Small-Area Market Potential of Hospitals

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Abstract

The author combines national inpatient hospitalization data with Census 2000 data to assess the market potential of hospital cardiac care in South Carolina. The author discusses the implications for small-area hospital planning.

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Introduction

During the 1980s, the level of competition within the health care industry reached unprecedented heights. Traditional providers of care such as hospitals and clinics were challenged by a proliferation of innovative facilities, ranging from minor medical centers to freestanding surgicenters. Similarly, traditional means for financing health care were challenged by the growth of managed care and alternative financing arrangements such as health maintenance organizations (HMOs) and preferred provider organizations. Established providers of care were faced with declining reimbursements and head-on competition for patients and revenue (Thomas, 1997).* Although managed care is declining, the trend toward economic efficiency and competition for market share continues unabated today.

The financial stakes of this competition are immense. In 2001, national health expenditures on hospitals were $451 billion. In 2002 these expenditures had increased to $484 billion and by 2003 to an estimated $511 billion.

The infrastructure necessary to support these expenditures has grown as well. The 2002 National Estimates Dodge Construction Potentials, developed by F.W. Dodge of McGraw-Hill Inc., New York, estimated the construction activity of hospital facilities for 2002 at 83 million square feet, a 4 percent increase from 2001. The 2001-2002 Construction Outlook published by FMI, Raleigh, N.C., forecast gradual increases in the construction of privately owned hospitals and nursing homes over the next few years. The report says that expenditures on construction of these facilities were $6.57 billion in 2001. These expenditures will be $6.65 billion in 2002 and $6.96 billion in 2003 (http://ewweb.com/ar/electric_hospital_market/).

* Once the health care centers for communities across the country, hospitals must now compete with a growing number of other service providers - including the hospitals' own physicians - in a world of rising dissatisfaction with medical costs, where cost-sensitive employers and insurance companies increasingly "call the shots" on treatment setting and method of care. Prior to 1983, hospital reimbursement was based simply on the cost of providing care. With reimbursement at cost, a hospital operated basically like a public utility - and rarely lost money. But then Medicare introduced the Prospective Payment System (PPS), which reimburses hospitals at predetermined prices according to diagnoses. Since the advent of PPS, hospitals must operate more like businesses, if only to survive. Responding to these changes in the market environment, many hospital managers have developed formal instructional planning procedures to guide their organizations through the more difficult financial climate. (Rives, 1997)

Hypothesis

From a hospital perspective, the planning necessary to capture their share of national health expenditures is of incredible importance, but for many remains a highly unrefined science. Unlike most retail markets with established customer target groups, identifying and planning for prospective hospital customers involves identifying actual or perceived illnesses. However the onset of illness and the use of a hospital is for many people an unexpected occurrence. At the individual level, illness may even be considered a random event. So how can hospitals possibly plan for individuals facing a random event?

With respect to the age and sex of the population as a whole, it turns out many hospital procedures have a fair degree of predictability (Feldstein, 1979). As individuals age, the incidence of illness increases and morbidity patterns change. Although medical expenses are about the same for both sexes in the early years, there is a difference in the need for hospital care between men and women. But the relationship between age, sex and use of hospital services is not linear, nor is it the same for each type of hospital service.

Our hypothesis is that we can estimate current market potential for hospital services at very low levels of geography to help support facility planning and service area delineation. In this exercise we create refined rates by joining inpatient hospitalizations by age, sex and condition with age and sex data from Census 2000[1]. These refined rates are applied to block group age and sex data from Census 2000, from which cumulative likelihoods of inpatient hospitalization are built. These cumulative likelihoods are tested against *actual* hospital inpatient data from 2000 on a statewide and county-by-county basis in South Carolina to assess the market potential for the cardiac services. Cumulative frequencies at the block group level are used to illustrate current proximity of estimated cardiac patients to existing South Carolina hospital facilities.

This research contributes to existing studies by studying inpatient data by Service Line (Please refer to "Tabulate Diagnosis Related Groups (DRGs) and Service Lines") by block group.

Data Source

The primary data source relied upon in this research is the Year 2000 edition of the annual "Nationwide Inpatient Sample (NIS)". The NIS is part of the Healthcare Cost and

[1] Census 2000 SF1 P12 age by sex data are joined within each of the four geographic Census 2000 regions.

Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality (AHRQ). The NIS is a database of hospital inpatient stays which researchers and policymakers use to identify, track, and analyze national trends in health care utilization, access, charges, quality, and outcomes. The NIS is the largest all-payer inpatient care database that is publicly available in the United States, containing data from over 7 million hospital stays from about 1000 hospitals sampled to approximate a 20-percent stratified sample of U.S. community hospitals. The NIS is available for a 13-year time period, from 1988 to 2000, allowing analysis of trends over time.

The NIS is the only national hospital database with charge information on all hospital patients, regardless of payer, including persons covered by Medicare, Medicaid, private insurance, and the uninsured. Inpatient stay records in the NIS include clinical and resource use information typically available from discharge abstracts. Hospital and discharge weights are provided for producing national estimates. It is important to note NIS has data user requirements designed to protect patient confidentiality – such as prohibiting the user from attempting to identify any individual and from linking NIS data to data from another source that identifies individuals.

NIS data are coded at the state level. As it is known that there is a considerable amount of interstate hospital utilization, and that hospitalization rates vary significantly nationwide, we determined the best compromise was to roll up these state data to Census 2000 regions.

Tabulate Diagnosis Related Groups (DRGs) and Service Lines

Within the NIS, inpatients are coded by Diagnosis Related Groups (DRGs). A DRG is a classification of patients by diagnosis and procedure into homogenous clinically relevant categories - each containing specific diseases, disorders, or procedures. In the NIS, there are over 500 detailed DRGs, of which many are very similar. For example, an inpatient could be classified as DRG 488 (HIV w/Extensive OR Proc) or 489 (HIV w/Major Related Condition). From a planning standpoint it is largely irrelevant whether a patient is classified as one or the other, so many these DRGS can be grouped into a smaller number of homogeneous “Service Lines”.

Within the U.S. healthcare analysis industry, there are many schemas for Service Lines, but most include approximately 20 classifications. Our classification schema began with 22 service lines, but was quickly pared to 18. Testing clearly illustrated that hospitalization rates for

two of the service lines were unaffected by age and sex (alcohol/drug abuse and psychiatry) and two involved data on children (newborn births and neonatology) which are highly sensitive. Please refer to Appendix 1 for a list of original and refined Service Lines. One Service Line in particular, "cardiac", will be used here as a numerator for refined cardiac hospitalization rates and to help estimate cardiac market potential in South Carolina. Census 2000 data will be used as the denominator.

Market Potential by Geography

With the data from NIS and Census 2000 - the first and most intuitive demographic exercise is to calculate refined age and sex inpatient use rates[2] by Service Lines. The calculation of these rates is a relatively easy exercise, but one fundamental to the development of inpatient market demand by geographic entity[3].

It is important to note that the temporal correspondence between the 2000 NIS data and Census 2000 is imperfect. Census 2000 was conducted on April 1 of 2000 – reflecting a snapshot of the national population on that day. NIS data, however, reflect a dynamic and constantly changing population over the course of the year.

Refined hospitalization rates are calculated by dividing weighted NIS inpatient cardiac incidents (by five-year age and sex groups) by the Census population (by five-year age and sex groups) at the Census region level. These rates for the South region are then applied to the Census 2000 block group population in South Carolina by five-year age and sex groups.[4] These

[2] The term 'rate' most appropriately refers to the number of demographic events in a given period of time divided by the population at risk during that period. The population at risk is usually only approximated. It may be the population at the middle of the period (which is used to approximate the average population over the period) OR the population at the beginning of the period – or an even more complex definition. The 'crude' rate typically refers to the entire population. The adjective is especially appropriate when studying obstetric phenomena, as men, children and elderly women are at no risk of childbearing. Various refinements are introduced in the population base in order to obtain a more meaningful rate. These refinements may only omit a part of the population for which the risk is zero, but they may also take account of the fact that the risk is much greater for some population subgroups than others.

