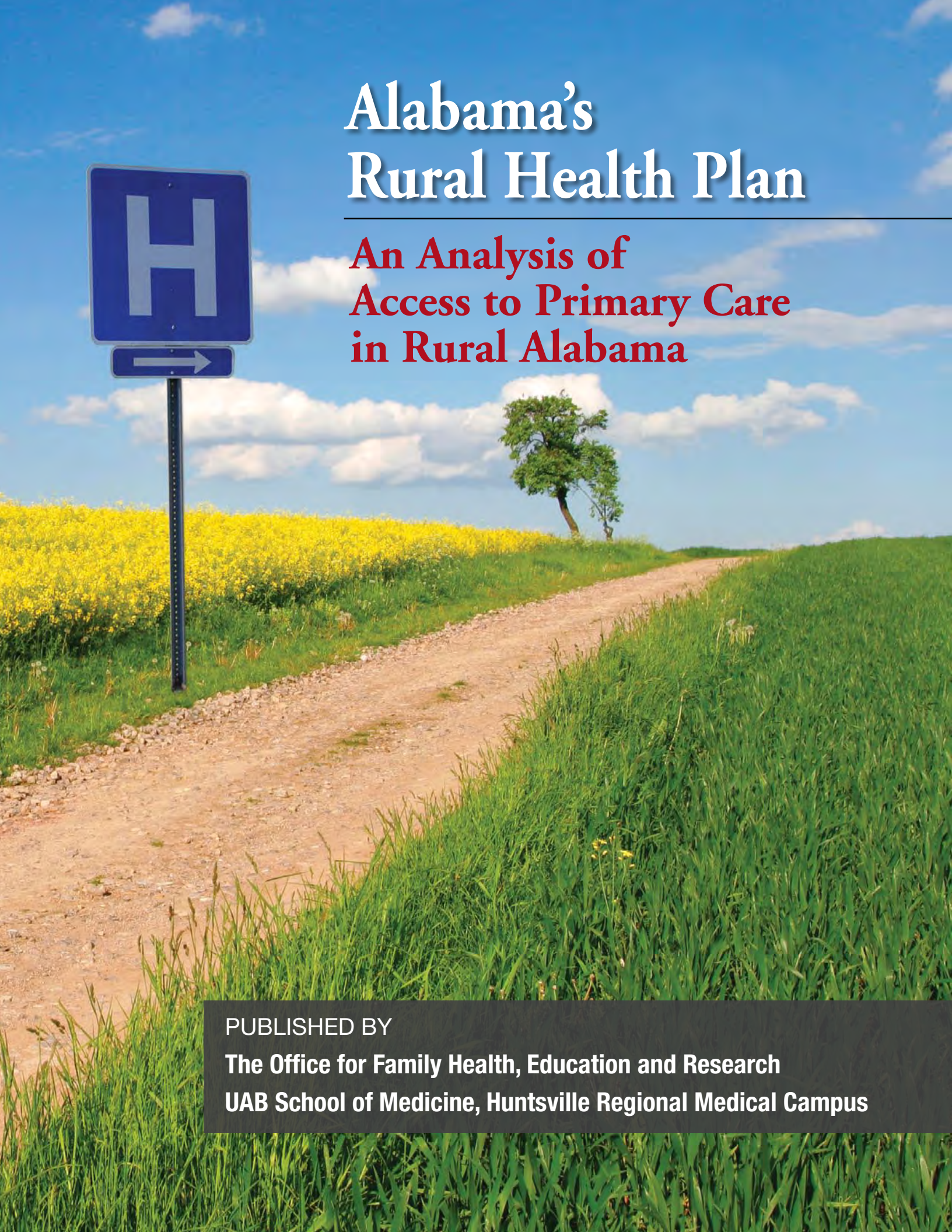

Alabama's Rural Health Plan

An Analysis of Access to Primary Care in Rural Alabama

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The Office for Family Health, Education and Research
UAB School of Medicine, Huntsville Regional Medical Campus

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About the Office for Family Health, Education and Research

The Office for Family Health, Education and Research provides an infrastructure where opportunities for research in education, policy, clinical medicine and other scholarly works in primary care can flourish. The office produces and disseminates practical clinical information to primary care physicians, coordinates and conducts studies that deal with the health care education of medical students, primary care physicians and families, as well as the broader issues of state health policy, health access and health manpower. The office is an entity within the UAB School of Medicine, Huntsville Regional Medical Campus academic organization and is directly responsible to the Associate Dean for the Huntsville Regional Medical Campus. The office manages the Project to Recruit Rural Medical Students, a program that is based on the "pipeline" concept for recruiting rural students into the medical profession; the Huntsville Rural Pre-medical Internship, an 8 week summer pre-medical experience for rural pre-medical undergraduate students; and the Rural Medicine Program, a special UAB School of Medicine rural student admissions and education curriculum.

Areas of interest include:

Education:

- The production and implementation of practical education in medical management of patients in the ambulatory setting.
- The development and implementation of programs for improving access to health information for rural practitioners, non-urban communities, and individual families.
- Education of pre-medical students and medical students in the areas of rural medical practice, rural life styles and rural experiences.

Health Access:

- The development of a model for a statewide physician workforce database to serve as the basis for developing state health manpower policy and physician workforce research.
- The development of a rural workforce model that will increase access to healthcare for non-urban and underserved families.
- To increase the number of family physicians in non-urban Alabama through the development and implementation of a rural physician pipeline.

Health Policy:

- Study the impact of reimbursement paradigms and state legislative initiatives on the non-urban family/primary care physician workforce.

Study Aims

Purpose

The purpose of this study is to present a plan for improving the health status of Alabama's rural citizens using a model for rural primary care access that addresses access to primary care at the community level while at the same time giving direction and allowing coordination at a state level.

Specific Aims

1. To assess the health status of Alabama's rural population.

2. To determine the barrier(s) to improving the health status of Alabama's rural population.

3. To determine the assets needed to overcome the barriers that are preventing the improvement of the health status of Alabama's rural population and to present the rational for the approach used.

4. To present a methodology that has the capacity to analyze, model, and make projections at specific geographical locations using the population demographics, spatial allocations and provider assets at that location.

5. To determine appropriate locations for primary care points of access that allows rural Alabamians to have access to primary care.

6. To determine the asset needs specific to each primary care point of access.

7. To produce a model that can be used to enhance and coordinate Alabama's current rural initiatives and stimulate new initiatives.

Executive Summary

A comparison of the health status of Alabama's citizens to nationally recognized health status indicators show that rural Alabamians do not compare well with the U.S. as a whole or even with Alabama's urban population. Alabama's rural residents have significantly poorer outcomes than urban residents. While there are multiple and diverse barriers to improving the health status of Alabama's rural residents, the most significant and universal is their inability to access a primary care physician and more specifically a family physician. Removing this barrier is dependent on having sufficient family physicians (availability) at appropriate locations throughout the state (accessibility) to meet the primary care demands of Alabama's rural population. Global observation of the geographic location of Alabama's rural hospitals and their associated communities indicate that they are spatially positioned in the state to serve as centers for primary care access.

To confirm that rural hospitals are, in fact, the appropriate service points for Alabama's rural population and to determine the number of family physicians needed at each of these locations this study used GIS technology and spatial analysis to create a spatial accessibility model unique for each of 99 general hospital locations in Alabama. This model used the known health care assets (family physicians); the population demographics and driving time impedance, along with the practice variables panel size and office visits to make demand a function of local census derived population data. Spatial analysis was then used to create area/provider ratios which in turn were used to create bands of accessible populations at these locations. GIS software was then used to analyze the bands of influence and characteristics that fall within and outside of those bands to determine the family physician need at each of these 99 locations.

Findings

An extensive review of the health outcomes literature relative to primary care services, primary care access and primary care providers finds that patients of primary care physicians had better health outcomes regardless of the geographic area, year or outcome measured. Traditionally derived physician/population ratios using the 2012 medical licensure data base and the 2010 Alabama census data finds that the supply of primary care physicians in rural Alabama is inadequate to meet the current rural population demand, thus making access to a primary care physician a major barrier to improving the health status of Alabama's rural citizens. Literature review also finds that the primary care physician with the most extensive impact on population health outcomes is the family physician.

A geographical survey of medical facilities and primary care providers in rural Alabama found that the most appropriate medical facility to serve as a center for rural accessibility is the rural hospital. The rural hospital is also the community resource that historically and currently is the major recruiter of family physicians to rural communities. Review of the 2010 medical licensure data base finds that the most available primary care physician practicing in communities where rural hospitals are located are family physicians.

Applying spatial accessibility analysis to the location of Alabama's general admission hospitals and using the family physicians located within a 20 minute driving time of each hospital as their primary care assets finds that Alabama's rural hospitals are geographically located and spatially distributed within the state to allow Alabama's rural population physical access to a family physician. To meet the population demand for family physicians, this study shows that Alabama currently needs and additional 76 family physicians in 25 locations throughout the state. Of the 25 locations where family physicians are needed 23 are in rural Alabama. Mapping of coverage bands for metropolitan hospitals show that metropolitan coverage bands have no significant effect on rural populations.

Conclusions

Community oriented access to primary care through a relationship with a family physician is the most functional and practical way to improve the health status of Alabama's rural population. The communities in which Alabama's rural hospitals are located are spatially distributed throughout rural Alabama in a manner that allows Alabama's rural residents physical access to a family physician. Rural hospitals are the most essential resource for recruiting, retaining and supporting the rural family physician. In this model rural hospitals are the geographic locations for primary care access and family physicians managing 2,650 person panels are the availability assets at each of these sites. A rural health plan based on a family physician/rural hospital model for access to primary care as described in this presentation is realistic and achievable. It directs Alabama's current rural physician pipeline activities and sets the stage for expansion and addition of activities to recruit and educate a cohort of rural students to be family physicians, while identifying and designating the rural communities where state and federal resources can be utilized with local resources to maximize recruitment and retention of family physicians. In short, this model provides a foundation for expanding our current primary care coverage in general and to pursue more in-depth analysis of workforce issues and barriers to primary care access based on the micro-populations at individual rural sites. It identifies local strengths and needs and gives focus for developing public and private partnerships, rural public policy, legislative support, pilot projects and rural outcomes research. It gives direction to rural educational programs.

LIST OF FIGURES and TABLES

Key to Abbreviations

APR – area/provider ratio

ARHA – Alabama Rural Health Association

BMSA – Board of Medical Scholarship Awards

CPC – Center for Primary Care

FP – family physician

GIS – geographic information system

OVD – office visits per day

PCHSPA – primary care health professional shortage area

PCP – Primary Care Physician

PVD – provider visits per day

RHCPC – rural hospital center for primary care

SA – spatial accessibility

UABSOM – University of Alabama at Birmingham School of Medicine

VPY – visits per patient per year

SECTION ONE

Health Status of Rural Alabama

Alabama is experiencing a crisis in the health of its citizens statewide and more specifically among rural Alabamians. The health status of Alabama's citizens is well documented in the Alabama Rural Health Association monograph "Alabama Community Health Resource Guide". The data from this report demonstrates that Alabama's rural residents do not fare as well as the either the U.S. population or Alabama's urban population. For example, one of the most widely recognized indicators of health status, life expectancy, shows that a rural Alabamian born in 2005 is expected to have a lifetime that is more than six months shorter than an urban Alabamian and 3.5 years shorter than that expected for residents of the United States as a whole (Alabama Center for Health Statistics, 2005). The disease specific health status data in Table 1 supports and emphasizes the seriousness of rural Alabama's health crisis (The Alabama Community Health Resource Guide, 2008).

TABLE 1

In rural Alabama, deaths from cervical cancer are 56 percent higher than the U.S as a whole and 30 percent higher than non-rural Alabama,

In rural Alabama, deaths from prostate cancer are 40 percent higher than the U.S., and 26 percent higher than non-rural Alabama,

In rural Alabama, diabetes-related deaths are 25 to 44 percent higher than the U.S. and 5 to 18 percent higher than non-rural Alabama,

In rural Alabama, deaths from heart disease are from 52 to 83 percent higher than the U.S. and 47 to 78 percent higher than non-rural Alabama,

In rural Alabama, deaths as the result of strokes are 64 percent higher than the U.S. and 56 percent higher than non-rural Alabama.

The reasons for the health disparity between Alabama's rural and urban residents are multiple and diverse. The 2008 Alabama Community Health Resource Guide identifies a number of socio-economic factors (such as, education, age, ethnic diversity, personal wealth, insurance coverage, and transportation issues) which differ between urban and rural populations and have traditionally been associated with a population's health status. While these socio-economic factors undoubtedly can have an impact on the health status of Alabama's rural residents, they are of little consequence if rural Alabamians cannot physically access health care services and the providers of health care services.

SECTION TWO

Access and Availability

There are several ways that access can be defined in terms of healthcare. These definitions can include the act of using healthcare, receiving healthcare, the actual delivery of care or it can be defined as Guagliardo did in his 2004 article “Spatial accessibility of primary care; concepts, methods and challenges”, where he defines access by presenting it in terms of stages and dimensions. The stages are “potential” for delivery of care, followed by “realized” delivery of care.

The former exists when a population in need is present at the same location with a willing and able healthcare delivery system. The latter follows when all barriers to “potential” for delivery of care are overcome. A number of barriers can impede the delivery of care and progression from potential to realized delivery of care. Penchansky and Thomas, in their 1981 article “The concept of access”, grouped existing barriers to health care into five dimensions: affordability, acceptability, accommodation, availability and accessibility.

While barriers to healthcare in rural Alabama are multiple and diverse, they can be categorized by the five dimensions described by Penchansky and Thomas. The relationship between health care cost (affordability) and utilization has received a lot of attention in the U.S and Alabama. Overcoming this barrier is dependent on healthcare financing arrangements at the national level (The Patient Protection and Affordable Care Act of 2010) and is beyond the capacity of an Alabama rural primary care access plan. Should there be national changes in healthcare financing, Alabama should have a plan for dealing with increased utilization of primary care services by its rural citizens. Cultural differences (acceptability) and personal preference (accommodation) are barriers to realized delivery of care that cannot be addressed until potential for delivery of care barriers have been removed (Figure 1).

Figure 1: Relationship of barriers to health care

Accessibility and availability are potential delivery of care barriers. These two dimensions are spatial in nature. Accessibility is travel impedance (distance or time) between consumer location and service points. Availability can be either the number of service points from which a consumer can choose or the presence of a provider at a service point or having an adequate number of providers at a service point to serve the population. In this presentation, access refers to the potential for delivery of care and the focus will be on accessibility and availability in the context of service point location and travel impedance and having enough providers at a service point to service the population.

Accessibility: the Rural Hospital

One of two essential considerations for achieving rural health care access hinges on the location of points of service. The service points must be located where they are geographically accessible to rural Alabamians (travel impedance) and spatially distributed throughout the state in a manner that provides physical access to the state's entire rural population. For identification and discussion, each of these service point locations will be termed a Center of Primary Care (CPC).

Looking at the standard Alabama road map from a global perspective, it is apparent that Alabama's networks of highways converge on population centers in a pattern that makes them convergent points or hubs for Alabama's road system. Birmingham is seen as the largest and most extensive road system hub in Alabama, but clearly the map shows that there are multiple regional hubs. This pattern progresses to smaller and smaller population centers (traditionally designated by population density as cities, towns, small towns, and communities). This pattern continues in Alabama's less populated areas – rural Alabama. It identifies certain rural communities as convergent points or hubs for local road systems.

When the locations of Alabama's rural hospitals are overlaid on a map of Alabama, a number of rural hub communities are identified as having both travel access to surrounding rural areas and appear to be spatially distributed throughout the state to provide access for Alabama's rural population (Figure 2). In addition these same communities serve as non-urban commercial and government centers (70% house the county courthouse) The rural hospitals located in these communities also meet both of these spatial requirements of a point of service and in most cases, they not only meet these requirements, but have been the historical and traditional centers for medical care. Since these communities are currently convergent points for Alabama's rural highway network, this geographically positions rural hospitals in these communities to be points of access for primary and secondary medical services for local residents who already access non-medical services at these locations (Figure 3).

The rural hospital influences access to medical care services in several ways beyond its physical location. It is the common denominator of the rural physician workforce. Just as physicians in urban areas tend to cluster around hospitals, in rural Alabama they tend to locate in communities with hospitals and this is especially true of primary care physicians (PCPs). Rural hospitals supply PCPs with immediate access to back-up services and resources that support their primary care practice (such as emergency services, laboratory services, hospital services). This close relationship also allows for minimal driving time and/or distance for patients to obtain services not offered by the physician and for the patient to access back-up services (Figure 4).

