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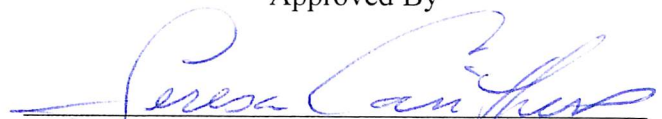
AN ASSESSMENT OF PRIMARY CARE PHYSICIAN SHORTAGES IN
MISSISSIPPI

by
Megumi Diane Mathis

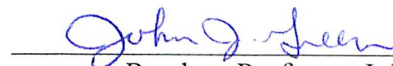
A thesis submitted to the faculty of The University of Mississippi in partial fulfillment of
the requirements of the Sally McDonnell Barksdale Honors College.

Oxford
May 2013

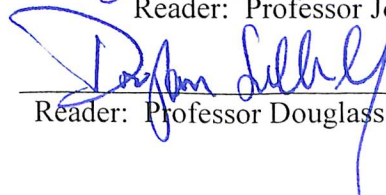
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A blue ink signature of Teresa Carithers, written in a cursive style, positioned above a horizontal line.

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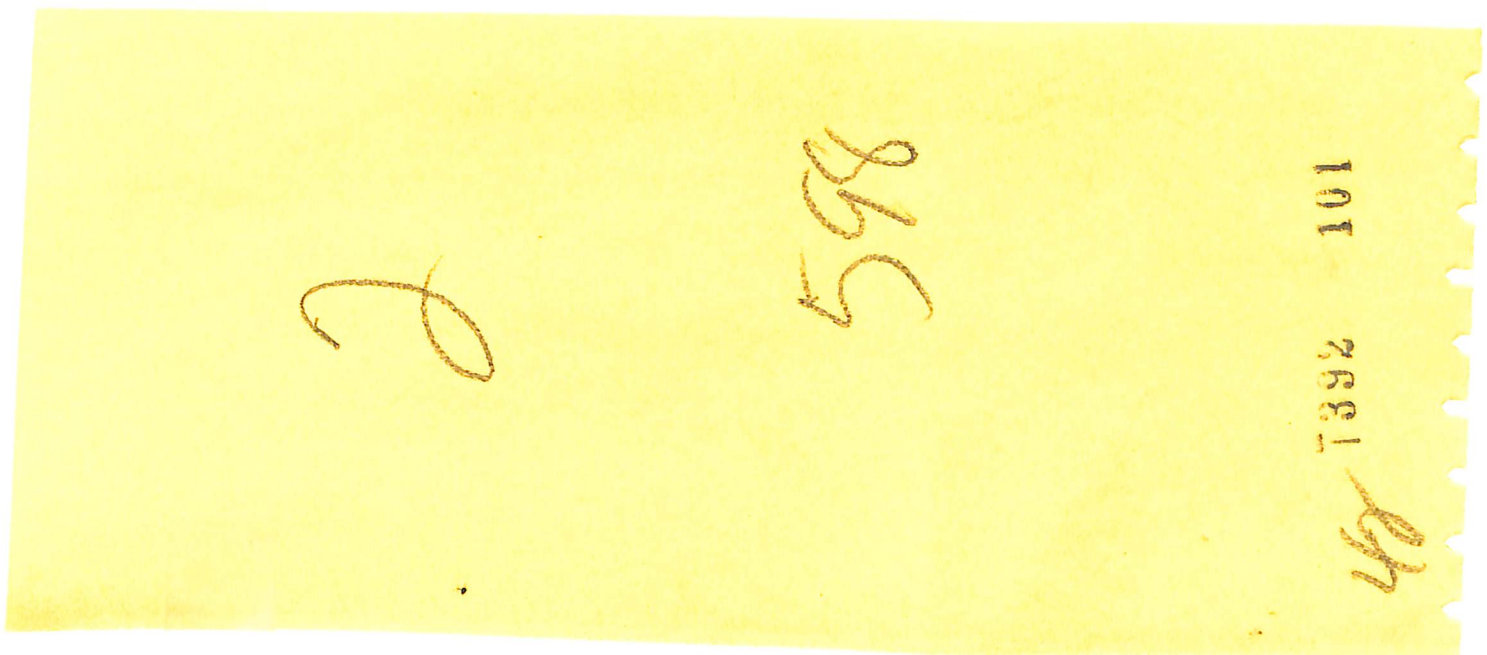
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ABSTRACT

