

Poverty and Healthcare: Using Drive Times to Represent Access to Care

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Abstract

It is no secret that poverty is heavily correlated with health care access. One attempted means of fixing this is creating more health centers. Those affected by a lack of health centers fall in a category known as the 'geographically underserved.' Geographic Information Systems (GIS) is one potential way to analyze this, as it has increasingly been used to combat public health problems. The Greenville Health System wanted to see if there was a correlation between poverty and the geographically underserved. Drivetimes were created around hospitals to show areas of geographical underservice and this was correlated with numbers from a map depicting poverty ratios for Greenville county. While no strong correlations were found between geographical underserved and poverty, areas of underserved do exist. Furthermore, the hospitals in Greenville County were built during times of different wealth distributions for Greenville County, so a map of current poverty for Greenville County may not have been the most relevant for relating to hospital locations. A potential remedy for the sparsely populated areas of underservice are Community Health Centers (CHCs) which are not extremely expensive, but do provide care to underserved areas.

Introduction / Lit Review

It is no secret that poverty is heavily correlated with health care access (Phillips and Lindbloom, 2000). In policy, the attempted means of remedy have long been either (1) giving access to insurance coverage to individuals or (2) creating more health centers. According to research, there are more gains in access per dollar with the former action, but the creation of healthcare centers is important as well (Cunningham and Hadley, 2004). Those affected by a lack of health centers fall in a category dubbed the 'geographically underserved' (Cunningham and Hadley, 2004). To determine where these areas are, and if there is a problem associated with the designated areas, GIS must be used to analyze the spatial component of this problem.

GIS (Geographic information systems) has increasingly been used to combat problems associated with public health (Graves, 2008). Studies of this nature include analyzing the increase in ambulatory calls on hot days (Dolney and Sheridan, 2005) or mapping disease rates over certain areas (Rushton, 2003). Thus there is substantial evidence that GIS is an effective way to address the problem of poverty and the geographically underserved.

According to the U.S. Census Bureau, 14.7% of individuals in Greenville county are below the poverty line. This is very near the national average. Recently, Furman University and the Greenville Health System formed a partnership, so representatives from the Greenville Health System met with two faculty members and myself to discuss possible research projects involving GIS and the Greenville Health System. Initially, the proposal was to do an analysis of emergency call hotspots and dispatch center locations. However, this would have required confidential information, and thus an IRB process. We finally settled on looking for a correlation between poverty and geographical access to care; that is, how long it takes to drive to a hospital. We hypothesized that there could be areas of geographically underserved correlated with poverty.

III. Methodology

A list of the 6 locations in Greenville County providing emergency care, all hospitals though not all associated with the Greenville Health System, was compiled. The 6 Greenville Hospital Locations were geocoded and then converted to points in ArcMap, the ARCGIS software used for mapping. This was layered over a map of Greenville County divided into block groups, using data obtained from the 2010 census. The attributes in this data involved income to poverty level ratio. A ratio of 1 corresponds to a household that is living at the poverty line. A ratio of .5 means the household is living at half of the poverty line. A choropleth (figure 1) was then created indicating poverty rates in various parts of Greenville from 2010, mostly as a reference point. The result was the base map from which all subsequent maps would come.

This file was then run through a program, Business Analyst, which calculated the amount of time it would take from everywhere in Greenville to drive to each hospital. The shortest route to any hospital was chosen for each point and rings of the resulting 'drive times' were created based on the desired rings (5, 10, 15, 20, 25, 30). A choropleth (figure 2) was also created indicating drivetimes for the county to each hospital. Most areas in Greenville were within the 30-minute drive time to a hospital.

6 layers were created holding the rings for each drive time for all 6 hospitals (i.e. the 5 minute drive time had all the places in Greenville County where a hospital could be reached in 5 minutes or less). To determine the average drive time for the block groups, it was assumed that if a majority of the block group was in the drive time ring, the block group belonged in that drive time. Each block group was then designated a drive time based on which ring the centroid, or geometric center, of the block group was in. The basic premise behind this decision is that if the geometric center of a polygon was in a ring, it was highly probable that the majority of the block group was in this ring. Finally the block groups of each drive time were aggregated in to one group and then the average poverty rates were calculated.