Figure 2: Locations of Alabama's general admission hospitals

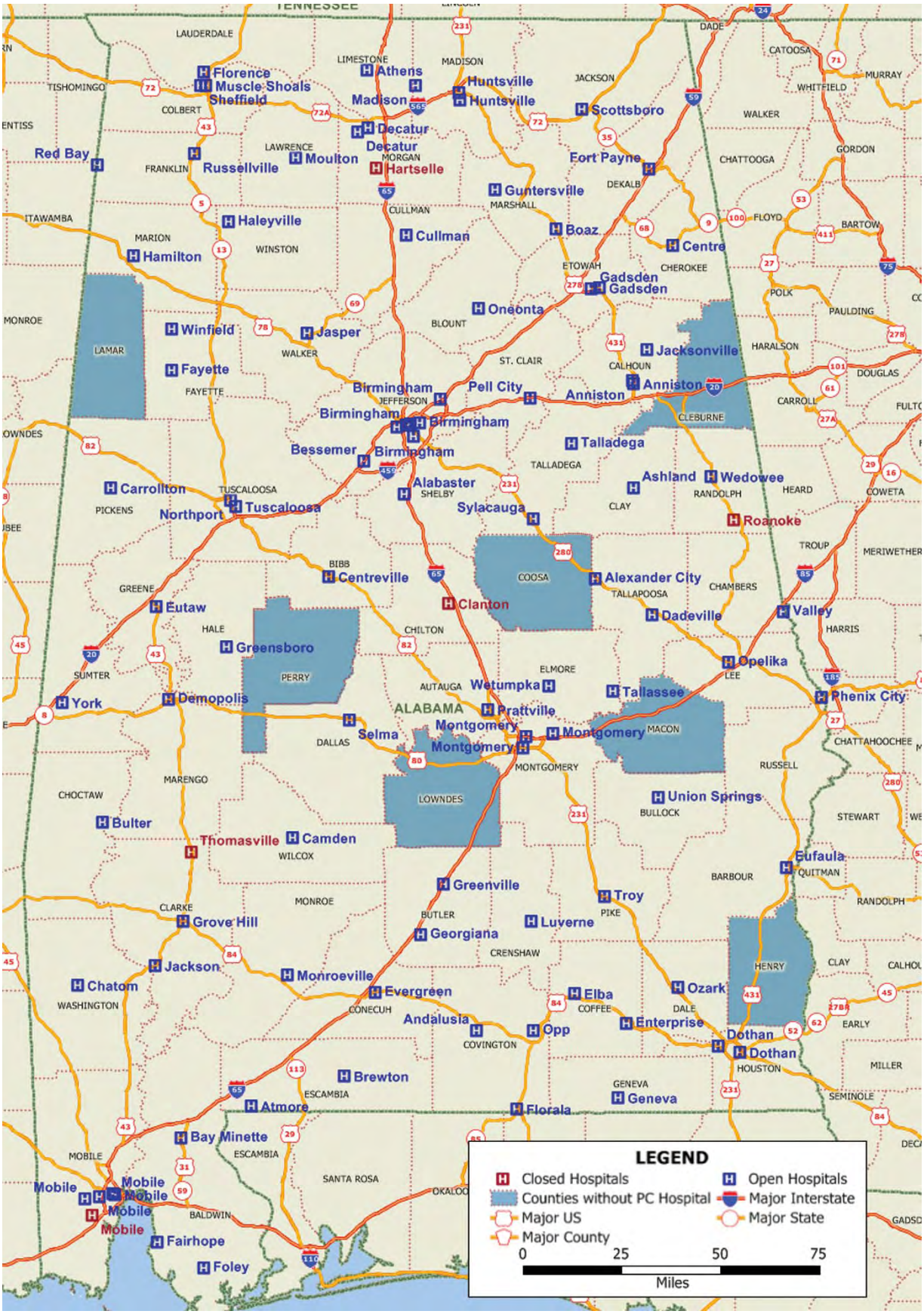
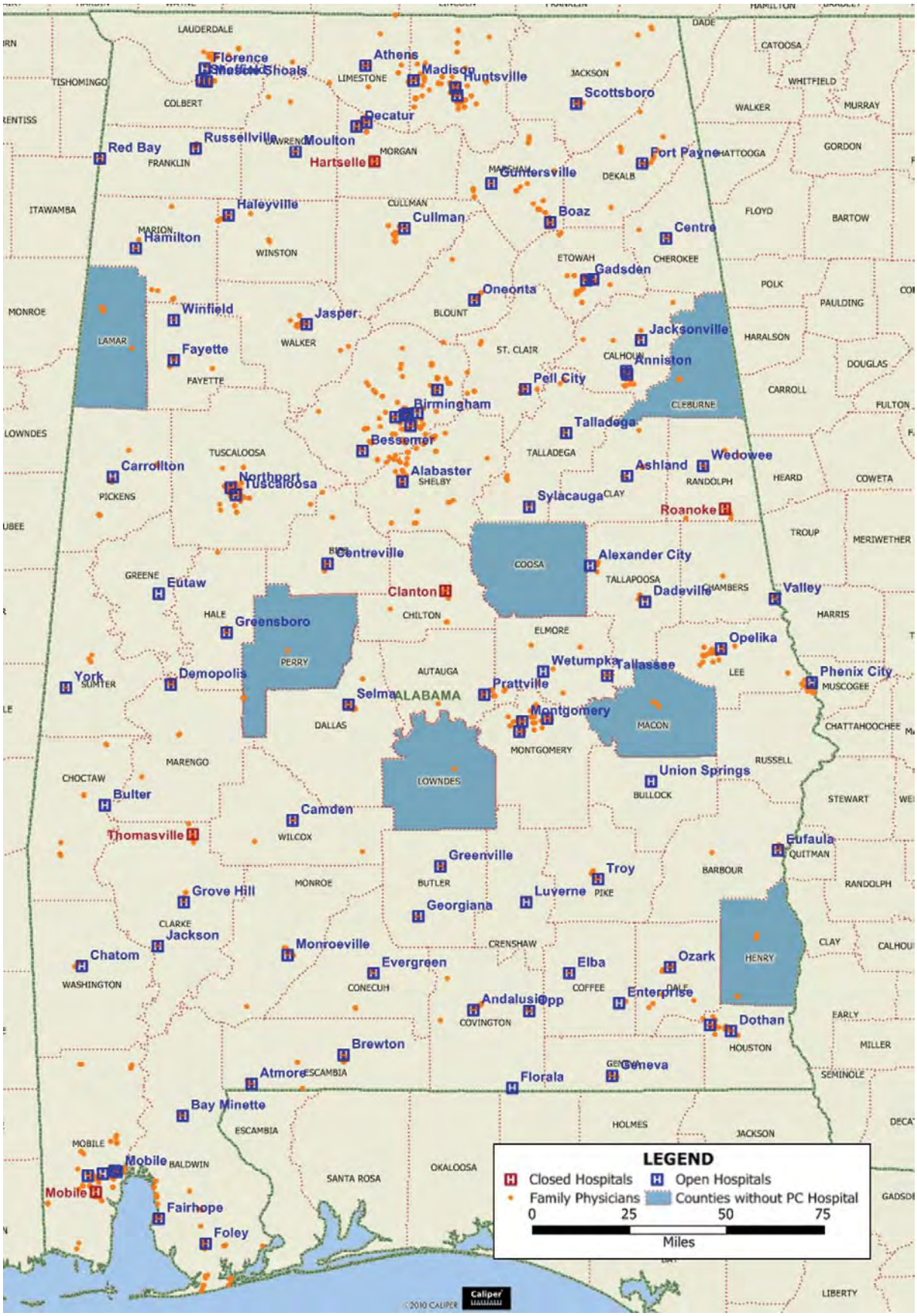


Figure 3: Camden, AL and John Paul Jones Hospital demonstrating the converging road network

Figure 4: Alabama Hospitals with Family Physicians



Rural hospitals are Alabama's major recruiters of physicians, especially PCPs, to rural practice. Also their economic impact on the community serves as a secondary recruiting tool as they are often the largest or second largest employer in the community (Rickets and Heaphy, 2000). This results in an economic impact on the level of cultural, educational, and recreational assets within a community. The significance of increased cultural, educational and recreational opportunities in a community relative to physician recruitment is supported by a study of 1,012 family medicine residents about which factors influence their choice of an initial practice site. This study found that recreational and cultural opportunities were among the top reasons for family physicians choosing a site to start their practice (American Academy of Family Physicians [AAFP] Committee on Rural Health, 2002).

The interaction between rural hospitals and PCPs enhances the rural hospital's status as a CPC due to the integration of PCP's primary care services with the non-primary care physician services that they provide at these hospitals. Studies have shown that family physicians provide a significant portion of maternity, labor and delivery, and inpatient newborn care in rural hospitals (Cohen 2003 a & b). Family physicians also provide a significant percentage of emergency department care in rural America (Peterson et al., 2006).

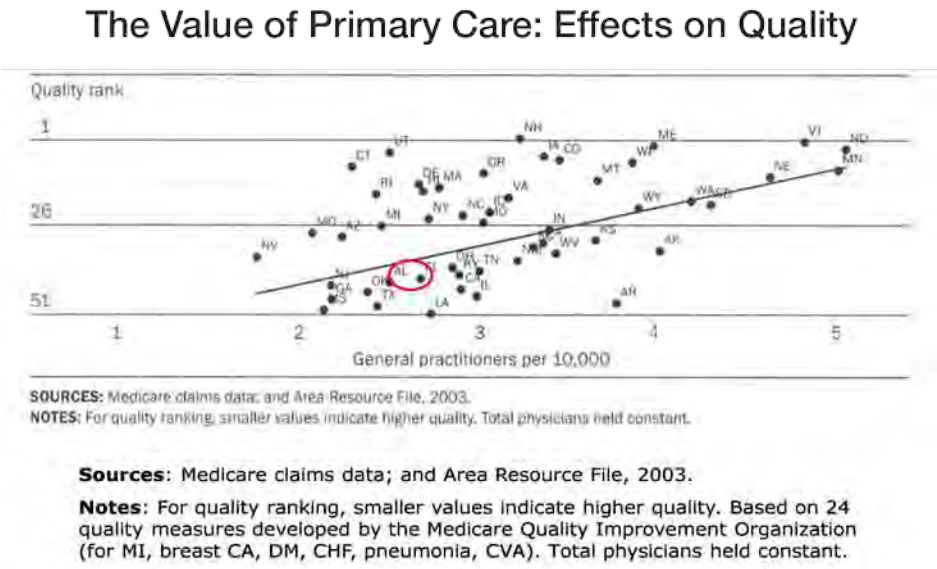
Geographical access, spatial distribution, current numbers of PCPs at rural hospital locations, recruiting abilities and known economic impact combine to make Alabama's rural hospitals the most logical entities to designate as rural Centers of Primary Care.

Availability: The Primary Care Physician

The second of the two essential considerations for rural health care access is having enough providers at the service point to service the population. However, before one can determine the number of providers needed at a CPC, one must determine the appropriate provider(s) to place at rural CPCs. Current consensus in the literature is that the most significant factor affecting a person's health status is having access to a PCP (Starfield et al., 2005).

Review of the literature also shows that preventive medicine has a considerable impact on a person's health status and it has been shown that preventive services are more likely to be given to patients of PCPs and that those patients also receive better management of chronic illnesses (Safran et al., 1998). Starfield's literature review on the impact of primary care on health outcomes found that in general a higher ratio of PCPs was related to lower hospitalizations, better self-reported health, longer life span, better health outcomes, and increased quality of health care services. This was the case no matter the geographic area, year or outcome that was measured. Higher ratios of PCPs have also been demonstrated to equate to lower rates of all causes of mortality, especially lower rates of mortality from heart disease, cancer and stroke, as well as infant mortality (Shi 1994). The effect of access to primary care services on health status is further emphasized by several studies that have shown a link between primary care and improved health outcomes. A study done by Roetzheim and colleagues in 1999, showed that at a county level, for every 0.1% increase in the number of PCPs the odds of being diagnosed with late-stage colorectal cancer decreased by 5%. In contrast, the same study showed that for every 0.1% increase in the number of specialty physicians the odds of late-stage cancer diagnosis increased by 5%. Primary care access has also been linked to better outcomes in breast cancer diagnosis, where it was shown that every 0.1% increase in PCP supply results in a 4% increase in the early detections and diagnosis of breast cancer (Ferrante et al., 2000). Figure 5 graphically shows the effects of PCPs on quality of care (Morris-Singer, 2010).

Figure 5: The relationship of primary care physicians to quality of care



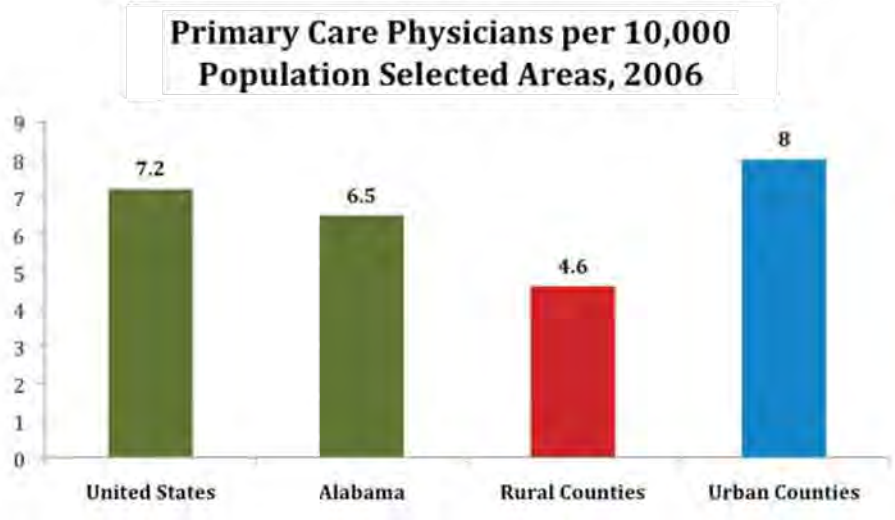
Sources: Medicare claims data; and Area Resource File, 2003.

Notes: For quality ranking, smaller values indicate higher quality. Based on 24 quality measures developed by the Medicare Quality Improvement Organization (for MI, breast CA, DM, CHF, pneumonia, CVA). Total physicians held constant.

Rural Alabama: Primary Care Physicians

As the studies cited above have shown, there is a direct correlation to the supply of PCPs and the health of a population. Thus the question, what is the status of Alabama's rural PCP workforce? The Alabama Rural Health Association (ARHA) identifies 60 of 67 Alabama counties including 51 of 55 rural counties as currently having a shortage of PCPs. The ARHA has determined that Alabama needs 128 more PCPs to correct the current shortages and a total of 402 to provide optimum care. In addition, all but 2 of Alabama's counties are listed on the federal list of Medically Underserved Areas (ARHA). In rural Alabama the problem is even worse. According to 2006 data from the Medical Licensure Commission and the US Bureau of Labor Statistics, the ratio of PCPs per 10,000 population for Alabama as a whole was 6.5 compared to 7.2 nationally, however, in rural counties that ratio was 4.6 (Alabama Community Health Resource Guide, 2008), (Figure 6).

Figure 6: Rural Alabama's status relative to access to primary care physicians



This suggests that the rural Alabamians would have more difficulty in accessing a PCP than their urban counterparts. Furthermore, it is likely that the problem will only continue to get worse due to Alabama's aging rural population (Cherry et al. 2010) plus the newly added federal initiatives that increase the pool of individuals seeking conventional primary care services (i.e. rural Alabamians who have not historically had access to conventional primary care) (The Patient Protection and Affordable Care Act of 2010). The latter will significantly increase the number of rural Alabamians who will have the economic ability to access primary medical care further increasing the demand on an already strained system. In addition, more than half of the practicing PCPs in Alabama are over the age of 50 (Medical Licensure Commission, 2012). The current rural PCP shortage and the aging rural PCP workforce is further compounded by inadequate numbers of Alabama's medical school graduates choosing primary care medical careers and ultimately practicing in rural Alabama (Wilder et al., 2010). At the same time, the expected number of office visits to primary care physicians in the state is expected to increase by nearly 1.8 million by 2025 and over 904,000 of these visits will be to rural physicians in the state (The Alabama Community Health Resource Guide, 2008).