According to the Department of Health and Human Services, there are Health Professional Shortage Areas in all states and territories of the United States.¹ Since fewer students graduating from medical school are choosing primary care,² it is imperative that future graduates in the field know which regions are in greatest need of primary care physicians. In a joint effort with the Mississippi Rural Physicians Scholarship Program and the Sally McDonnell Barksdale Honors College, this thesis used data obtained from the Mississippi Department of Health, the United States Census Bureau, the Mississippi State Medical Association, and the Mississippi State Board of Medical Licensure to research primary care physician shortages per specialty in each of the 82 Mississippi counties and to calculate each county's relative need for primary care physicians. For the purposes of this thesis, the primary care specialties considered were family/general practice, internal medicine, obstetrics and gynecology, and pediatrics. Both the primary care physician to population rates and average and median physician ages per county and for each specialty were used to calculate indices of care that compare each county's relative need for primary care physicians. Results showed that for overall primary care physicians and for those in family practice, relatively more counties had lower scores on their indices of care, while for those in obstetrics and gynecology, over half of the counties received the worst score, indicating that there were no physicians practicing obstetrics and gynecology in the county. These results are primarily intended to serve as a tool by which the Mississippi Rural Physicians Scholarship Program may direct its graduates to areas in need of their services.

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LIST OF ABBREVIATIONS

FP	family practice
HPSA	Health Professional Shortage Area
IM	internal medicine
OB/GYN	obstetrics and gynecology
PCP	primary care physician
PED	pediatrics
UA	urbanized area
UC	urban cluster
U.S.	United States

INTRODUCTION

According to the Department of Health and Human Services, there are Health Professional Shortage Areas (HPSAs) in all states and territories of the United States (U.S.).¹ Further, primary care physicians (PCPs) are outnumbered by specialist physicians in the U.S., and the percentage of PCPs falls far below the 50% of physicians that is commonly presumed necessary for the effective provision of healthcare.³ The problem is even worse in rural areas, where 11% of physicians must care for 20% of the nation's population.⁴ A higher number of PCPs, as manifested by greater physician to population rates, has been linked to reduced death rates from heart disease, stroke, and cancer, improved life spans, and a reduction in hospitalizations and healthcare costs.⁵⁻⁹ Conversely, a lack of PCPs would lead to poorer patient health, millions of preventable deaths, and increased healthcare costs.¹⁰ Since fewer students graduating from medical school are choosing primary care,² it is imperative that future graduates in the field know which regions are in greatest need of PCPs.

Physician to population rates have often been used to describe areas of healthcare provider shortages and to differentiate between varying levels of deficiency. The author of this thesis, however, felt that need could be better expressed with the addition of another variable, physician age. In this way, an area's need for future physicians could be more accurately determined, especially given that 42% of the country's physicians are over 55.¹¹

As a project performed in conjunction with the Mississippi Rural Physicians Scholarship Program, which funds the medical education of prospective rural Mississippi PCPs, the results are primarily intended to calculate each Mississippi county's relative

need for PCPs and serve as a tool by which the program may direct MRPSP graduates to areas in need of their services.

LITERATURE REVIEW

What is Primary Care?

Comprised mainly of generalists, primary care is noted by the American College of Physicians as being characterized by “first contact care, continuity of care, comprehensive care, and coordinated care”.¹⁰ PCPs are the first tier of management of chronic diseases, and they provide long-term care to their patients. They also focus on prevention of illness, thus helping to avoid potentially costly chronic conditions.¹⁰ Physicians in primary care must coordinate patients’ care, educate patients on the benefits of being referred to specialists or of diagnostic tests and treatments, and supply continuity of care to patients with complicated or multiple diseases.¹² As part of their preventive focus, they also deliver counseling in proper nutrition.¹³ For the purpose of this thesis, the primary care specialties considered were family/general practice, internal medicine, obstetrics and gynecology, and pediatrics.

PCPs are vital to the efficiency and quality of care in the U.S. healthcare system. The continuity of care and comprehensiveness that are characteristic of primary care will become even more important in light of increases in life span and higher prevalence of chronic disease.¹⁰

PCPs typically place higher value on interpersonal bonding and continuity of care than do specialists, whose care tends to be episodic and brief.³ Further, it has been shown that when physicians spend time and give advice to patients, there is an increase in adherence to suggested lifestyle changes.¹³

An increasingly more common option has been for specialists to provide the main care for patients whose illnesses lie within the specialists' field of expertise. However, the extent to which specialists can function as PCPs and provide accessible, comprehensive, continuous, and coordinated care for most of patients' illnesses is unclear. Due to the more specific nature of their training, they tend to negatively impact their cost of healthcare by seeking consultation and utilizing specific procedures of their specialties more frequently than would generalists.¹⁴