IV. Results and Discussion

The results are displayed in table 1. There is not a strong correlation between drivetime and poverty rates. There is no marked increase in poverty associated with increased drivetime. In fact the opposite holds true, in that for the first 15 minutes, poverty actually decreases as drivetime increases. Our hypothesis was not confirmed. There was a large level of poverty in the 20 minute drivetime group, but this is an anomaly. There are very few block groups in the 20, 25, and 30 minute drivetimes because most of the block groups in Greenville County fall within the 15 minute drivetime ring. So this is less an area of geographically underserved, and more a statistical blind spot.

There are several reasons the results are less than conclusive. First, many of these hospitals were built when money was distributed differently throughout the county. Specifically, St. Francis Downtown was built in 1921 and Greenville Memorial Hospital was built in 1972, while many of the others were built in the 1960s. While the buildings have stayed in the same place, the areas of impoverishment have undoubtedly changed. So while the hospitals may have been built to serve a population near the hospital, urban expansion and suburban flight has changed the demographics of the areas they may have been meant to serve.

Second, there are two hospitals geographically near the highly impoverished west end, as can be seen in figure 1. This especially affects the 5 and 10 minute drivetime statistics of the overall hospital system. However, many of these individuals can not attend both hospitals, as St. Francis Downtown is a private hospital, and many of the citizens do not have the insurance to pay for hospital visits to this hospital. The same is true of St. Francis Eastside, but it is closer to the less impoverished suburbs of Greenville County.