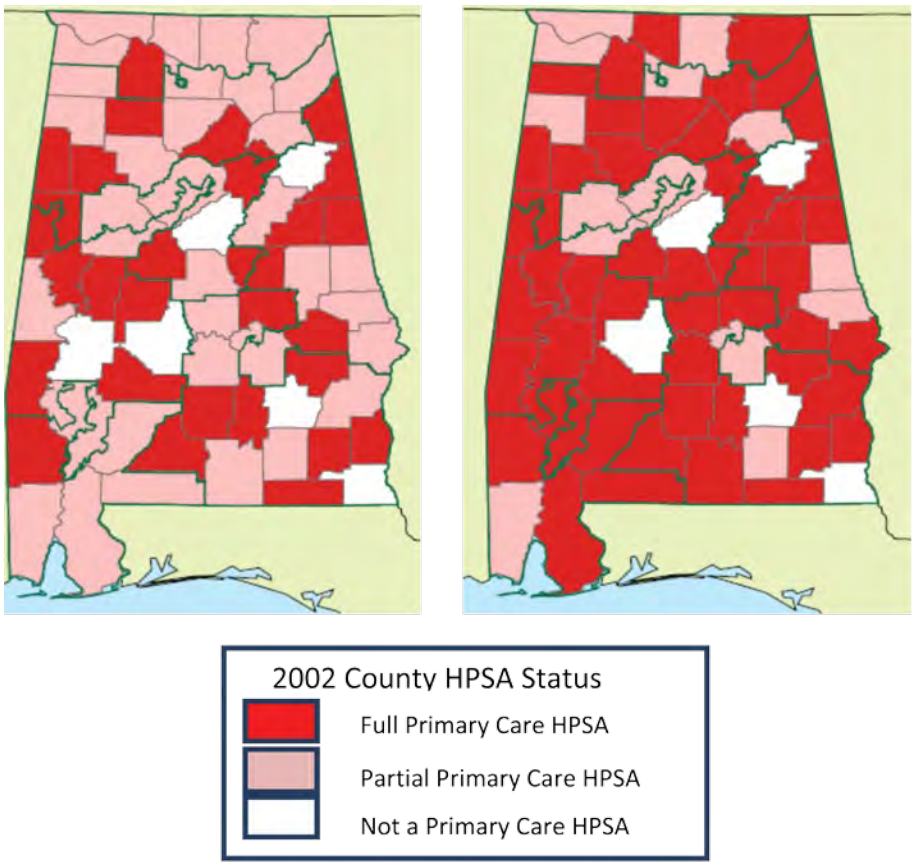
While both demand and supply factors significantly impact any attempts to make adequate access to primary medical care a reality in rural Alabama, at present there is no realistic way to decrease the demand for primary care services. In addition, Alabama's aging rural population alone will increase demand and further pressure the current rural PCP workforce (Cherry et al., 2010), therefore, any strategy to provide adequate access to rural primary care must address the supply factor (i.e. the rural PCP workforce).

Primary Care Physicians: Family Physicians

This analysis focuses on the dimensions of availability and accessibility to rural primary care. Rural hospitals have been identified as appropriate CPCs for physical access (accessibility). The PCP has been identified as the provider of choice to service the population at a CPC (availability). The federal government recognizes PCPs as family physicians, internists, pediatricians, geriatricians and obstetricians/gynecologists. Rural health care planning in Alabama does not generally include obstetricians/gynecologists as rural PCPs. Since there are multiple options available, the major goal of this analysis is to determine the appropriate type of PCP(s) to place at CPCs. The Alabama Board of Medical Examiners 2012 database was used to identify the number and type of PCP(s) at each Alabama Hospital Association determined rural hospital CPC (RHCPC). Analysis of the data from 2012 Alabama Board of Medical Examiners database found that the predominating PCP at all RHCPCs is the family physician.

Family physicians have long been the providers of medical care in rural areas of our country because their geographical distribution matches that of the rural population (AAFP, 2006); also their ability to see any age and any problem make them suitable to serve any part of population (Green et al., 2004). We know that approximately 1/3 of the US population consults with a family physician each year and between the years of 1995-1999, 69% of all office visits to PCPs in Non-Metropolitan Statistical Areas were made to family physicians (Green et al., 2004 and National Ambulatory Medical Care Survey). Nationally, family physicians have the largest impact on whether or not a county is designated as a Primary Care Health Personnel Shortage Area (PCHPSA), which is dependent on the number of PCPs practicing in that county. If family physicians were removed from all the counties in the U.S. then an additional 1,332 of the 3,082 urban and rural counties in the US would qualify as a PCHPSA. Conversely, if all internists, pediatricians, and obstetricians/gynecologists combined were removed then only an additional 176 counties would qualify as PCHPSA counties. (Fryer et al., 2001). If this same process (withdrawal of family physicians from the pool of primary care physicians) were applied to Alabama, the result would be that the current 27 whole county PCHPSAs would increase to 44 and 1 non-PCHPSA county would convert to a full county PCHPSA (Robert Graham Center, Primary Care HPSA Maps) (Figure 7).

Figure 7: Primary care shortage areas: before (left) and after (right) the withdrawal of family physicians



In today's health care scene, primary care services are provided by several different disciplines. Pediatricians and internists serve their corresponding populations. Nurse practitioners and physician's assistants provide limited primary care services appropriate to their training and practice roles. However, the family physician's domain is theoretically all inclusive (Shi et al., 1999). Family physicians are trained to deliver "…comprehensive health care for the individual and family. Family medicine is a specialty in breadth that integrates the biological, clinical and behavioral sciences. The scope of family medicine encompasses all ages, sexes, each organ system and every disease entity" (American Board of Family Medicine Official Definition of Family Medicine); this is in contrast to an internist or pediatrician who only attends adults or children respectively. Thus the delivery of a full scope of primary care services at any rural CPC would require both an internist and a pediatrician to provide the primary care services provided by one family physician. The current and future availability of general internists for rural CPCs is negatively affected by a lack of medical student interest in general internal medicine as a career choice (Hauer et al., 2008).

In addition to the many studies demonstrating that there is a benefit to increasing access to primary care physicians, the benefit of increasing access specifically to family physicians has shown even greater improvements in health outcomes. Access to family physicians results in greater delivery of preventive services, earlier intervention into health issues before they develop into more serious medical conditions, and lower usage of the Emergency Room (Orr et al., 1991). In geographic areas that have high numbers of family physicians per population, there were lower hospitalizations from conditions that typically benefit from preventive services such as diabetes mellitus, hypertension and pneumonia (Parchman and Culler 1994). Advanced cervical cancer has been found to be less in areas where the

ratio of family physicians is favorable. Melanoma is also identified earlier where family physicians are in a high concentration (Starfield and et al., 2005). Though the access to primary care has been shown to lower mortality in many different diseases (Shi 1994), if the effect of the three separate primary care specialties (Family Medicine, General Internal Medicine, and General Pediatrics) is individually studied, then only family physicians have a significant impact on reducing mortality (Shi 2003).

In addition to the health impact family physicians have on a community there is also an economic impact. A study by the Robert Graham Center for Policy Studies in 2007 found that a family physician in Alabama has an economic impact of $776,585 per physician, with a total annual impact of all family physicians in Alabama valued at $779, 691,512 per year. Family physicians in Alabama also employ an average of 5.7 employees per physician.

This information (i.e. spatial distribution, current numbers at specific locations, versatility, quality indicators, and known economic impact) confirms that the most logical and cost effective rural PCP is the family physician (FP). Therefore, the family physician is used as the PCP for this analysis and its projections.

SECTION THREE

Methods and Analysis

Overview

The aim of this Alabama rural primary care access plan is to make physical access to adequate numbers of family physicians available to Alabama's rural residents. Accomplishing this goal requires a methodology that has the capacity to analyze, model and make projections at specific geographical locations (RHCPCs) using the population demographics and FP assets at these sites. The specific objectives to be met are to determine the geographic location of RHCPCs, the FPs available at each location, the demographics and density of the corresponding population, and the number of individuals that a FP can reasonably be expected to manage at each specific site (availability dimension). It must demonstrate that individual RHCPCs are spatially distributed throughout the state in a manner that provides the state's rural population physical access to FPs (accessibility dimension). In addition, it must be capable of determining quantitatively the need for FPs at each RHCPC and have the ability to periodically reevaluate accessibility at an individual RHCPC.

Historically primary care accessibility and availability has been studied using provider to population ratios such as the number of physicians per 10,000 people (Starfield et al. 2005). Census tracts, zip code data, and data on a county level have been used in attempts to develop primary care physician to population ratios that more accurately reflect the adequacy of the supply of primary care physicians in a specific area (Ku et al., 2011; Penchansky and Thomas, 1981). In contrast, this analysis utilizes a spatial accessibility model, where spatial accessibility (SA) is defined as the fusion of accessibility and availability (Guagliardo, 2004). The methodology utilized in this study overcomes the historic weaknesses of studies using data based on provider/population ratios from zip codes, census tracts and counties because these methods do not account for crossing of borders. This methodology overcomes those weaknesses by having the capacity to identify and analyze data relative to any point that can be located on a map. It was developed by Robert Edwards, M.D. at the UAB School of Medicine, Huntsville Regional Medical Campus. In this study, the point on the Alabama map is the location of an Alabama general admission hospital (CPC). This SA methodology accounts for the accessibility dimension by utilizing geographic information systems (GIS) technology in calculating the impedance of travel time to limit projections of available care at individual CPCs. It assigns FP populations to designated CPCs (availability dimension). This methodology, using the unique population demographics at each CPC, predicts the effects of demand on FPs practicing at each of these locations. After developing reasonable predictions of the demand that exists at each CPC, FPs are assigned to prospective CPCs based on their practice proximity. If they practice nearby a CPC, they were assigned to that hospital CPC. By accounting for both supply and demand, this methodology creates a map that identifies locations in need of FPs and locations where competition between FPs exists. By using exact locations for CPCs along with GIS derived population data and drive time data for those locations, this methodology accurately determines areas of need and even quantifies that need. This analysis provides an assessment of where we are today and serves as a template for decisions that will affect how we adapt to meet the demand for the future.

Converting Hospital Centers of Primary Care to Centroids

Alabama's rural hospitals have been designated as rural centers for access to primary care (RHCPCs) using a visual assessment of their locations on an Alabama road map. Quantification of the population demographics, FP assets and spatial dimensions at individual RHCPCs cannot be evaluated in a meaningful way without simultaneous consideration of the same data at all CPCs, rural and non-rural or metropolitan. The Alabama Department of Public Health website Health Facilities Directory was used to identify all of Alabama's hospitals and their locations. The information on each hospital's website was reviewed and 99 hospitals* were determined to be general admission hospitals. Each hospital was located on the Alabama state map (via latitude and longitude) and viewed for their spatial distribution within the state of Alabama using the geographical information system (GIS) software, Maptitude version 6.0. The Maptitude GIS software identified each hospital's physical location as a specific point. The mathematical modeling term for this point is a *centroid*. Each hospital CPC centroid was then denoted within the GIS mapping tool.

Maptitude GIS version 6.0 is a commercial geographic information system software package for spatial analysis. It is a combination of software and geographic data that includes the 2010 United States Census data. Its geographic analysis tools can automatically create *bands* around any number of map features and analyze the characteristics of those areas, such as population density and population demographics. The bands may be created based on time, distance or other attributes of the U.S. Census and geographic data bases stored in the software.

Centroids Population Density and Demographics

Maptitude GIS version 6.0 houses the 2010 Census data and the spatial analysis tools to extract centroid based population density and demographics data for each CPC/centroid. This information was used to develop individual centroid FP/population ratios as needed. The population was sampled at a 15 mile radius, which represents the statewide average mile radius for a 30 min driving time, from each centroid, based on age. These demographics will serve as the raw data to calculate provider panels.

Panel Size and Provider per Population Ratios

Knowing the number of patients that a FP can be reasonably expected to manage (panel size) is the cornerstone of this SA model. Knowing panel size is basic to determining the availability, quantifying access and being able to delineate local need at CPCs. To ascertain this, two dimensions were allowed to vary with demographic variation: *office time visit* and *visits per patient per year*. According to Murray et al,2007, the panel size can be calculated from predictions of *visits per patient per year* (VPY), *provider visits per day* (PVD), and *provider days per year*.

Panel Size × Visits per Patient per Year = Office Visits per Day × Provider Days per Year

Provider days per year were set at 240 days and *hours with patients per day* was set at 8, which is a standard estimation for studies based on availability (Guagliardo 2004). *Office visits per day* (OVD) were determined by first calculating *minutes per office visit*, where *minutes per office visit* were allowed to become a function of the each centroid's population's age distribution. Office visit time was arbitrarily set at 15 minutes per office visit for 0-45 years of age (yoa), 20 minutes for 45-65 yoa, 25 min for 65-75 yoa,

*This number includes 3 hospitals that have closed since this method was developed. We kept these locations in our analysis because they will likely reopen and the family physicians assigned there are still located there.

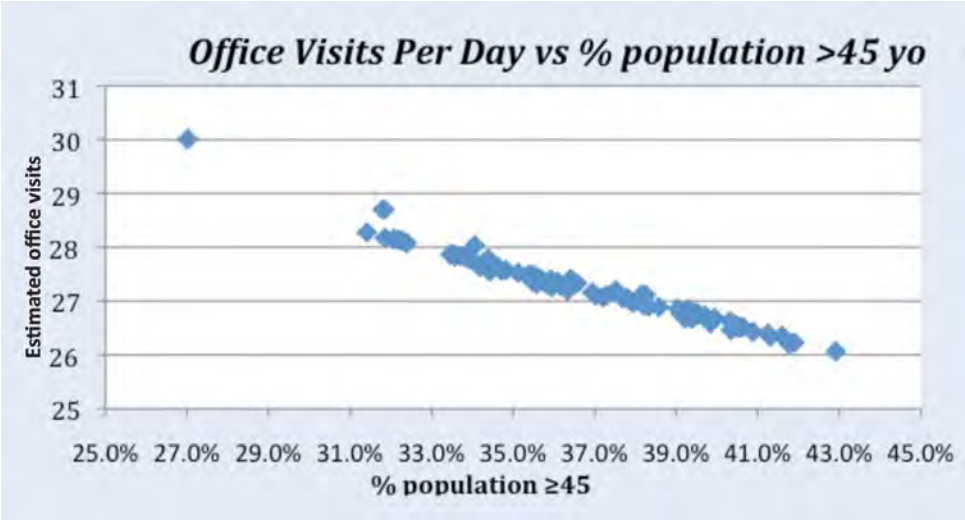
and 30 min for 80 yoa and above. Age-determined visit lengths allow one to individualize predictions of office visit time by making them a function of their specific populations, in this case, the population at each centroid. Office visits per day were then determined by the following relation:

$$\textit{Office visits per day} = \sum_{k} \textit{(Hrs with patient per day)} \frac{\textit{(Minutes per office visit)}_k\textit{(\% population)}_k}{\textit{60 min}}$$

Where *k* is the differing age groups.

The effect of age on *office visits per day* is shown in Figure 8. Figure 8 shows the variation of office visits per day as a function of % population over 45 yoa among the general admission hospital centroids. The mean *office visits per day* using this technique was 27 with a 95% confidence interval of 26.88 to 27.12.

Figure 8: Office visits per day vs % population > 45 yoa using a graduated age-based scale of increasing office visits



Knowing the percentage of age groups in the population at each centroid, the *visits per patient per year* (VPY) at each centroid were then determined, by estimating coverage based on techniques that address the effects age and sex have on the number of patients a provider can be expected to manage (Murray et al, 2007). This "likelihood factors" for age and sex were applied to the specific age and sex demographics at each of the 99 centroids and the estimated VPY for a provider (FP) in each specific population field was determined by the following relations:

$$\mathrm{VPY}_{male} = [\sum_{j} \textit{(\% of age group in the population)}_j \textit{(Murray factor for each age group)}_j]_{males}$$

$$\mathrm{VPY}_{female} = [\sum_{j} \textit{(\% of age group in the population)}_j \textit{(Murray factor for each age group)}_j]_{females}$$

$$\mathrm{VPY}_{total} = \textit{(\% of population male)}(\mathrm{VPY}_{male}) + \textit{(\% of population female)}(\mathrm{VPY}_{female})$$

Using this data (Murray derived VPY) plus VPD and *provider days per year* centroid based population panels were independently generated at each of the 99 centroids that represented the number of people that a FP could be reasonably expected to manage based on the population demographics and population density at each centroid. In addition, the centroid Murray based VPYs were summed and a mean VPY calculated. The mean VPY was 2.47 office visits per year.