One benefit of primary care is an economic one. Primary care could reduce healthcare expenditures while maintaining quality of care.¹⁰ Studies on privately insured and Medicare/Medicaid patients have found that more contact with PCPs was linked to fewer hospitalizations¹⁵⁻¹⁶ and fewer preventable hospitalizations.¹⁷ Rizza et al confirmed this trend by analyzing admissions data at a hospital in Italy.¹⁸ A primary care emphasis within the healthcare system led to "enhanced continuity of care, higher rates of preventive services, fewer hospitalizations, and lower death rates" at a medical center in California¹⁹ and decreased hospitalization rates for specific illnesses in Spain.²⁰ Care by PCPs has also been shown to cut down on emergency room visits.²¹⁻²²

Research comparing the cost-effectiveness of care by PCPs versus that of specialists has shown that PCP involvement leads to shorter hospital stays¹⁰ with lower costs.²³

Studies looking at cost directly revealed that PCPs provide less expensive care than specialists,²⁴⁻³⁰ though patient outcomes were equivalent^{24,26,28} and one study found that PCPs and the specialists in that study had "no apparent differences in technical efficiency".²⁶

PCPs also produce better health outcomes.¹⁰ Studies in several countries have found that primary care reduces all-cause mortality^{19,27,31-32} and lowers premature mortality from cardiovascular and heart diseases, emphysema, and other causes. This reduced mortality was seen even after adjusting for various population traits.³¹

Research using surveys has shown that PCPs reduce the association between income inequality and self-reported health, with the association greatest in regions with more inequality.³³ Similarly, Shi and Starfield concluded that people residing in states with a higher PCP:population rate were more likely to describe themselves as being in good health.³⁴ A hospital-based study saw that uncontrolled hypertension was more likely to be present in patients with no PCP, even after controlling for various demographic and health factors.³⁵

PCPs also enhance quality of care by means of their preventive focus.¹⁰ Turner et al surveyed physicians for beliefs on screening for breast cancer and found that not only were general internists more educated on screening guidelines, but they were more inclined to have their patients undergo screening for the disease.³⁶ Research by Lewis et al surveyed “members and fellows of the American College of Physicians to determine their counseling practices in the areas of smoking, exercise, and seat belt use.” Their analysis showed that specialists were less prone to provide “at least one counseling session” to at-risk patients and were not as aggressive in their efforts to counsel.³⁷ Numerous other studies have investigated the relationship between primary care and preventive medicine and have found that patients who visit PCPs have better odds of receiving appropriately scheduled immunizations, screenings, and diagnostic tests.³⁸⁻⁴⁵

PCPs also provide continuity of care. Continuity of care, defined by Hjortdahl and Laerum as “the duration and intensity of the present patient-doctor relationship”,⁴⁶ decreases overall healthcare costs,⁴⁷⁻⁴⁸ can help physicians recognize specific illnesses in their patients,⁴⁹ and can increase patient satisfaction.⁴⁶ A study on children conducted by O’Malley and Forrest concluded that continuity of care doubled the odds that age-appropriate preventive care would be received,⁵⁰ and Christakis et al found that higher levels of continuity of care led to lower hospitalization rates from diabetic ketoacidosis.⁵¹

Saultz and Lochner scanned forty studies to find a relationship between continuity of care and the quality and cost of care. They found that 41 out of 81 care outcomes and 35 of the 41 cost variables were improved by continuity of care. The study also concluded that continuity of care is correlated with lower hospitalization rates.⁵²

Effects of Primary Care Physician Shortages and Benefits of Increasing Primary Care Physician Supply

As noted by Walker et al, a key component in mending population health in areas with poor access to care is the sufficient supply and distribution of PCPs.² In fact, improving the supply of PCPs would make it easier to find a personal physician, aid in the shifting of physicians to underserved areas, improve the efficiency of provided care, and reduce healthcare costs.¹⁴ Studies have shown that when PCPs are present in insufficient numbers, the quality of care delivered can suffer, resulting in millions of preventable deaths and an increase in healthcare costs.¹⁰

PCPs will become even more important as the population grows and the elderly live longer, leading to 29% more visits to ambulatory care clinics by 2025. Likewise, an increase in the number of children could cause 13% more patient visits.⁵³ The continuity of care that is offered by PCPs will also be critical in the management of the growing number of people suffering from chronic diseases.⁵⁴

