17%	0.62%	0.82%	0.74%	-0.43%	-0.27%
Neurosurgery	-2.32%	-1.27%	-0.10%	0.04%	1.46%	0.29%	0.59%	-1.03%	-0.23%

Limitations and Implications

This analysis uses counties and county equivalent areas to calculate the relative distribution and concentration of physicians and surgeons. Using counties provides a general picture of the distribution of geographical access to physicians. Since counties vary widely in size and population, especially in the western part of the U.S., they are not ideal units of measure. However, the variations are not so large as to make the index unusable.

Counties are also used as the basis for policy tools related to the distribution of physicians. For instance, the Bureau of Health Professions uses the county as a default starting place for the designation of health professional shortage areas (HSPAs), and the Bureau of Primary Health Care uses counties as the basis for medically underserved areas. While these designations generally refer to primary care, mental health, and dental health care shortages, the Affordable Care Act established a 10 percent bonus for general surgeons who perform major surgery in a primary care HPSA. A recent American College of Surgeons Health Policy Research Institute publication outlines preliminary steps for a developing surgical HPSA designation.[5] Using the Gini index to estimate the inequality in surgeon distribution is a way to monitor surgical access issues over time. Moreover, it underscores the need to develop a surgical HPSA designation to help improve access to surgery in underserved areas.

Data and Methodology

This analysis uses the Area Resource File (ARF) data from the Health Resources and Services Administration (HRSA) across the period 1999–2008. All ARF physician data come from the American Medical Association Physician Masterfile. For this research, residents were excluded from physician and surgeon counts. Otherwise, physicians with the applicable, self-reported primary specialty are included in the data. Primary care physicians were defined to as medical doctors who self-reported primary specialties of family medicine, general internal medicine, general practice, and pediatrics.

The population data is from the U.S. Census Bureau as reported in the ARF, and was aggregated at the modified Federal Information Processing Standards (FIPS) level for all U.S. counties. All years of data except for 2000 and 2001 are official census estimates.†† In 2000, the actual census count was used, so that count is not an estimate. All Gini index calculations were done in STATA® 11, and percent changes and trends were calculated in Microsoft® Excel 2010. ❖

References

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