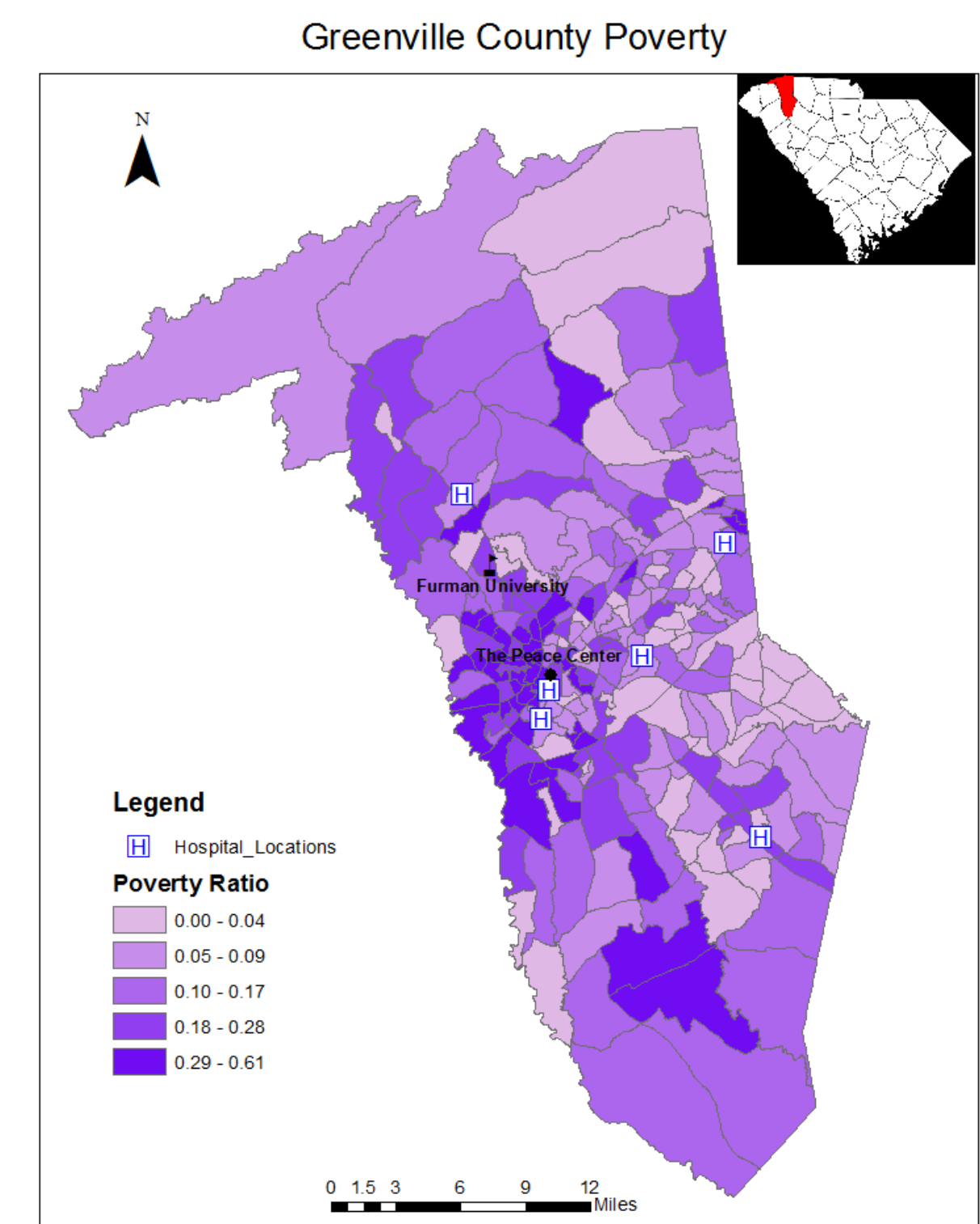


Figure 1: Choropleth depicting the ratio of people below the poverty line

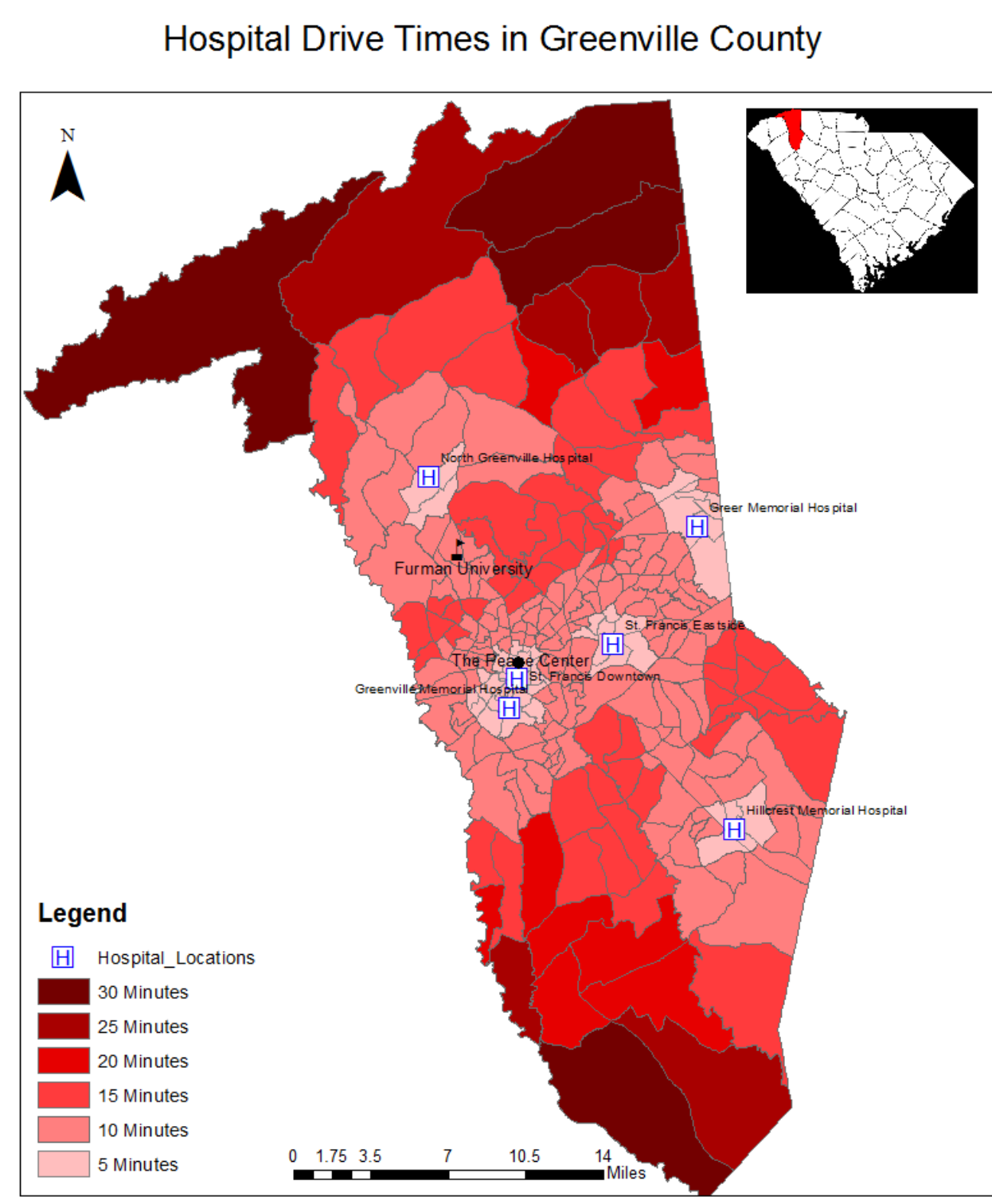


Figure 2: Choropleth depicting the the drivetimes to hospitals in Greenville County

	Income To Poverty Ratio						
	0.0-0.5	0.5-1.0	1.00-1.24	1.25-1.49	1.5-1.84	1.85-1.99	2.00 and over
5 Minute Drivetime	8.35	8.86	5.57	4.49	5.92	3.60	63.20
10 Minute Drivetime	6.83	8.02	5.09	5.16	6.96	2.89	65.05
15 Minute Drivetime	4.55	6.42	4.24	4.47	6.00	2.40	71.92
20 Minute Drivetime	13.76	4.25	4.50	6.00	8.95	1.40	61.14
25 Minute Drivetime	1.83	8.61	6.04	4.76	9.92	2.62	66.22
30 Minute Drivetime	3.19	3.51	0.87	5.44	11.00	2.03	73.97

Table 1: Table displaying the results of aggregation of drivetime rings vs. income to poverty ratio

V. Conclusion

There is not an impoverished area of the geographically underserved as it relates to emergency health centers. While there are a few places of interest, such as the deep poverty in the 20 minute drivetime, these are more statistical shortcomings than correlative results. However, there are areas that are geographically underserved. They are mostly in the north of the county, as the south of the county can be served by the Laurens County hospital, not depicted here. The north part of Greenville county consistently has to drive 25 minutes or more to reach a hospital. However, this is a relatively small part of the population, and would constitute the building of a new hospital with an emergency care center.

A second analysis of the geographically underserved conducted by mapping where hospital patients are actually coming from may elucidate areas of geographically underserved due to the fact that they can not afford private healthcare. Specifically, those closest to St. Francis Downtown are most likely not the patients of this hospital, due to the high level of impoverishment around this hospital.

Currently, there is no geographic problem with hospital placement in Greenville County. Geographically, all levels of income are served equally when not accounting for level of insurance required to be a patient at a certain hospital. Hospitals are placed evenly throughout the county, and serve the community quite equitably.

V.I. Future Research

An analysis of actual service by area i.e. where patients in each hospital generally come from. This could reveal an area of underserved based on the fact that they can not attend the private hospitals in Greenville County.

In areas of underservice that also have relatively low levels of population, an analysis of where Community Healthcare Centers (CHCs) can be built would be an interesting area of study.

VIII. Acknowledgements

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VII. References/ Data Sources

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