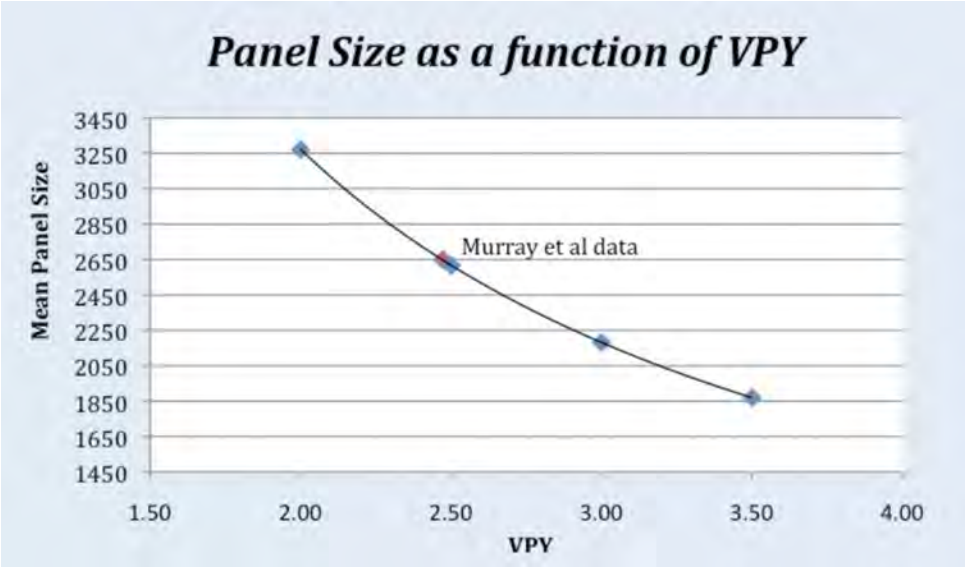
The Murray VPY estimation was tested to see if it correlated well with our population dynamics. We arbitrarily chose patient VPYs of 2.0, 2.5, 3.0, and 3.5 and used each of the four VPYs experimental values for panel size at each centroid to calculate a mean panel size for each VPY. In this comparison, *minutes per office visit* were allowed to vary based on the specific population demographics of each centroid for each method of estimating VPY. Table 2 lists mean predicted values for panel sizes along with Murray's clinic based panel size estimate.

Table 2: Mean panel size variation. * Murray et al., 2007 data

VPY	Mean Panel Size	95% Confidence Variation	Standard Deviation
2.00	3271	14.7	74.6
2.47*	2650	27.6	139.9
2.50	2617	11.8	59.7
3.00	2181	9.8	49.7
3.50	1869	8.4	42.6

The five mean panel sizes were plotted against their VPYs (Figure 9). The regression of these VPY values with their predicted panel size was nearly a linear regression. This confirms the appropriateness of the Murray based methodology for estimating panel size based on our population dynamic.

Figure 9: Panel size variations with different methods of estimating VPY.



Area per Provider Ratio

While panel size is the cornerstone for developing centroid based provider/population ratios for CPCs, the key to developing a spatial accessibility model is fusing the availability and accessibility components at each centroid. This methodology accomplishes this by converting centroid based provider/population ratios into area/provider ratios in the following manner. The provider/population ratio was inverted and divided by the given population density at each centroid to determine an *area/provider ratio* (APR):

$$Area\ per\ provider = \left(\frac{population}{provider}\right)\left(\frac{miles^2}{population}\right) = \frac{miles^2}{provider}$$

Where population is FP patient panel size and provider is a FP, and miles^2 is the miles square that is occupied by the FP panel. As such the APR becomes the working unit for determining spatial accessibility (SA) in this study and is calculated for each of the 99 centroids, which will be used to determine the FP coverage at each centroid and to determine if there is a need.

Driving Time Impedance

A study conducted by Pathman and colleagues in 2006 showed that driving times of 30 minutes or more significantly decreases the likelihood that a patient would routinely seek primary care services at a specific location. Based on this study, we used geographic analysis tools housed in Maptitude 6.0 to create 30 minute travel time bands (impedance bands) from each centroid. We used these impedance bands to compare with the APRs at each centroid to determine if there is need for more FPs.

Accounting for the Current Family Physicians at CPCs/Centroids

Knowing the APR at each centroid allows Maptitude's GIS software to carry out a true SA analysis at each of the 99 centroids. Maptitude, using the APR, is able to visually assign a geographic area or band around each centroid based on the number of providers at a given centroid. The number of providers at each centroid determines the distance the band extends into the area surrounding the centroid. Since this study bases primary care access on a FP providing primary care to a known number of patients at a specific location, the next step in this process is to identify the number of FPs at each CPC/centroid. Quantitative data from the Alabama Board of Medical Examiners 2012 data base was used to identify the FP population in Alabama. Of the 2146 family physicians licensed to practice in Alabama, 494 have their primary practice location outside of the state and were therefore removed. Of the 1652 remaining family physicians whose primary practice location is in Alabama, 250 were removed because we determined that their practice type did not meet the generally accepted criteria for true primary care. The reasons for removal include: retirement, working as a hospitalist, working as an emergency room physician, working for the military, working in business/consulting, working in government, working for the Veterans Administration, working locum tenens assignments, doing occupational medicine, working in solely sports medicine/orthopedics, and having a limited license as designated in the database. These physicians would not have their own individual outpatient coverage areas and therefore are not included in this analysis. While this list is not exhaustive of the reasons, it represents the vast majority. If there was no way to determine practice type of the physician then we gave them benefit of doubt and included

them in our study. This leaves us with approximately 1402 physicians to locate* and assign to each CPC/centroid in the following manner: if they practiced within a city where a hospital CPC was located or if they were located within a 13.4 mile driving distance from the centroid they were included in that CPC. If a FP practiced within 13.4 miles of 2 separate hospitals, they were assigned to the closest centroid. This distance for inclusion was determined by calculating the mean travel distance state-wide for a 20 minute drive time to each of the 99 centroids. This spatial analysis study is based on assignment of FPs to all centroid locations, including both densely populated urban areas and sparsely populated rural areas. Each requires attention to insure that the ultimate result is a realistic appraisal of the ability of Alabama's rural citizens to access FPs. In urban areas with multiple hospitals, assignment of FPs to individual hospital centroids was an issue; however, the assignment of FPs to a centroid is rarely an issue in rural areas.

Urban CPC/Centroids

For urban areas with 2 or more hospitals there was conflict in deciding which hospital centroid to assign each FP. Since most centroids in urban areas are relatively close together and there were no apparent "availability" gaps in coverage within any urban areas, FP location and numbers at a location is not as important as simply measuring their cumulative effect on the coverage areas they generate. We assigned FPs to urban centroids based on a weighted scale of general admission hospital bed availability. This was accomplished by determining the number of available hospital beds within each urban area with more than one hospital and summing all the beds each hospital was licensed to service. The percent of the total beds at each centroid was calculated. The family physician population in those urban areas was assigned to hospital centroids proportional to the percentage of hospital beds at each CPC. For Birmingham, Alabama these values are in Table 3.

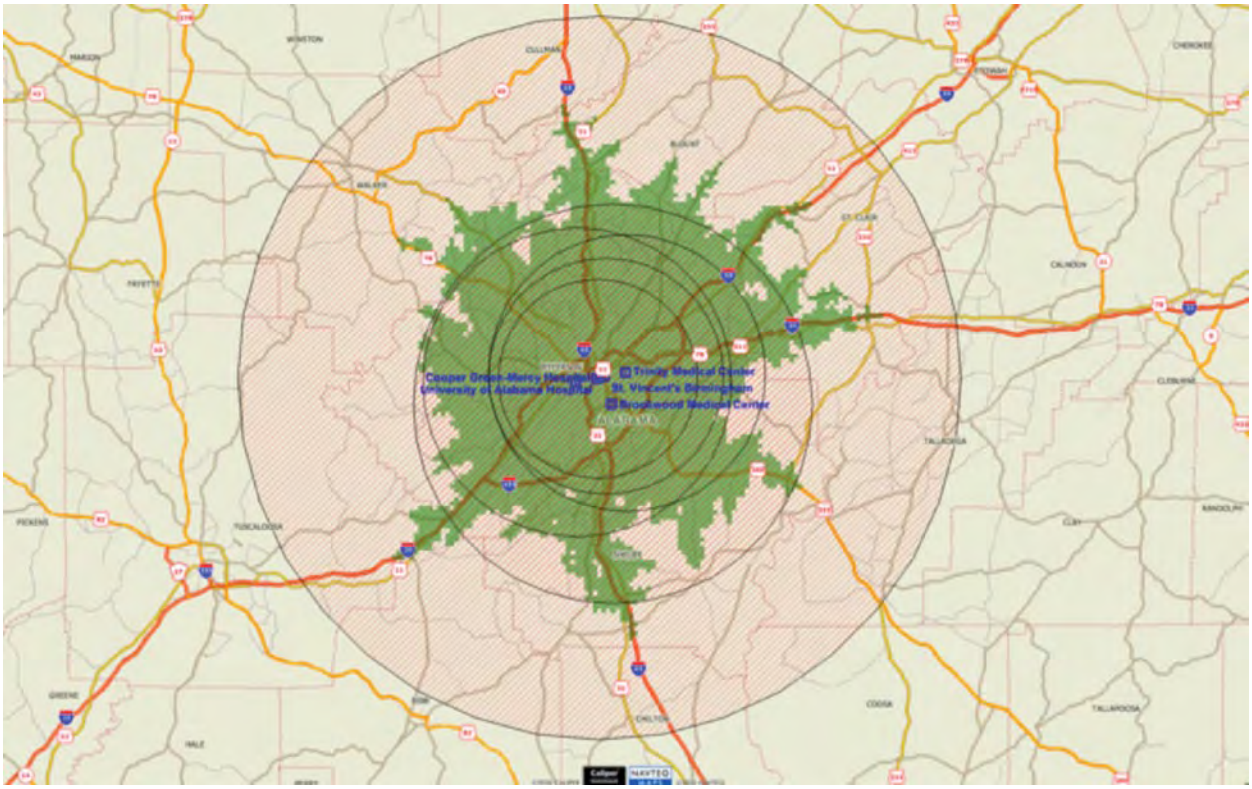
Table 3: Family Physician allocation per hospital using percentages of hospital beds as the allocating factor.

Birmingham Hospital	Beds per Hospital	% Beds in City Per Hospital	Number of Family Physicians Assigned
Baptist Medical Center-Princeton	499	13.6%	17
Brookwood Medical Center	631	17.2%	22
Cooper Green-Mercy Hospital	319	8.7%	11
St. Vincent's Birmingham	372	10.1%	13
St. Vincent's East	282	7.7%	10
Trinity Medical Center	428	11.6%	15
University of Alabama Hospital	1,146	31.2%	40
TOTALS	**3,677**		**128**

*Of the 1402 physicians we located, 1375 were able to be located exactly via either their latitude and longitude or their address. The remaining 27 were assigned and located to their nearest hospital.

Although there is some degree of inaccuracy associated with this method, for the scope of this rural SA study it is irrelevant which point of access dominates as long as all of the practicing FPs are accounted for and their influence on coverage is calculated. The important issue to consider is whether urban coverage bands affect rural access. Using this method of assigning family physicians to urban centroids showed conflicting information at 4 of these urban areas: Birmingham, Mobile, Decatur, and Florence. At each of these 4 locations, the hospitals are in such a close proximity that the effect of dividing physicians amongst the hospitals showed need at some locations and no need at others within the same urban area. To address this conflict the impedance was calculated for the combined hospitals in each urban area. If the APR for one of the hospitals in that urban area exceeded the impedance of the combined hospitals, then it is reasonable to assume that we should use the impedance limitation for all of the centroids in that urban area. Figure 10 demonstrates this method in Birmingham.

Figure 10: APR coverage bands for family physicians in Birmingham, AL



Rural CPC/Centroids

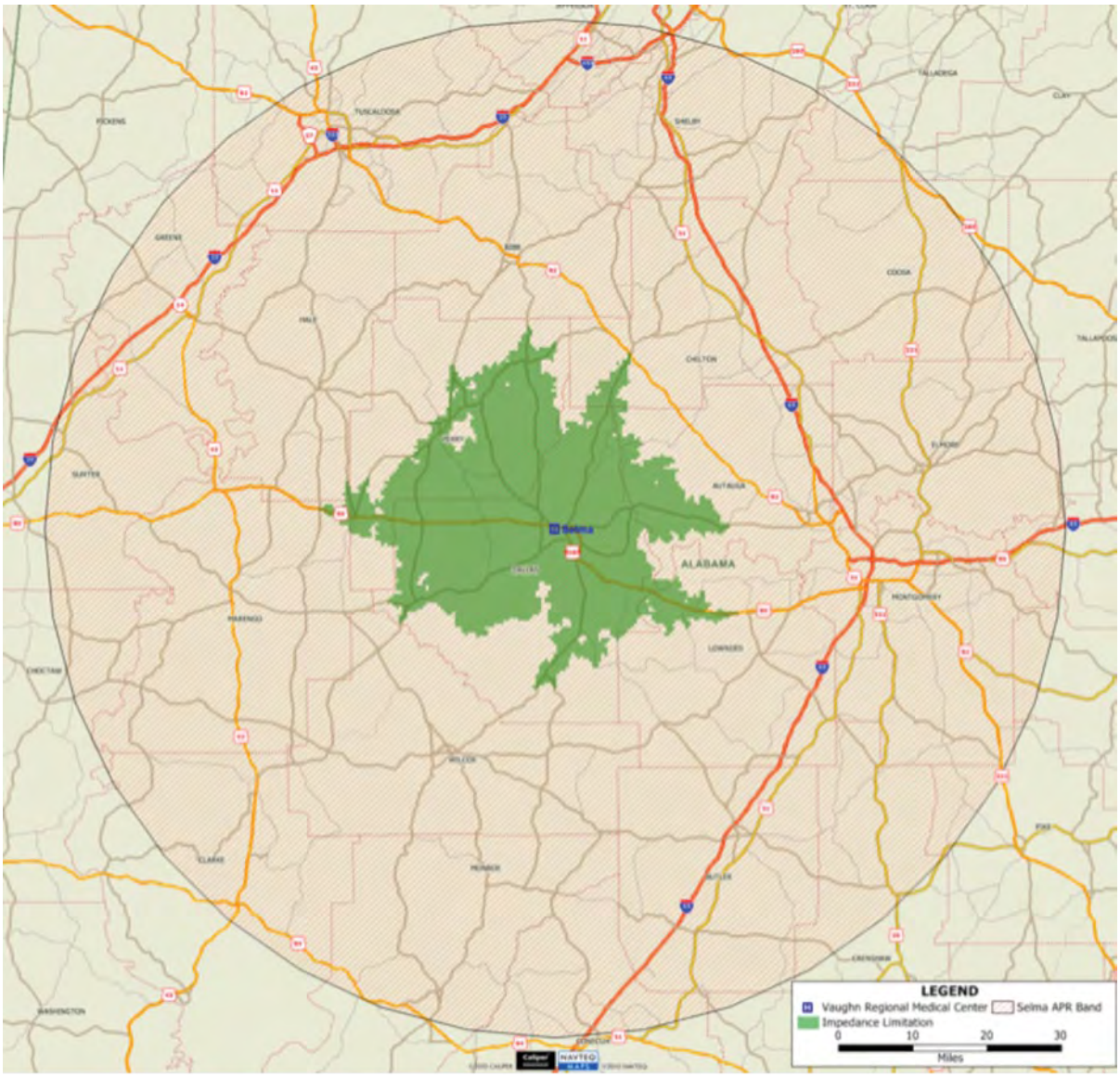
For the non-urban centroids, there is less confusion about the assignment of the FP to their respective centroid due to the 13.4 mile requirement and the usual distance between non-urban hospitals. This, for most part, creates non-competing fields for these centroids. The family physicians are assigned to the centroid of their respective RHCPC and, as one would expect, this analysis becomes more accurate in areas that do not have competing centroids since there is less ambiguity to the supply of providers and their locations. On the other hand, rural areas face two “rural” issues: the availability of FPs and travel limited access (travel impedance) to available FPs.

Impedance/APR Limitations

To determine if there is a need at any given centroid we compared the APRs to the impedance limitations. When centroids are over supplied by providers and/or the population is more dispersed, the provider/population ratios extend out from centroids to the point that that travel time becomes a barrier (impedance barrier) to the access of FPs (Pathman et al., 2006).