[3] In addition to distinguishing crude and refined rates, demography follows the actuarial science in distinguishing central rates from probabilities. In central rates, the denominator is the population at the midpoint of the period. Probabilities, on the other hand, are based on the population at the beginning of the period which is then viewed as the population at risk of experiencing the event during the period. The distinction is somewhat blurred for short periods when the population is not closed (e.g. when it is subject to immigration and emigration). When the population is not closed, the inclusion of any deaths of immigrants at age x and the exclusion of any deaths of emigrants make the resulting rate not strictly a probability because the deaths are no longer restricted to those occurring in the original population.

[4] These rates can be easily calculated and applied for all Service Lines in any region to any level of geography for which age and sex data are available.

crude rates are refined by using only the population age 18+ as a denominator, as serious cardiac conditions for those under age 18 are rare. While numerous other refinements are possible, we are in an investigative stage of the approach and do not want to "over-refine" any rates to the degree they may lead to an underestimate of inpatient market potential.

With refined rates calculated by five-year age and sex groups, the cardiac Service Line can be calculated with cumulative frequencies. For instance, to estimate the number of cardiac inpatient admissions we would multiple the refined age and sex cardiac rates by each five year age and sex groups and cumulate the totals. An example of these cumulative frequencies by block group for cardiac hospitalizations may be seen in Figure 1. An aggregate of these values can be tested against frequencies and distributions at higher levels of geography to confirm their validity. These aggregates can then be tested against actual inpatient data to determine the cardiac market potential on a statewide and county-by-county basis.

Results

Our first question is whether cumulative frequencies applied at the block group level are valid. In the South Census region, there were 74,669,917 people 18+ in the South region from Census 2000. Within these, there were 2,155,515 NIS cardiac hospitalizations – representing 2.88 percent of the population age 18+.

There were 3,002,371 people age 18+ in South Carolina from Census 2000. By applying refined inpatient cardiac rates to five-year age and sex populations to each block group in South Carolina, then aggregating these values to the state level, we estimate that there were 85,389 cardiac patients in SC in 2000 – representing 2.84 percent of the population. The consistency of this percentage with the regional percentage validates this assumption.

Our next concern was comparing the cardiac inpatient estimate of 85,389 with official South Carolina cardiac inpatient data for 2000[5]. The South Carolina data indicated that there were 79,659 SC cardiac inpatients in 2000, and that an additional 2,474 cardiac inpatients were treated from Georgia and North Carolina – for a total of 82,133 SC cardiac hospitalizations in the South Carolina in 2000. The residual of the estimate (85,389) and the actual inpatients (79,659) is -5,730. This number represents an estimate of the number of cardiac inpatients that are being treated out of state.

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[5] South Carolina is one of a handful of states that collect patient-by-patient hospital discharge information from all facilities throughout the state.

Is an estimate of 5,730 cardiac patients leaving the state reasonable? To answer this, we can refer to research on state-by-state flows of hospital care spending conducted by the Centers for Medicare and Medicaid Services (Martin et al, 2002). Therein, an index has been calculated for every state by dividing expenditures by state of residence by expenditures by state of provider. This indicates the degree to which states are net "importers" or "exporters" of patients – specifically patient revenue. Wyoming ranks as the greatest exporter of revenue, with an index of 1.2, while North Dakota ranks as the greatest importer, with an index of .87. In regards to our study – South Carolina ranks 7th with an index of 1.05, proving they are exporting patient revenue. But where do Georgia and North Carolina lie? Georgia has an index of .97 and North Carolina has an index of .98 – proving that they are importing hospital patient revenue from South Carolina and perhaps beyond.

The estimate of 5,730 cardiac patients being exported is deemed reasonable. As a very broad assessment of economic impact, this number may be multiplied by the average hospital charge of $13,000 in the cardiac Service Line to estimate nearly $75 million dollars in statewide hospital market dollars being exported annually.

The next logical question is where specifically within South Carolina are patients being lost from? Again, a comparison may be made by rolling up the cumulative frequencies from block groups to counties, then comparing with the county-level South Carolina cardiac inpatient data. As seen in Figure 2, the difference between cardiac incidence and the provision of cardiac service varies dramatically across the state. In Spartanburg County for example, there were 1,686 more people that required hospitalization for a cardiac event than actually utilized cardiac care in one of Spartanburg's hospitals. While other counties, such as Florence and Marion counter this trend and treat more cardiac patients than emerge there every year – the net effect is still a loss for the state.

Exporting and Importing Patients

Why would a state be an exporter of such an important health service? Research has shown that there is substantial variation among states in residents' tendency to travel to another state to seek health care. Because urban areas often supply specialized services, states that have large cities near a border (for example, Grand Forks and Fargo, North Dakota, and Memphis and Chattanooga, Tennessee) or are on major interstate highways that ease accessibility (for example,

Nashville and Knoxville, Tennessee), or have facilities that provide unique services (Minnesota's Mayo Clinic, for example), tend to be net importers of patients. Thus residents of exporting states such as South Carolina may cross borders seeking health care providers that are not available near their residence in their own state.

Research also has shown that border crossing for health care tends to be more predominant for high-technology procedures, such as advanced imaging, cardiovascular surgery, and oncology procedures, than for more routine evaluative services. Interstate net flow ratios show the greatest variation for inpatient hospital and physician services, as patients seeking non-emergency, highly specialized care are more likely to travel greater distances.

Urgent care (such as in emergency departments) as well as home health care, nursing home care, and dental services typically are provided locally and show smaller variation in interstate flow ratios.

Approaching the Market Potential

Given that a state such as South Carolina has a demonstrated unmet market potential for inpatient hospital services, how might this potential be fulfilled? Intuitively, better or more accessible services can be provided. There are a number of ways in which a service area for health care can be delineated, and the method utilized must consider the type of service (Garnick et al., 1987; Massey and Blake 1987).

For emergency hospital care, the most frequent measure of a service area is determined by what constitutes reasonable travel time. Although this approach has historically been more appropriate for determining the service area for ambulatory care, it has become a more viable criterion for hospital service areas now that patients are more frequently choosing a hospital on the basis of convenience. If proximity were the sole consideration for attracting cardiac patients, how might we assess the current service of South Carolina hospitals? A basic approach is to buffer each hospital a fixed distance, then measure the number of estimated patients (in this case cardiac patients) within that buffer. As a test in South Carolina, each hospital was buffered ten miles, and the estimated cardiac patients within the buffer were tabulated by Census block group. Figure 3 illustrates that of the 79,659 actual cardiac inpatients in 2000, 17,653 (22 percent) were not within ten miles of a South Carolina hospital – let alone a facility that specializes in cardiac care.

For assessing service areas for non-emergency care, one frequently used method is to examine the origin of existing patients and identify the geographic areas (zip codes, census tracts, or other unit) from which a majority of the patients is drawn. This area is usually delineated so as to take in 70 to 80 percent of the facility's admissions. However, if no (or minimal) service is being provided this approach is not practical. Alternatively, the most realistic approach is the most qualitative. Information needs to be combined on existing service areas, driving times, physician practice patterns, and particularly on existing health services utilization patterns – which we have demonstrated here - to plan new service areas and facilities to help capture the market potential that is being lost.

Conclusion

By applying refined cardiac inpatient rates from the NIS to very small pieces of geography (Census block groups) – we were able to calculate the amount of cardiac hospitalization potential being lost out of the State of South Carolina. We illustrated on a county-by-county basis where there were over- and under- provisions of cardiac services. Finally, we showed from a spatial perspective the number and proportion of patients proximal to South Carolina's hospitals.

Appendix 1

Service Lines

Original Service Lines	Refined Service Lines
Alcohol & Drug Abuse	X
Cardiology	Cardiology
Endocrine	Endocrine
Ear Nose Throat	Ear Nose Throat
Gastroenterology	Gastroenterology
General Medicine	General Medicine
General Surgery	General Surgery
Gynecology	Gynecology
Neonatology	X
Nephrology	Nephrology
Neurology	Neurology
Newborn Births	X
Obstetrics	Obstetrics
Oncology	Oncology
Open Heart	Open Heart
Ophthalmology	Ophthalmology
Orthopedics	Orthopedics
Psychiatry	X
Pulmonary	Pulmonary
Thoracic Surgery	Thoracic Surgery
Urology	Urology
Vascular Surgery	Vascular Surgery

Figures

Figure 1 Aggregate annual cardiac patients by block group, with South Carolina hospital locations