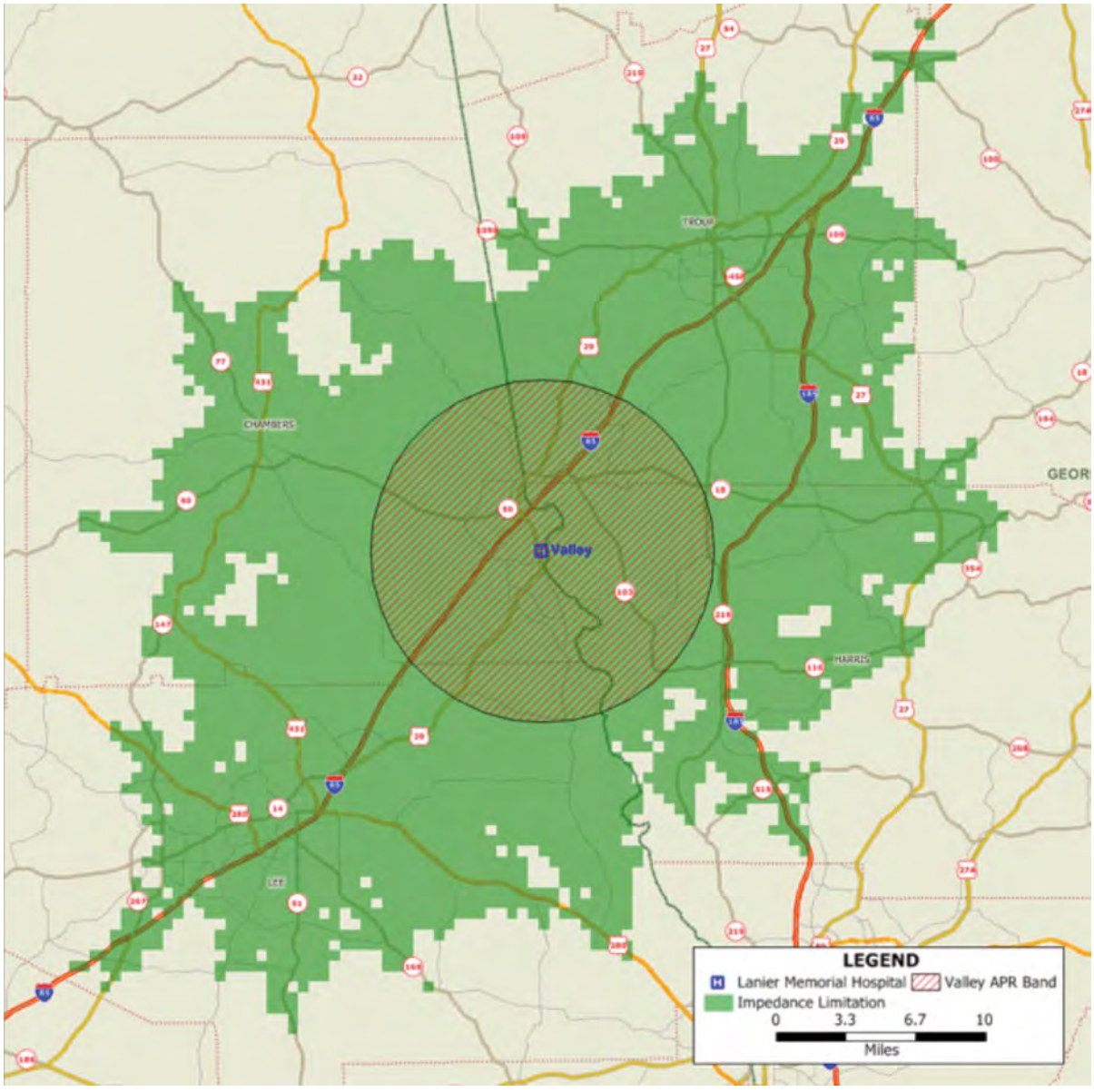
Based on Pathman's data, we developed two competing methods for evaluating and displaying coverage at each centroid, the calculated APR coverage bands that estimate physician availability and the travel impedance bands that estimate accessibility. If the projected APR band expanded beyond the travel impedance band of a 30 minute driving time, the APR band was discarded and the travel impedance band represented the coverage area for that centroid (CPC). Of the 99 centroids, 74 were found to have APR coverage bands that exceeded travel impedance limits. In these cases, their projected coverage was limited to their travel impedance limitations. At these CPCs, access to primary care would be travel impedance limited and the travel impedance area would be the working coverage band. The hospital centroid located in Selma, Alabama is an example of one of the 74 centroids where projected coverage is impedance limited. Figure 11 is a coverage map for the Selma hospital based centroid.

Figure 11: Selma's APR coverage band and travel time impedance.



In this map, the red band surrounding Selma represents the APR coverage band and the green area represents driving time impedance of 30 minutes. Because driving time limitations are much smaller than the predicted APR coverage band, Selma's access to care is deemed to be "impedance limited" and the travel impedance area would be our working coverage band. In short, Selma has sufficient family physicians to cover the population within the 30 minute driving time limitation whereas the opposite is true at other locations.

Figure 12: Map showing the Valley centroid with travel impedance (green) and APR coverage (circle).



The red circle surrounding the town of Valley represents the APR coverage band and the green area is the travel impedance at 30 minutes. In this example, Valley would be defined as being “provider limited” and the APR coverage band area (the red area) would be the working coverage band. Using this data, it is easy to determine that Valley could benefit from increased number of FPs.

FPs were assigned to each CPC as described above and the total number of FPs at each CPC was placed in the APR calculation at each centroid. Maptitude generated APR bands for each centroid which were then visualized on an Alabama map. The APR’s were overlaid with a driving time impedance of 30 minutes and 25 centroids were identified whose FP population did not cover the population. By calculating the area that is needed to cover the 30 minute impedance and by knowing the radius of coverage that a FP at each centroid provides, we calculated the need at the APR limited centroids. This number is then the total number of FPs needed (as projected by this model) to cover the entire state population (Table 5, Appendix D*). The number of FPs added at each CPC locates where additional FPs could be placed to allow state wide access to FPs.

*The number of physicians needed at each centroid is reported as a whole integer. Normal rounding rules were applied with any number greater than 0.5 was rounded up to the next whole integer and any number less than 0.5 was rounded down to the next whole integer. The only exception was at three locations were the need was between 0.0 and .049, these numbers were rounded to 1 to show that there was a need at that location.

SECTION FOUR

Results

The consensus among health care analysts and researchers is that the most significant effect on positive health outcomes for individuals and populations is an ongoing relationship with a PCP (Starfield et al., 2005) and in rural Alabama that is an FP. In terms of barriers, the converse is true; the most significant barrier to improved health for individuals and populations is not having access to a PCP. The health outcome literature further documents that among PCPs positive health outcomes are most often associated with the FP (Ferrante et al., 2000 and Fryer et al., 2001). A functional Alabama rural primary care access plan would be a plan that makes physical access to adequate numbers of FPs available to the state's rural residents. A geographic study of Alabama's non-urban communities, non-urban health resources and Alabama's highway system identified communities with rural hospitals to be the most appropriate sites to establish as points of access (RHCPCs) to FPs.

Based on these facts, the development of a functional rural primary care access plan for Alabama requires a methodology that has the capacity to analyze, model and make projections at specific geographical locations using the population demographics, spatial allocations and provider assets at specific sites. In this case, the specific sites are rural hospitals and their associated communities. Family physicians are the PCP assets at those locations. We developed measures to evaluate if this spatial accessibility tool has the capacity to analyze, model and make projections of population access, availability of FP assets and the FP need at specific geographical locations. These measures are listed in Table 4.

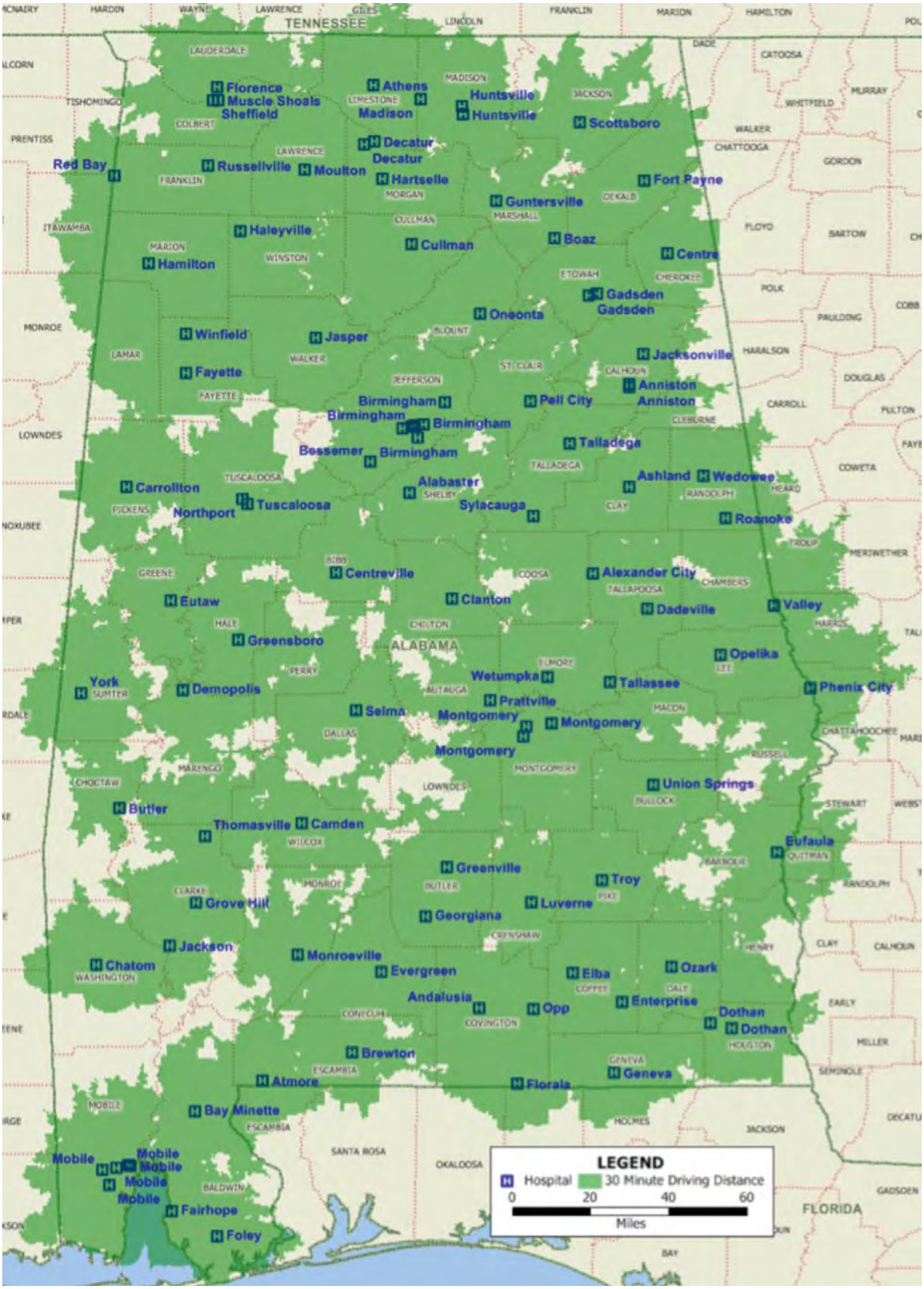
Table 4

1) Show that Alabama's rural hospitals are geographically located to serve as primary care points of access (CPCs) for rural Alabamians
2) Determine the population density and demographics at each RHCPC
3) Determine the number of individuals that one FP can reasonably expect to manage at each CPC
4) Determine the FP assets available at each RHCPC
5) Determine that RHCPCs actually do provide physical access to Alabama's rural population
6) Determine the FP need at each RHCPC
7) Have the capacity to periodically reassess the status of availability and accessibility at each RHCPC

The methodology described herein clearly shows and confirms that the APR methodology and spatial analyses satisfy the requirements of measures 1 through 4. The fifth measure requires that a functional rural primary care access model must demonstrate that individual RHCPCs are spatially distributed throughout the state in a manner that provides the state's rural population physical access to FPs (accessibility dimension). Mapping locations of RHCPCs on an Alabama highway map grossly suggests that they are spatially distributed throughout the state in a manner that provides the state's rural population physical access to FPs (Figure 2); however, suggesting is not confirming. Calculating the 30 minute travel impedance for each centroid confirms that the RHCPCs do provide physical access to Alabama's rural population (Figure 13). In Figure 13, the green areas represent areas that are within 30 minute driving times of current hospitals. With all 99 FP APRs at maximum coverage, this is a pure access limited view of coverage and is totally dependent on the spatial location of hospital based CPCs. This map clearly shows that CPCs based on rural hospital locations are well placed to provide access to most of Alabama's rural residents. Also note that this map demonstrates one of the strengths of the spatial accessibility model. When used with exact provider locations you can account for border crossing not only between zip codes and counties but even among state borders. Thus Alabama's rural hospitals are spatially ideal entities for creating mathematical models and serving as CPCs for Alabama's rural residents.

It is important to note that use of the 30 minute driving time impedance assumes 100% FP availability at each of the 99 centroids (i.e. that APR bands equal or extend beyond the 30 minute impedance limits at all of the 99 centroids). This creates the maximum coverage that can be obtained using the 99 centroids in this model. In essence, everyone that resides in the green area would be within 30 minutes of a CPC and there would be adequate FPs to serve them.

Figure 13: Potential primary care coverage map. Green areas represent areas within 30 minutes driving time of an Alabama hospital.



Measure 6 requires that this model and the analyses that develop it must be capable of determining the FP need at each RHCPC (pure availability). Again, APR and GIS technology were used to create APR coverage bands around the 99 individual CPC/centroids. In contrast to Figure 13 where FP availability is adequate to produce coverage bands equal to or greater than the 30 minute impedance limit, Maptitude was used to create coverage bands relative to the actual number of FPs and the population density at each location. These calculations resulted in the APR bands matching or going beyond the 30 minute driving impedance limit at 74 locations and falling short of the 30 minute limit at 25 locations. Figure 14 (Appendix A for larger version) is a visualization of the 74 locations where coverage is at the maximum (at the 30 minute driving range limit) and there is an adequate number of FPs to cover the population. The green areas represent this coverage and the darker green color represents an overlap of impedance bands, which offers patients a choice.

Figure 14: Map showing CPC/centroids deemed impedance limited

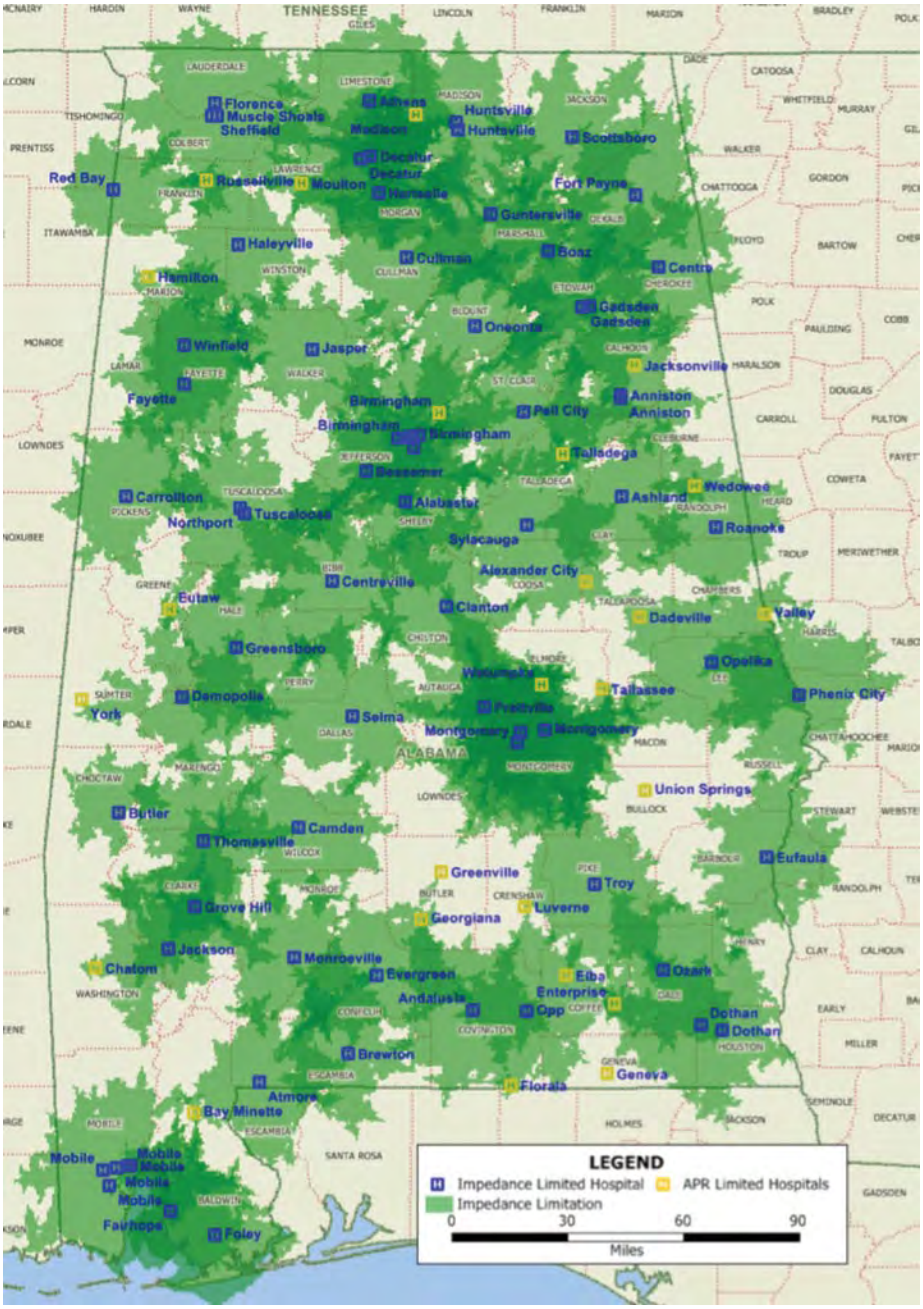
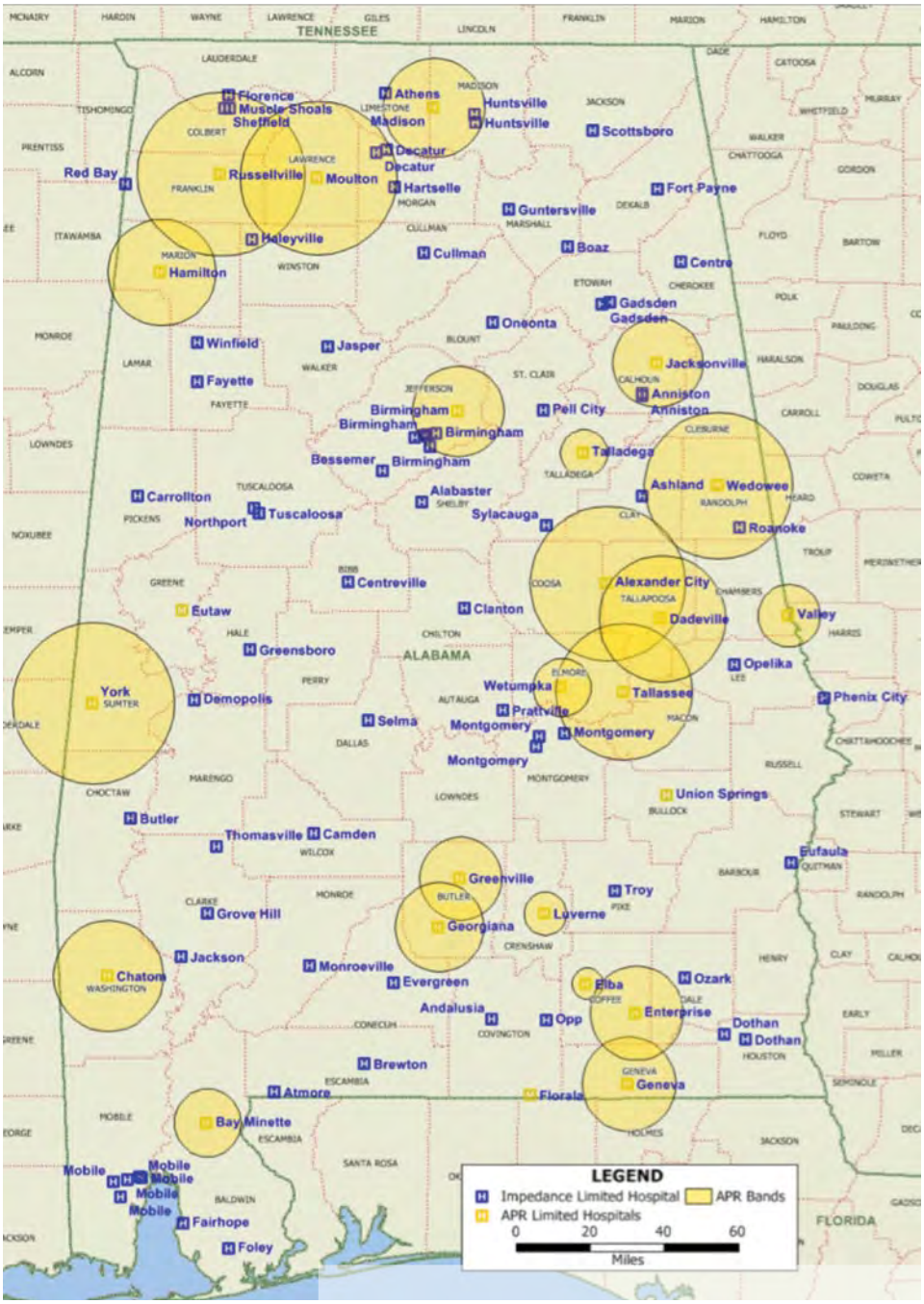


Figure 15 (larger version Appendix B) is a map visualizing the APR bands at the 25 CPC/centroids where there are not enough FPs to cover the population or in the terms of this analysis, the APR bands do not equal or exceed the 30 minute driving time at these CPC sites. The yellow bands represent the population covered by the current number of FPs at each of the 25 underserved locations. These bands* vary in size because the band at each location is a function of the number of FPs and the population density (the APR) at that site. For example, the larger the size of the band means greater coverage of the area.

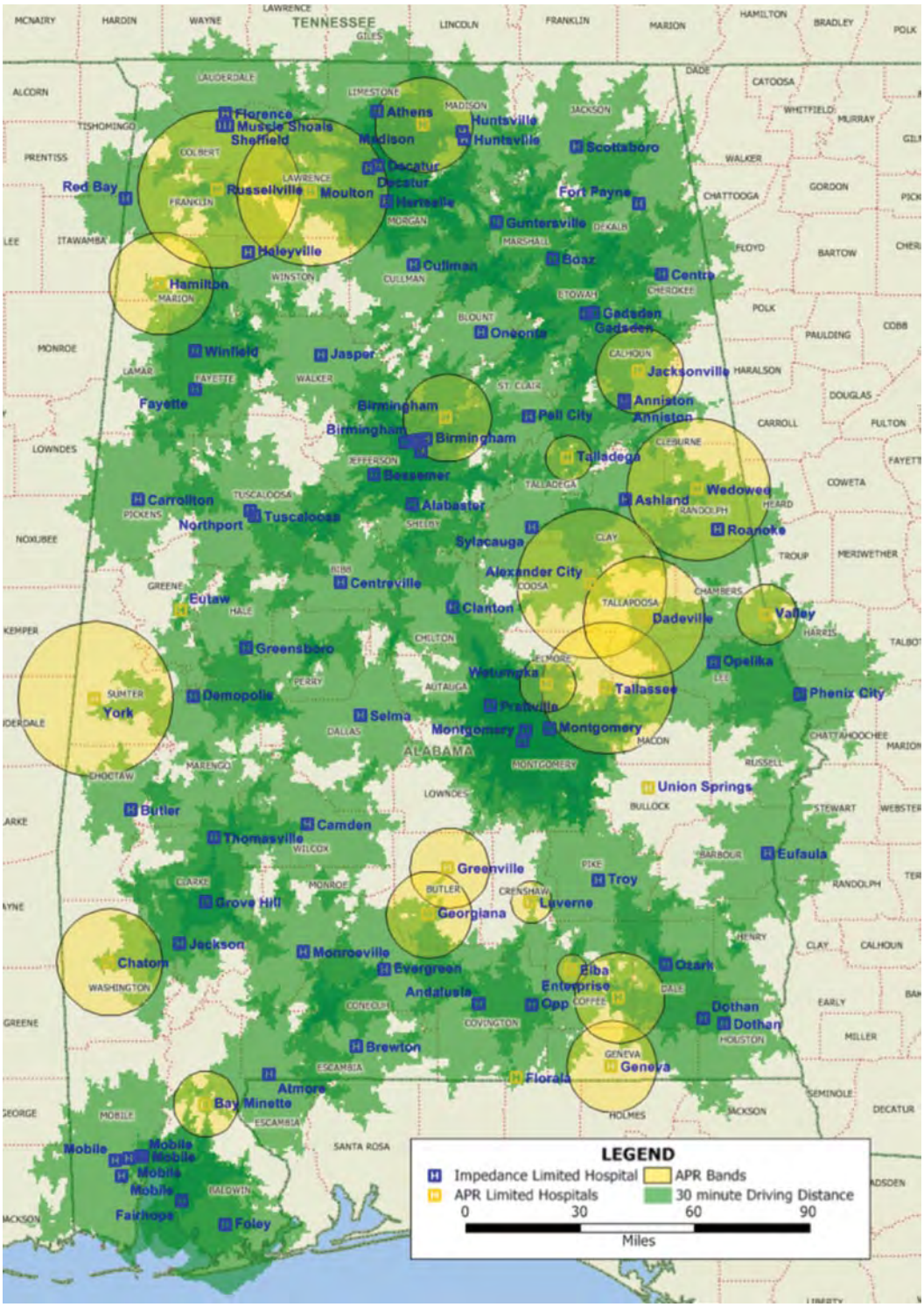
Figure 15: Map showing CPC/centroids deemed APR limited



*There are no APR bands around the centroids in Eutaw, Florala, and Union Springs because, based off our criteria, there are no FPs located at those centroids.

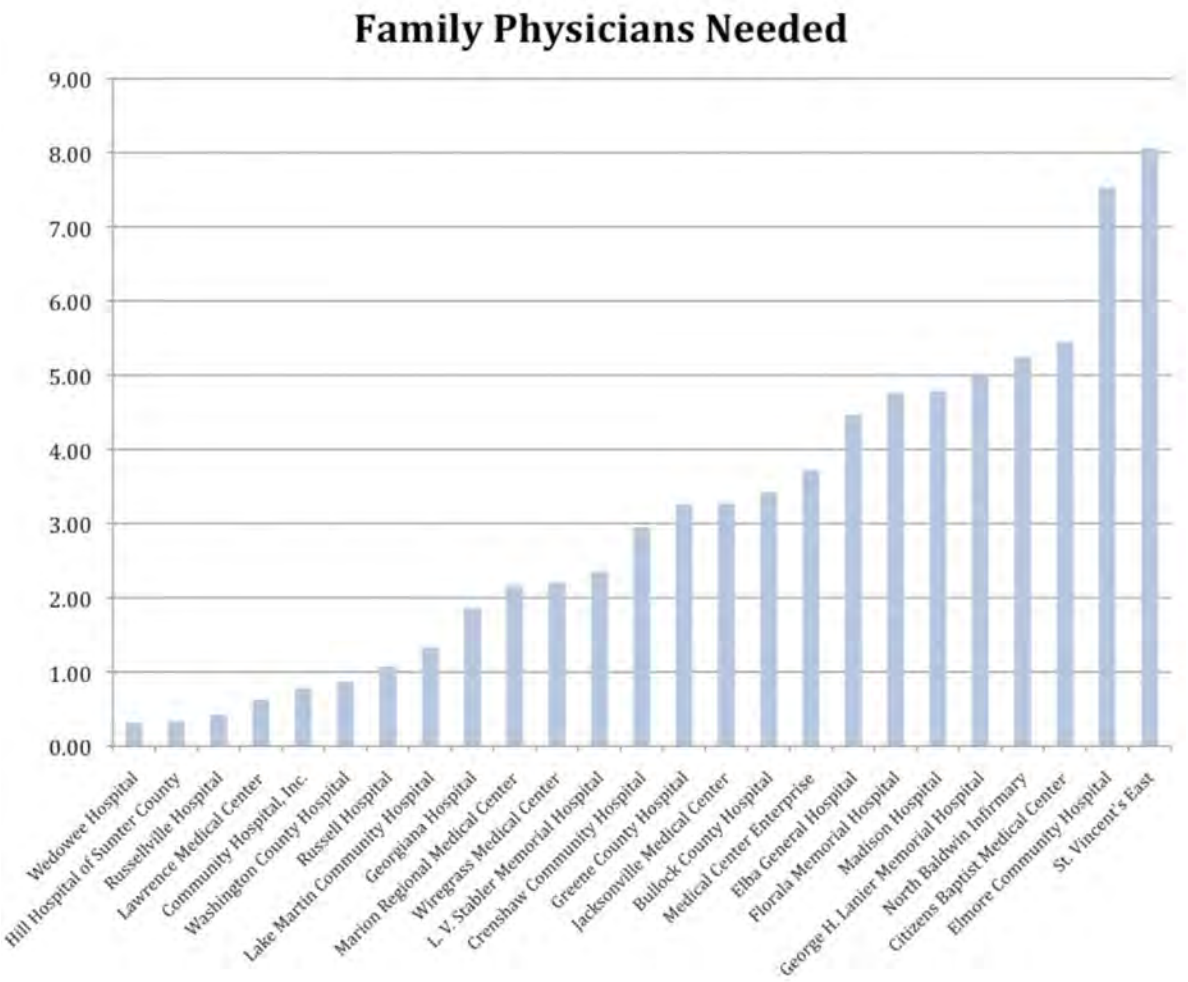
We then used Maptitude to overlay the map in Figure 15 on the map in Figure 14 to produce the map in Figure 16 (larger version Appendix C). This map then is a functional snapshot of the current spatial access to FPs in Alabama. Comparing figures 13 and 16 shows that there is an obvious need for additional FPs in rural Alabama.

Figure 16: Current coverage and areas of need in Alabama's primary care coverage. Green areas are adequately covered. Yellow areas have need to expand their coverage to 30 minute limitation.



Mapping is an excellent way to visually present these results, but the strength of this method is its ability to identify exactly where these assets (FPs) can be positioned to make the largest impact on the state's need (Table 5, Appendix D). In this case, the exact number of FPs needed at each of the 25 APR limited CPC locations on the map. Figure 17 shows the exact SA determined need at each of the 25 APR limited CPCs.

Figure 17: Projected family practitioner need at each hospital based centroid. See Table 5 for complete data.



The summation of the number of FPs needed to minimally cover the entire population within each hospital CPC's impedance limitations is 76.21 (with a 95% confidence range of 75.35 to 77.07). All but two deficient CPCs are RHCPCs (Table 5, Appendix D). Subtracting the number of physicians needed at the two urban outliers leaves rural Alabama needing 63 FPs today for Alabama's rural population to have the potential for access to primary care. The power of this SA evaluation lies not only in having an extremely accurate estimation of the number of FPs needed in rural Alabama, but also in knowing exactly how many additional FPs are needed at specific strategically placed locations throughout rural Alabama (i.e. Table 5, Appendix D). These finding clearly demonstrate that this SA methodology has the capacity to meet the objective of measure 6.

While our results demonstrate that this SA methodology satisfies the first six measures described in Table 4, the seventh measure raises the question can it be used to periodically reassess the status of Alabama's rural citizen's ability to access primary care?. The simple answer is yes. The formulas, equations and calculations used by this methodology use 2010 Census data housed within the Maptitude version 6 and new census data will be available every 10 years. If needed and/or appropriate, panel sizes can be easily recalculated since demand is directly related to visits per year. The road systems within Alabama are stable and are not expected to change enough to alter driving times currently determined for individual CPCs/centroids. The data that is most likely to change possibly at yearly intervals and have the most profound effect on RHCPCs is the number of FPs at individual RHCPC locations and this requires only the insertion of a new number into the APR equation.

SECTION FIVE

Summary

An extensive review of the primary care access, primary care providers, and health outcomes literature shows:

- The most significant barrier to improvement of population health outcomes is access to a primary care physician,
- The supply of primary care physicians in rural Alabama is inadequate to meet the current rural population demand,
- The primary care physician with most extensive impact on population health outcomes is the family physician.