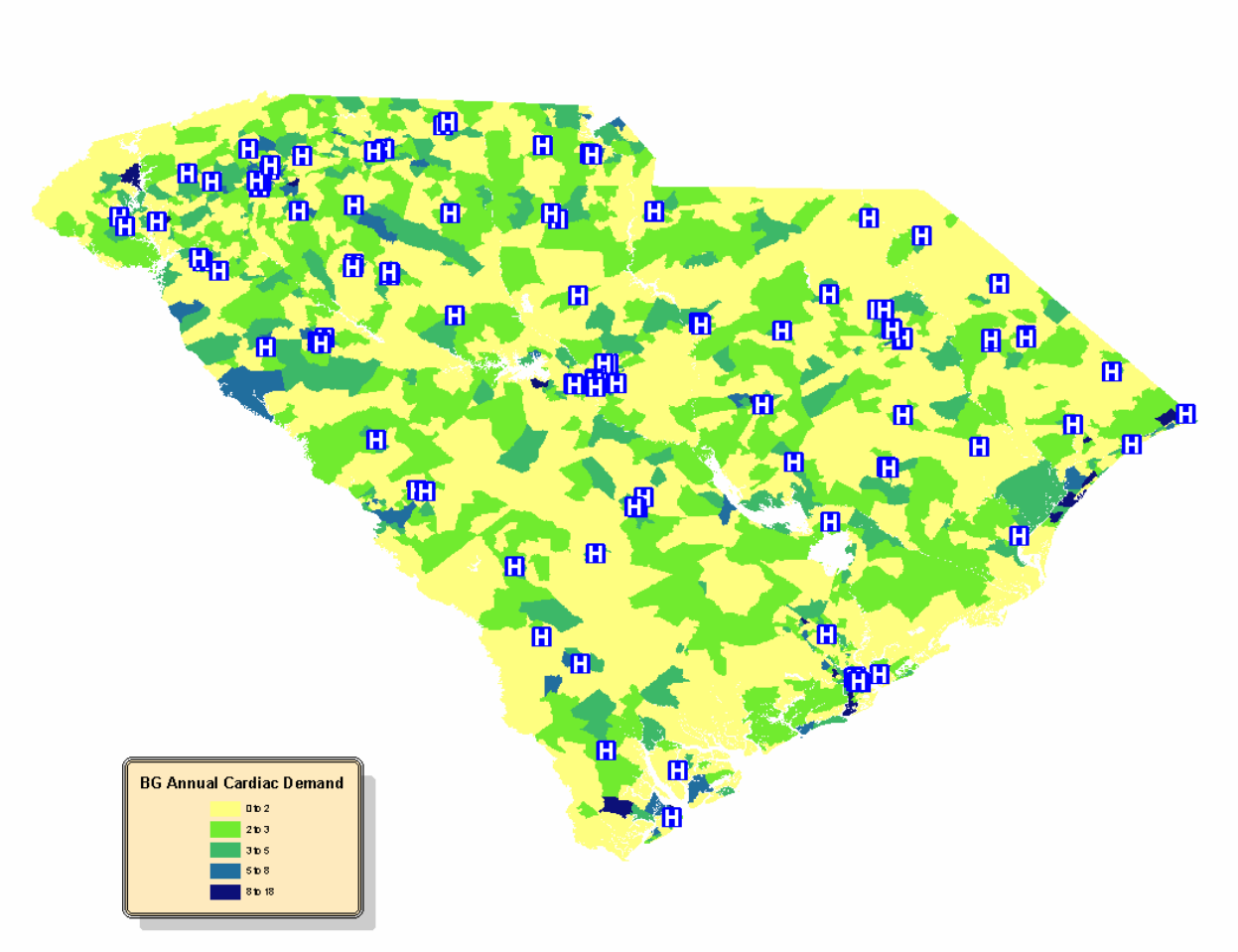


Figure 2