A geographical survey of medical facilities and primary care providers in rural Alabama shows:

- The most appropriate medical facility in rural Alabama to serve as a center for spatial accessibility is the rural hospital,
- The most appropriate community resource to coordinate recruitment and retention of FPs is the rural hospital,
- The PCP with the most availability currently at these locations is the family physician.

A spatial accessibility analysis was applied to actual locations (general admission hospitals) and their known primary care assets (family physicians) showing:

- Alabama's rural hospitals are geographically located and spatially distributed within the state to allow Alabama's rural population physical access a family physician,
- Alabama currently needs 76 family physicians to best meet the primary care demands of the state's population,
- 23 out of 25 locations where family physicians are needed are located in rural Alabama,
- Additional family physicians are needed at 23 rural hospital locations (communities) to meet the population demands within acceptable driving time impedance at each site,
- Metropolitan general admission hospital coverage bands in general have no significant effect on rural populations.

SECTION SIX

Discussion

Among knowledgeable institutions and individuals, in both the private and public sectors there is an acute awareness of Alabama's rural health crisis and an increasing awareness that the rural family physician is the fulcrum for improving the health of Alabama's rural citizens. Alabama's medical schools, governors, state agencies and rural health advocates have promoted increased access to rural primary care services for over 20 years and in recent years more emphasis has been placed on recruiting, training and placing family physicians in rural Alabama.

The Alabama Department of Public Health, Office of Primary Care & Rural Health has been diligent in utilizing federal monies to promote federal rural workforce programs directed at recruitment and retention of a rural health workforce including PCPs. Federally supported rural primary care clinics have a large footprint in rural Alabama. Alabama's medical schools rural education programs, the legislature supported Family Practice Rural Health Board and the Alabama Board of Medical Scholarship Awards (BMSA) along with in-state family medicine residencies spatially located throughout Alabama, when considered collectively, recruit, train, support and direct medical students and family medicine residents to rural family physician careers. Still, as Alabama's rural PCP shortage demonstrates, these efforts have been only minimally effective in recruiting and retaining rural physicians. This is not to say that rural initiatives have not had some impact on the rural primary care PCP workforce. Without these programs we would not have a rural family physician pipeline nor would we have our current number of rural family physicians.

In general these are stand alone initiatives that whether state, commercially, or federally directed, lack direct links with the rural communities in which they seek to place and retain FPs. In addition, initiatives developed specifically to produce and place adequate numbers of family physicians in rural communities have been hampered by a lack of adequate funding. There is little or no coordination among rural health advocates or between ongoing programs; even lines of communication between programs within the Alabama health system have been difficult to develop. A state wide plan for addressing the shortage of rural PCPs does not exist, and no public or private entity has indicated an interest in accepting leadership in the development of a state plan. However, in fairness to all rural primary health care advocates, until now, there has been no standardized method for quantifying and localizing rural populations and there has been no method for determining the primary care provider/population ratios specific to these populations. As a result, a database has not been available for global and/or local primary care access planning. Using the SA methodology presented in this monograph, one can determine specific local population to provider ratios and develop state wide databases for healthcare access planning. Our rural hospital/family physician rural primary care access model can be used to establish a state plan for resolving Alabama's rural PCP shortage. Now, with a model to guide the development of a state wide plan for rural primary care access, the need to coordinate activities of Alabama's rural initiatives should be apparent.

Alabama's rural health infrastructure is and always has been based in Alabama's rural hospitals and their associated family physicians. While the goal is to increase the number of family physicians in rural communities, the local practicing family physicians themselves usually do not have the resources, expertise or time to recruit additional family physicians. State incentives have been allocated to direct students to family medicine careers and guide them into selecting rural communities as practice sites but these resources have been inadequate and the programs have been under-funded. Even when family physicians do select rural communities for practice, they do not always remain long term, but rural

hospitals are, both historically and currently, a stable primary care infrastructure in rural communities. It is not an overstatement to say that without the presence of rural hospitals there would be no rural access to primary care in Alabama. Yet, rural hospitals and the communities in which they are located have not been integrated into Alabama's rural physician pipeline.

Alabama's two most successful pipeline programs are the UAB School of Medicine's (UABSOM) five year rural medical education programs and the BMSA's rural scholarship/loan program. While both are medical student centered, UABSOM's programs terminate with graduation. The BMSA scholarship/loan program goes a step farther in that it requires the student to practice in a non-urban community of need following residency graduation. While the BMSA program is an integral part of Alabama's rural physician pipeline, it is a broad stroke program that has lacked specificity in awarding scholarship/loans and is grossly under-funded.

In April of 2011, the Alabama Rural Health Association called for the strengthening of comprehensive primary care medical training and the positioning of primary care practices in Alabama's areas of greatest need. It identified areas for consideration and action including calling for the expansion of existing pre-professional health care career pipelines; development of pre-professional rural health honors programs; increase in existing rural medical education programs as well as support of their expansion; enlargement of family medicine residencies; augmentation of funding of rural loan repayment programs; development of medical school admission policies that target prospective students based on geography and cultural background such that each county will have sufficient manpower in the pipeline to staff and maintain patient centered medical homes; and lastly the creation of an office to coordinate the various efforts. The first five of the ARHA's recommendations deal with strengthening primary care medical training, however the last two suggest the formation of a state wide plan with established specific outcomes.

UABSOM's rural medical education programs and University of South Alabama's rural scholarship program currently target rural pre-medical students. While the ARHA brief recommends targeting at the county level, this spatial analysis model is more definitive in its targeting than counties or zip codes. It identifies rural hospitals and their communities as sub-county target areas based on local geographical access and population density and demographics instead of mandated boundaries. At the same time, a plan for improving the health of Alabama's rural population based on the outcome measure--rural population access to a primary care family physician--must go beyond an outcomes measure of rural student admission to medical school or even admission to a family medicine residency. Its goal must be, at a minimum, to admit rural pipeline and BMSA awarded students to in-state family medicine residencies (Henderson et.al. 2003) and, during residency, promote resident/rural community relationships. Within the infrastructure of Alabama's medical schools and current primary care pipeline initiatives, there is the potential to increase medical student selection of in-state family medicine residencies. However, there is no established method for directing graduated residents to rural communities other than the BMSA's requirement of serving in an underserved community of less than 50,000 people and independent private based enterprises. The entities best positioned to attract physicians to rural communities are Alabama's rural hospitals. They are the major recruiters of family physicians to rural communities; in fact, they are usually the only recruiters to rural communities. As the competition for rural family physicians has increased, hospitals, including many rural hospitals, are employing family physicians and even offering incentives to family medicine residents in advance of their employment dates. This not only makes them the end of the pipeline but also enhances their potential as active participants in the recruitment of medical students to in-state family medicine residencies.

At the beginning of this paper, health care status was addressed and presented as urban vs rural. The definition of rural has been based on agriculture output, population per square mile and distance from metropolitan areas. Health statistics are most often presented in terms of population ratios that are separated into rural or urban relative to county delineations. In Alabama, this leaves many counties with degrees of rural or urban status within their boundaries. Questions arise as to the capacity of urban FPs to extend coverage to rural populations relative to driving time to metropolitan areas. Since health status is usually presented in terms of population ratios and more specifically access to health care is usually

presented as provider/population ratios, the ability to spatially determine provider/population ratios has a significant impact on the physical access to a provider when the number of patients that a provider can manage is considered. The APRs used in this model account for all these variables without consideration of rural/urban boundaries. This unbiased approach shows that metropolitan FP APRs have no significant impact on rural access and that Alabama's lack of access to FPs is for all practical purposes a rural problem.

The ARHA brief recommended the creation of a coordinating office or structure for current and future pipeline activities. Such an entity has the potential to enhance, support and integrate current pipeline activities as well as coordinate the planning of future activities without being intrusive. The endorsement and support of the governor's office, the state legislative leadership and Alabama's medical schools would give it credibility in the private sector. This SA model would provide this entity with the framework for analyzing data, making projections, promoting partnerships and coordinating a state wide rural primary care workforce effort.

This plan and model only addresses the accessibility and availability dimensions of the realization of healthcare. It does not take into account whether the physicians at each location will accept a patient or the patient's economic ability to seek healthcare; these dimensions are outside the scope of this plan. Implementation of the Patient Protection and Affordable Care Act of 2010 has raised the specter that many more rural FPs would be needed because of the greater utilization of services by rural residents who are not currently accessing primary care services. This model accounts for all of Alabama's residents whether they are or are not currently accessing FPs. Thus emplacing FPs in sufficient numbers at the CPC locations described in this SA model will position Alabama to deal with potential increased utilization brought about by the Patient Protection and Affordable Care Act of 2010.

This model involves the classification of family physicians as true primary care providers. In parsing the medical licensure database, those physicians who, in our opinion, did not wholly practice primary care as defined by the AAFP were removed from this model. However, resident physicians that currently hold an unrestricted license to practice medicine were included because, although they do not typically have the ability to manage the same size patient panel as a physician not in residency, they do provide primary care.

Finally, this model does not take into account the differences in physicians' ability or proclivity as to how many patients they will see per day. It is well known that this is a variable factor, with some FPs see as few as 20 patients per day while some see upwards of 60 patients per day. This model used averages and estimations based on what was felt as the most accurate representation of current practicing physicians.

SECTION SEVEN

Conclusions

Community oriented access to primary care through a relationship with a family physician is the most realistic and effective way to improve the health status of Alabama's rural population. The communities in which Alabama's rural hospitals are located are spatially distributed throughout the state in a manner that allows Alabama's rural residents physical access to a family physician. Rural hospitals are the major resource for recruiting, retaining and supporting the rural family physician. A rural health plan based on a family physician/rural hospital model for access to primary care as described in this presentation is realistic and achievable. It directs Alabama's current rural physician pipeline activities and sets the stage for expansion of these activities to recruit and educate a cohort of rural students to be family physicians. The plan also identifies and designates the rural communities where state and federal resources can partner with local resources to maximize recruitment and retention of family physicians in rural communities.

In summary, this analysis provides a foundation on which to build our current primary care coverage and to pursue more in-depth analysis of workforce issues and barriers to primary care access based on the micro-populations at individual rural sites. This model gives definition and focus for developing public and private partnerships, rural public policy, legislative support, pilot projects, and rural outcomes research, as well as giving direction to rural educational programs.

Appendices

Figure 14: Map showing CPC/centroids deemed impedance limited

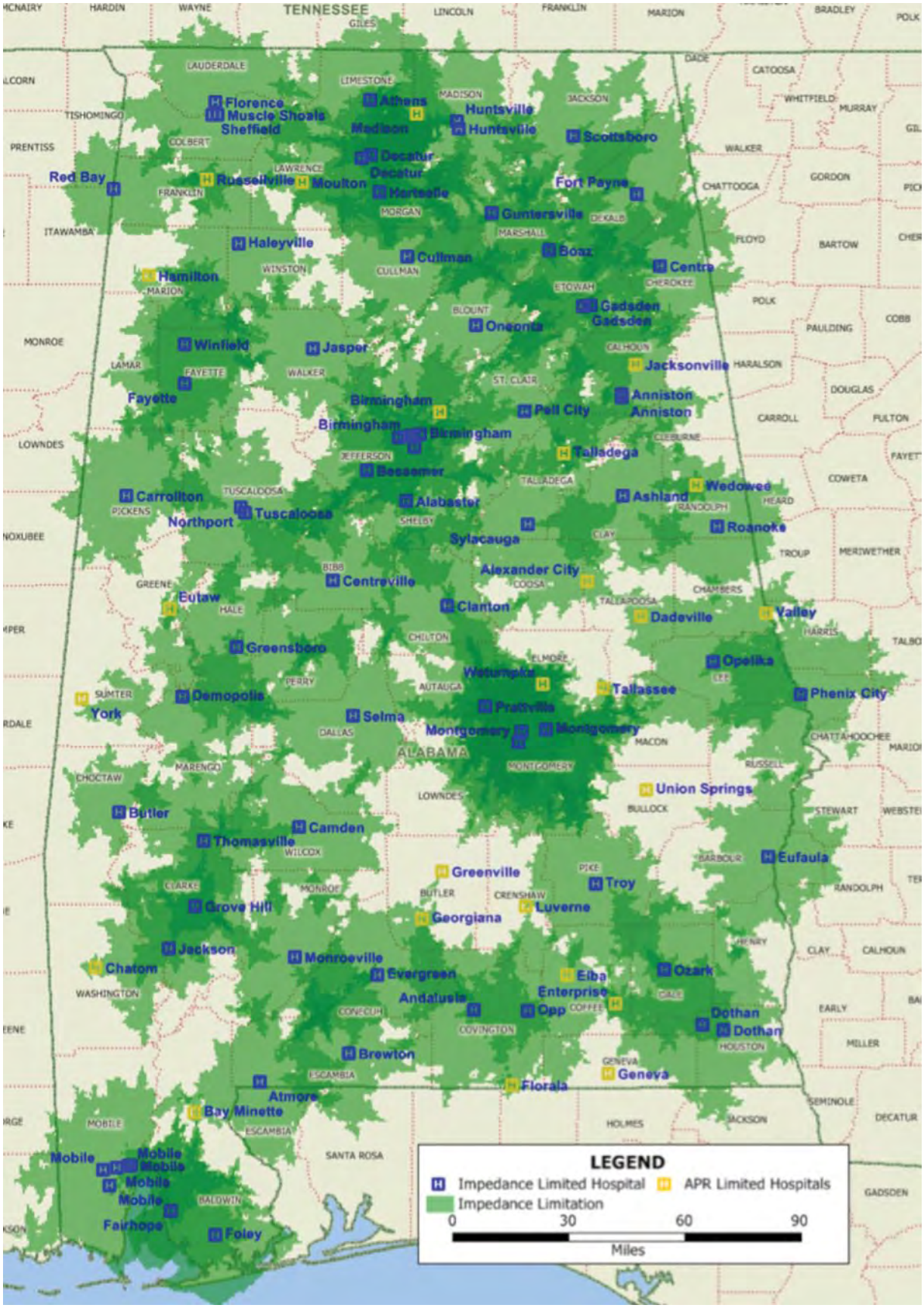


Figure 15: Map showing CPC/centroids deemed APR limited.