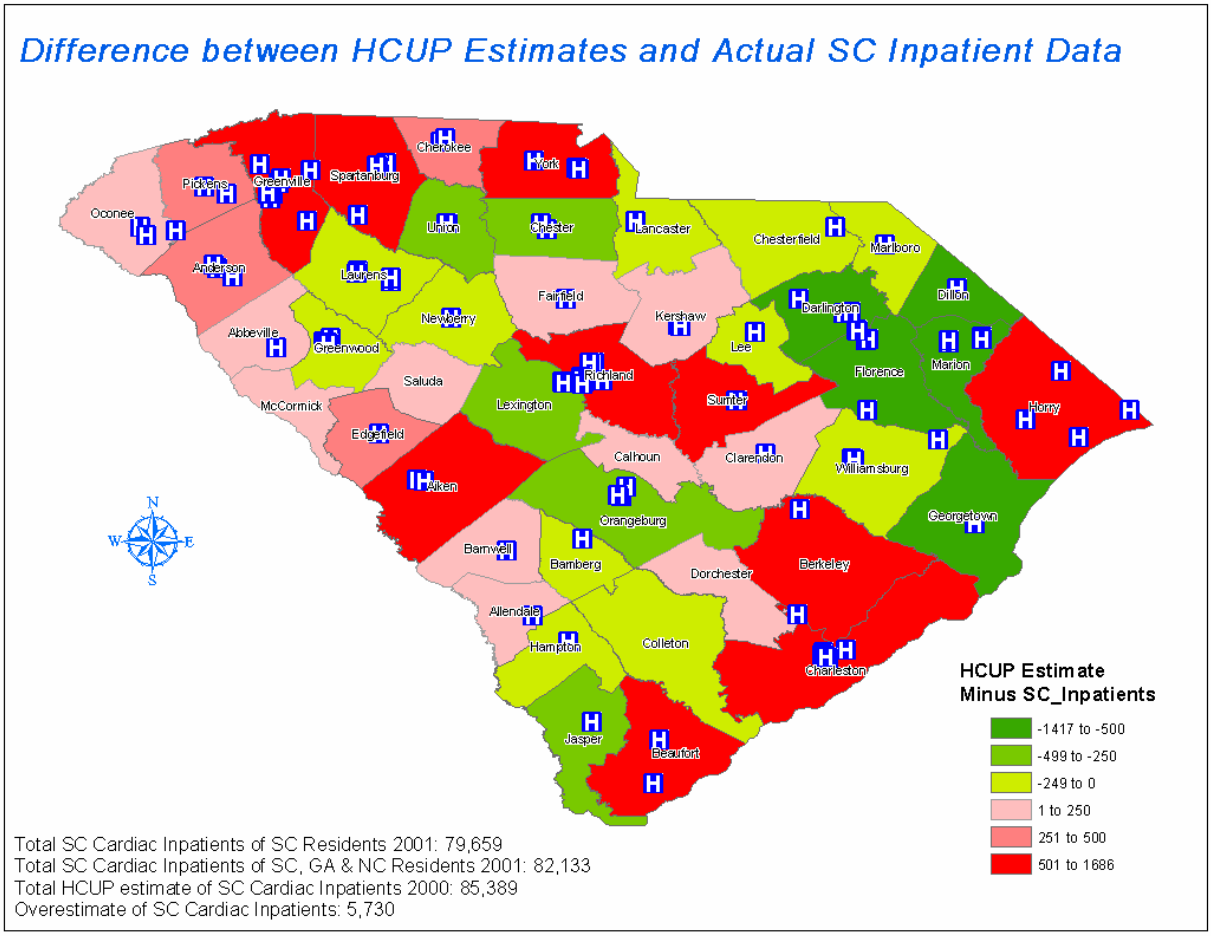
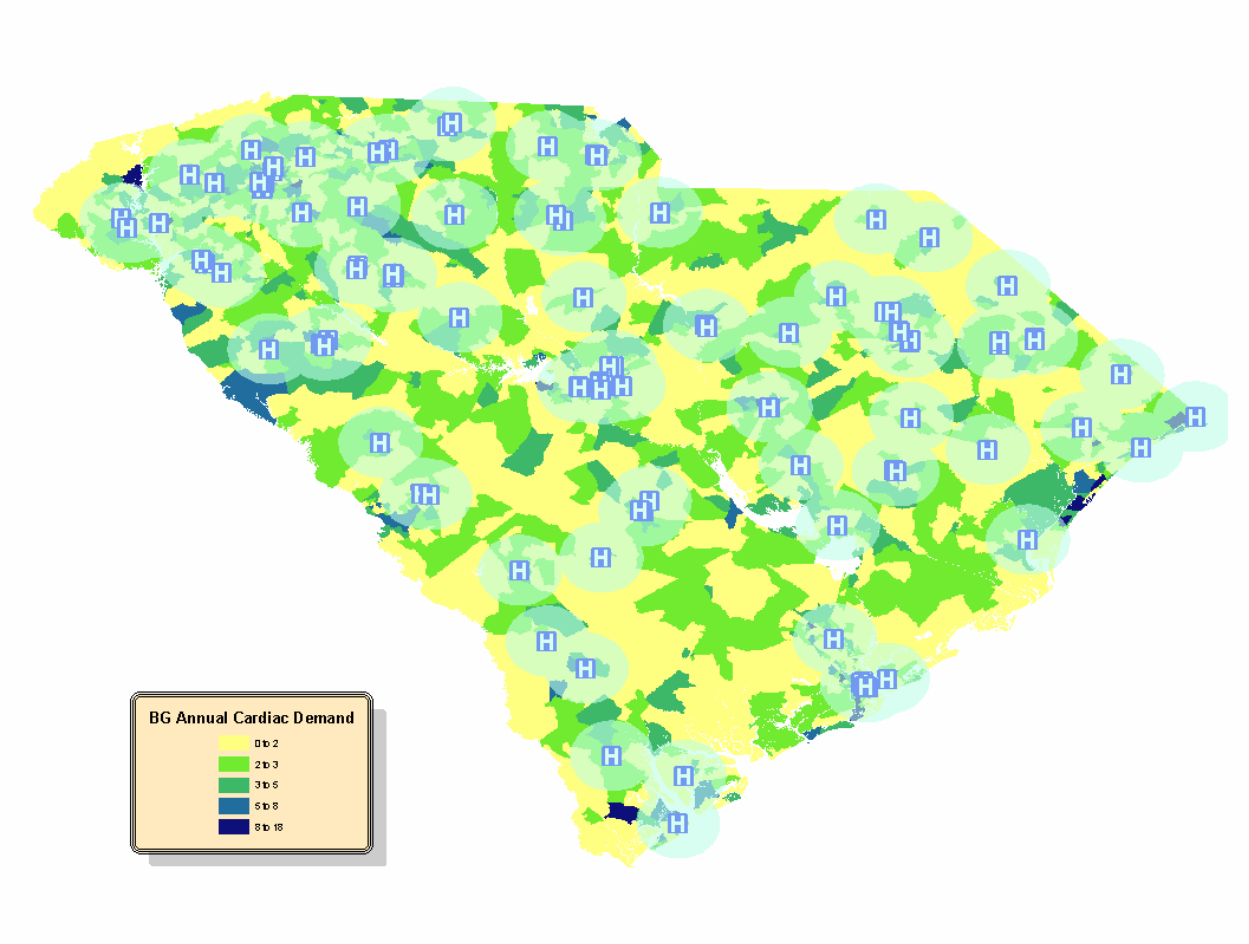

Difference between HCUP Estimates and Actual SC Inpatient Data
Cherokee
York
Pickens
Greenville
Spartanburg
Oconee
Union
Chester
Lancaster
Chesterfield
Marlboro
Anderson
Laurens
Fairfield
Dillon
Newberry
Kershaw
Darlington
Abbeville
Greenwood
Lee
Marion
Florence
Saluda
Richland
Horry
McCormick
Lexington
Sumter
Edgefield
Calhoun
Clarendon
Williamsburg
Aiken
Orangeburg
Georgetown
Barnwell
Bamberg
Berkeley
Dorchester
Allendale
Hampton
Colleton
Charleston
Jasper
Beaufort
N
W
E
S
HCUP Estimate
Minus SC_Inpatients
-1417 to -500
-499 to -250
-249 to 0
1 to 250
251 to 500
501 to 1686
Total SC Cardiac Inpatients of SC Residents 2001: 79,659
Total SC Cardiac Inpatients of SC, GA & NC Residents 2001: 82,133
Total HCUP estimate of SC Cardiac Inpatients 2000: 85,389
Overestimate of SC Cardiac Inpatients: 5,730

Figure 3 Ten Mile Buffer of South Carolina Hospitals



Of the 79,659 actual cardiac inpatients in 2000, 17,653 (22 percent) were not within ten miles of a South Carolina hospital – let alone a facility that specializes in cardiac care.

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