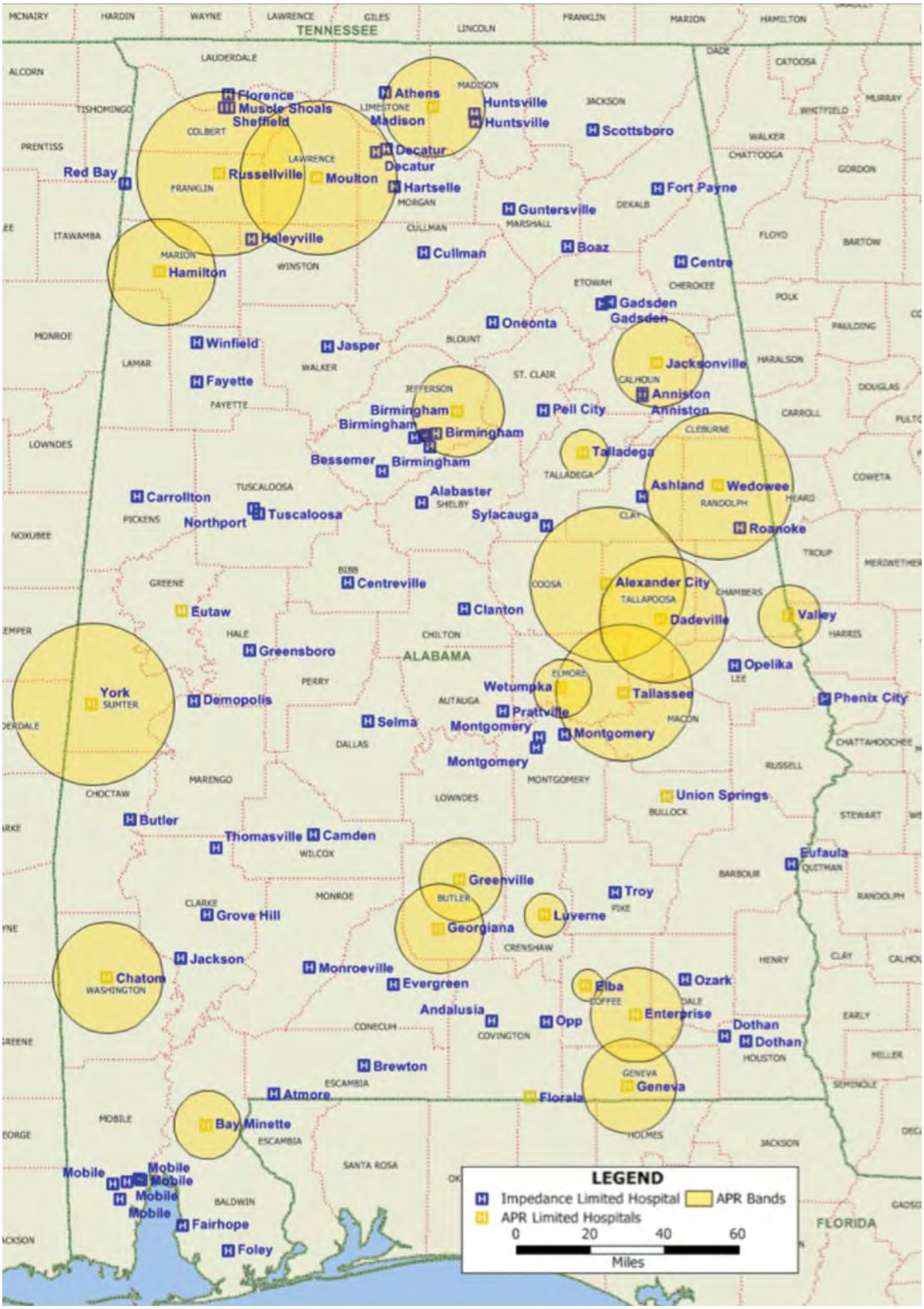
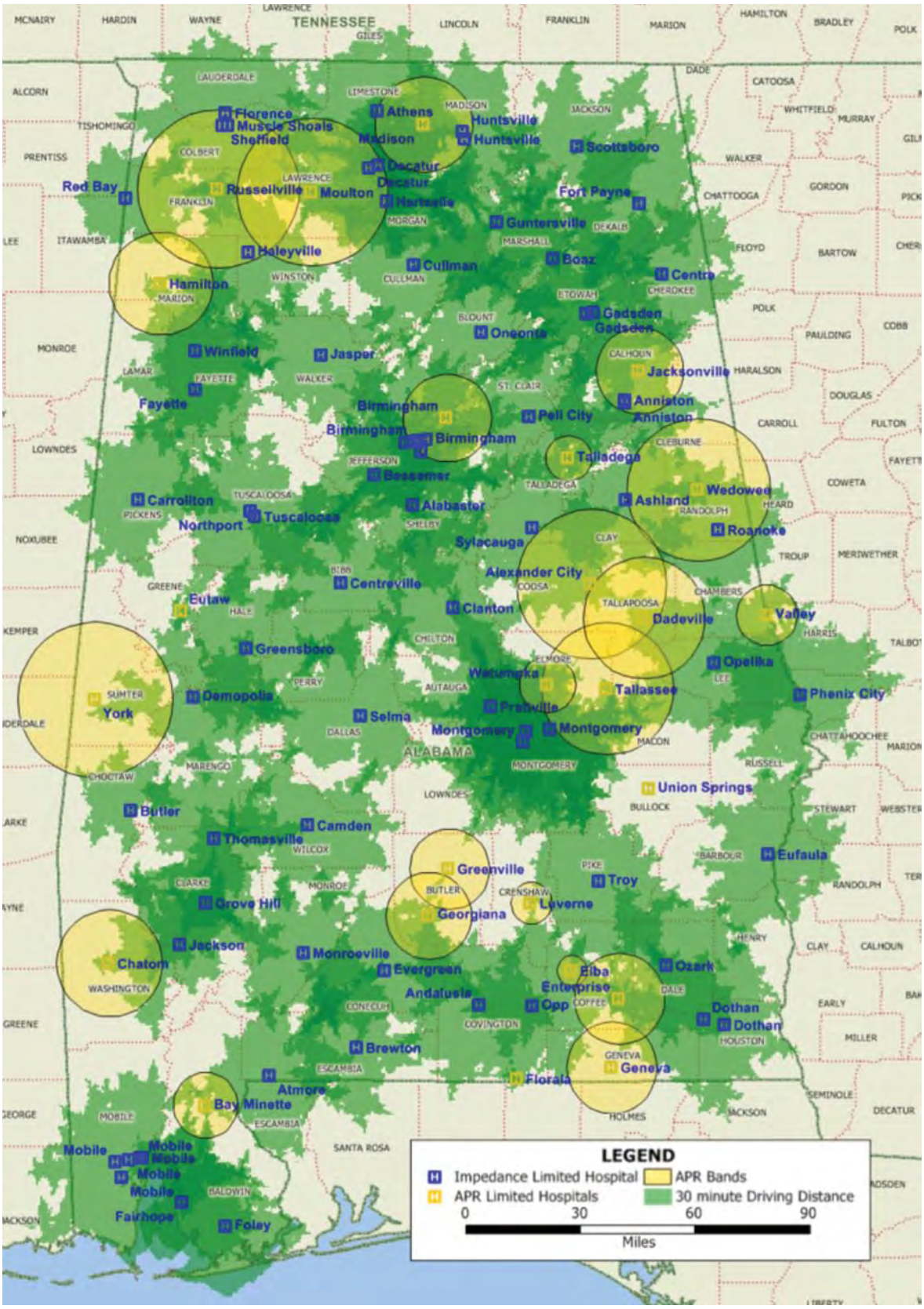


Figure 16: Current coverage and areas of need in Alabama's primary care coverage. Green areas are adequately covered. Yellow areas have need to expand their coverage to 30 minute limitation.



APPENDIX D

Table 5: Table summarizing the need and characteristics of each centroid

HOSPITAL	HOSPITAL CITY	PHYSICIANS PRESENT	PHYSICIANS NEEDED	COUNTY	ARHA DESIGNATION	ALAHA DESIGNATION**	IMPEDANCE OR APR LIMITED
Andalusia Regional Hospital	Andalusia	12		Covington	Heavily Rural	Rural	Impedance
Athens-Limestone County	Athens	13		Limestone	Moderately Rural	Rural	Impedance
Atmore Community Hospital	Etowah	9		Escambia	Heavily Rural	Rural	Impedance
Baptist Medical Center East	Montgomery	14		Montgomery	Urban	Urban	Impedance
Baptist Medical Center South	Montgomery	43		Montgomery	Urban	Urban	Impedance
Bibb Medical Center	Centreville	7		Bibb	Heavily Rural	Rural	Impedance
Brookwood Medical Center	Birmingham	22		Jefferson	Urban	Urban	Impedance
Bullock County Hospital	Union Springs	0	3	Bullock	Heavily Rural	Rural	APR
Cherokee Medical Center	Centre	10		Cherokee	Heavily Rural	Rural	Impedance
Chilton Medical Center*	Clanton	6		Chilton	Moderately Rural	Rural	Impedance
Choctaw General Hospital	Butler	3		Choctaw	Heavily Rural	Rural	Impedance
Citizens Baptist Medical Center	Talladega	2	5	Talladega	Moderately Rural	Urban	APR
Clay County Hospital	Ashland	7		Clay	Heavily Rural	Rural	Impedance
Community Hospital, Inc.	Tallassee	5	1	Elmore	Moderately Rural	Rural	APR
Cooper Green Mercy Hospital	Birmingham	11		Jefferson	Urban	Urban	Impedance
Coosa Valley Medical Center	Sylacauga	10		Talladega	Moderately Rural	Urban	Impedance
Crenshaw Community Hospital	Luverne	1	3	Crenshaw	Heavily Rural	Rural	APR
Crestwood Medical Center	Huntsville	20		Madison	Urban	Urban	Impedance
Cullman Regional Medical Center	Cullman	27		Cullman	Heavily Rural	Rural	Impedance
Dale Medical Center	Ozark	11		Dale	Moderately Rural	Rural	Impedance
DCH Regional Medical Center	Tuscaloosa	57		Tuscaloosa	Urban	Urban	Impedance
Decatur General	Decatur	17		Morgan	Urban	Urban	Impedance
DeKalb Regional Medical Center	Fort Payne	16		DeKalb	Heavily Rural	Rural	Impedance
DW McMillan Memorial	Brewton	10		Escambia	Heavily Rural	Rural	Impedance
East Alabama Medical Center	Opelika	26		Lee	Urban	Rural	Impedance
Elba General Hospital	Elba	1	4	Coffee	Heavily Rural	Rural	APR
Eliza Coffee Memorial Hospital	Florence	17		Lauderdale	Urban	Urban	Impedance
Elmore Community Hospital	Wetumpka	4	8	Elmore	Moderately Rural	Rural	APR
Evergreen Medical Center	Evergreen	7		Conecuh	Heavily Rural	Rural	Impedance
Fayette Medical Center	Fayette	8		Fayette	Heavily Rural	Rural	Impedance
Florala Memorial Hospital	Florala	0	5	Covington	Heavily Rural	Rural	APR
Flowers Hospital	Dothan	13		Houston	Urban	Urban	Impedance
Gadsden Regional Medical Center	Gadsden	22		Etowah	Moderately Rural	Urban	Impedance
Georgiana Hospital	Georgiana	2	2	Butler	Heavily Rural	Rural	APR

*Closed as of January 1, 2013
**Modified from ALAHA website

HOSPITAL	HOSPITAL CITY	PHYSICIANS PRESENT	PHYSICIANS NEEDED	COUNTY	ARHA DESIGNATION	ALAHA DESIGNATION**	IMPEDANCE OR APR LIMITED
Greene County Hospital	Eutaw	0	3	Greene	Heavily Rural	Rural	APR
Grove Hill Memorial	Grove Hill	4		Clarke	Heavily Rural	Rural	Impedance
Hale County Hospital	Greensboro	4		Hale	Heavily Rural	Rural	Impedance
Hartselle Medical Center*	Hartselle	19		Morgan	Urban	Urban	Impedance
Helen Keller Hospital	Sheffield	9		Colbert	Moderately Rural	Urban	Impedance
Highlands Medical Center	Scottsboro	17		Jackson	Heavily Rural	Rural	Impedance
Hill Hospital of Sumter County	York	4	1	Sumter	Heavily Rural	Rural	APR
Huntsville Hospital	Huntsville	119		Madison	Urban	Urban	Impedance
Infirmary West*	Mobile	0		Mobile	Urban	Urban	Impedance
Jack Hughston Memorial Hospital	Phenix City	3		Russell	Moderately Rural	Urban	Impedance
Jackson Hospital	Montgomery	17		Montgomery	Urban	Urban	Impedance
Jackson Medical Center	Jackson	6		Clarke	Heavily Rural	Rural	Impedance
Jacksonville Medical Center	Jacksonville	5	3	Calhoun	Urban	Rural	APR
John Paul Jones Hospital	Camden	3		Wilcox	Heavily Rural	Rural	Impedance
L.V. Stabler Memorial Hospital	Greenville	2	2	Butler	Heavily Rural	Rural	APR
Lake Martin Community Hospital	Dadeville	4	1	Tallapoosa	Moderately Rural	Rural	APR
Lakeland Community Hospital	Haleyville	14		Winston	Heavily Rural	Rural	Impedance
Lanier Health Services	Valley	3	5	Chambers	Moderately Rural	Rural	APR
Lawrence Medical Center	Moulton	6	1	Lawrence	Heavily Rural	Rural	APR
Madison Hospital	Madison	8	5	Madison	Urban	Urban	APR
Marion Regional Medical Center/NMMC Hamilton	Hamilton	3	2	Marion	Heavily Rural	Rural	APR
Marshall Medical Center North	Guntersville	18		Marshall	Heavily Rural	Rural	Impedance
Marshall Medical Center South	Boaz	21		Marshall	Heavily Rural	Rural	Impedance
Medical Center Barbour	Eufaula	13		Barbour	Heavily Rural	Rural	Impedance
Medical Center Enterprise	Enterprise	4	4	Coffee	Heavily Rural	Rural	APR
Medical West, UAB Health System	Bessemer	18		Jefferson	Urban	Urban	Impedance
Mizell Memorial Hospital	Opp	6		Covington	Heavily Rural	Rural	Impedance
Mobile Infirmary Medical Center	Mobile	29		Mobile	Urban	Urban	Impedance
Monroe County Hospital	Monroeville	7		Monroe	Heavily Rural	Rural	Impedance
North Baldwin Infirmary	Bay Minette	3	5	Baldwin	Moderately Rural	Rural	APR
Northeast Alabama Regional Medical Center	Anniston	24		Calhoun	Urban	Urban	Impedance
Northport Medical Center	Northport	20		Tuscaloosa	Urban	Urban	Impedance
Northwest Medical Center	Winfield	6		Winston	Heavily Rural	Rural	Impedance
Parkway Medical Center	Decatur	8		Morgan	Urban	Urban	Impedance
Pickens County Medical Center	Carrollton	12		Pickens	Heavily Rural	Rural	Impedance
Prattville Baptist Hospital	Prattville	17		Autauga	Moderately Rural	Urban	Impedance

*Closed as of January 1, 2013
**Modified from ALAHA website

HOSPITAL	HOSPITAL CITY	PHYSICIANS PRESENT	PHYSICIANS NEEDED	COUNTY	ARHA DESIGNATION	ALAHA DESIGNATION**	IMPEDANCE OR APR LIMITED
Princeton Baptist Medical Center	Birmingham	17		Jefferson	Urban	Urban	Impedance
Providence Hospital	Mobile	14		Mobile	Urban	Urban	Impedance
Randolph Medical Center*	Roanoke	6		Randolph	Heavily Rural	Rural	Impedence
Red Bay Hospital	Red Bay	4		Franklin	Heavily Rural	Rural	Impedance
Riverview Regional Medical Center	Gadsden	17		Etowah	Moderately Rural	Urban	Impedance
Russell Medical Center	Alexander City	5	1	Tallapoosa	Moderately Rural	Rural	APR
Russellville Hospital	Russellville	6	1	Franklin	Heavily Rural	Rural	APR
Shelby Baptist Medical Center	Alabaster	28		Shelby	Urban	Urban	Impedance
Shoals Hospital	Muscle Shoals	9		Colbert	Moderately Rural	Urban	Impedance
South Baldwin Regional Medical Center	Foley	29		Baldwin	Moderately Rural	Urban	Impedance
Southeast Alabama Regional Medical Center	Dothan	24		Houston	Urban	Urban	Impedance
Southwest Alabama Medical Center*	Thomasville	7		Clarke	Heavily Rural	Rural	Impedance
Springhill Medical Center	Mobile	11		Mobile	Urban	Urban	Impedance
St. Vincent's Birmingham	Birmingham	13		Jefferson	Urban	Urban	Impedance
St. Vincent's Blount	Oneonta	11		Blount	Heavily Rural	Urban	Impedance
St. Vincent's East	Birmingham	10	8	Jefferson	Urban	Urban	APR
St. Vincent's St. Clair	Pell City	10		St. Clair	Moderately Rural	Urban	Impedance
Stringfellow Memorial Hospital	Anniston	9		Calhoun	Urban	Urban	Impedance
Thomas Hospital	Fairhope	31		Baldwin	Moderately Rural	Urban	Impedance
Trinity Medical Center	Birmingham	15		Jefferson	Urban	Urban	Impedance
Troy Regional Medical Center	Troy	10		Pike	Heavily Rural	Rural	Impedance
University of Alabama Hospital	Birmingham	40		Jefferson	Urban	Urban	Impedance
University of South Alabama Medical Center	Mobile	17		Mobile	Urban	Urban	Impedance
Vaughn Regional Medical Center	Selma	18		Dallas	Heavily Rural	Rural	Impedance
Walker Baptist Medical Center	Jasper	24		Walker	Moderately Rural	Rural	Impedance
Washington County Hospital	Chatom	2	1	Washington	Heavily Rural	Rural	APR
Wedowee Hospital	Wedowee	4	1	Randolph	Heavily Rural	Rural	APR
Whitfield Memorial Hospital	Demopolis	10		Marengo	Heavily Rural	Rural	Impedance
Wiregrass Medical Center	Geneva	3	2	Geneva	Heavily Rural	Rural	APR
				Cleburne	Heavily Rural		
				Coosa	Heavily Rural		
				Henry	Heavily Rural		
				Lamar	Heavily Rural		
				Lowndes	Heavily Rural		
				Macon	Heavily Rural		
				Perry	Heavily Rural		

*Closed as of January 1, 2013
**Modified from ALAHA website

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