One of the more notable impacts of an increase in PCP supply is decreased patient mortality.^{5-6,10,55-68} One study even showed that the number of PCPs in an area was more predictive of reduced mortality than was the availability of hospital beds.⁶ Along the same lines, patients residing in areas with a greater PCP supply enjoy better health outcomes, ranging from longer life spans⁷ and fewer hospitalizations^{9,57,67,69-70} to fewer low birthweights^{7,61} and a reduced incidence of disease because of improved diagnostic care.^{63-64,71}

Other research has focused on the economic impact of greater PCP supplies and concluded that areas without as many PCPs have higher healthcare costs for certain conditions.⁹ Mark et al and Baicker and Chandra conducted studies on Medicare beneficiaries to investigate the relationship between PCP supply and Medicare expenditures and concluded that expenditures were lower in states that had more PCPs.⁷²⁻⁷³ Baicker and Chandra went a step further in their study and calculated that when states added one PCP per 10,000 residents, the state's healthcare quality rank increased by over ten places and Medicare spending dropped \$684 per beneficiary. On the same note, the study estimated that adding one specialist per 10,000 residents would lead to a decrease in the state's quality rank of approximately nine places and add \$526 of spending per beneficiary.⁷³

Kravet et al studied the relationship between PCP supply and healthcare resource use. The study showed that higher proportions of PCPs were correlated with fewer total surgeries, fewer visits to the emergency room, and fewer admissions to the hospital, a relationship that was significant for every county in the U.S. The authors provided an illustration that stated that if a community of 775,000 added 35-40% more PCPs, it would experience 2,500 fewer inpatient admissions per year, 15,000 fewer visits to the emergency room each per year, and 2,500 fewer surgeries per year.⁷⁰

Rural Medicine in the United States

According to the Mississippi Office of Rural Health, 65 of the 82 Mississippi counties are considered to be non-metropolitan statistical areas, making Mississippi more rural than most states.⁷⁴ Since Mississippi is mostly rural, a review of rural medicine could help to provide a deeper understanding of healthcare in the state.

2010 Census criteria define rural areas in reference to urban areas: “Urban areas that contain 50,000 or more people are designated as urbanized areas (UAs); urban areas that contain at least 2,500 and less than 50,000 people are designated as urban clusters (UCs). The term “urban area” refers to both UAs and UCs. The term “rural” encompasses all population, housing, and territory not included within an urban area.”⁷⁵ 75% of the country’s counties and landmass are considered rural.⁷⁶ Towns in rural areas range from only a few residents to several thousand and vary in terms of racial and social characteristics.⁷⁷

According to the 2000 Census, rural residents comprise 20% of the country's population,⁷⁸ and this subset of the population is growing, though not rapidly.⁷⁷ Compared to those in urban areas, they tend to be older, have lower incomes, are more likely to be uninsured,⁷⁸ unemployed or underemployed,⁷⁶ and have limited mobility and decreased access to a PCP.⁷⁹ There are also relatively more children in these areas,⁷⁷ who are at increased risk of death from vehicular crashes and firearm accidents. In 1992, children in rural areas from 1 to 19 years of age had a 44% higher rate of death.⁷⁹ Rural residents involved in farming are at increased risk for "brain, stomach, lymphatic and hemopoietic, lip, prostate, and skin cancers", and their children suffer from higher pesticide exposure and related illnesses. Residents in rural areas may also often delay seeking care and have greater stress levels.⁷⁹

Despite the fact that a fifth of Americans reside in areas considered to be rural, only 9% of the physician workforce has practices located in these areas.⁸⁰ In rural counties, PCPs are at most half as available as in urban areas.⁷⁷ Recruiting and keeping physicians is more difficult for smaller towns.⁷⁸ This maldistribution is speculated to be due in part to a paucity of recreational and professional outlets, pervasive poverty, high percentages of ethnic minorities, and poor health insurance coverage.⁷⁷

Another factor that affects the distribution of physicians is specialty. Physicians practicing the primary care specialties of family medicine, pediatrics, or internal medicine are significantly more likely to be found in rural areas than physicians in other specialties.⁷⁷ Of physicians in rural towns with populations of 10,000 or less, 41% are family physicians and 19% are either pediatricians or internists.⁷⁸ In more remote towns, there are virtually only family physicians, likely due to their broad scope of practice and

thus larger patient base. The other primary care specialties are typically found in rural communities of 10,000 or more.⁷⁷

The financial nature of rural healthcare delivery systems is unique, as well. They are often characterized by “high fixed costs per service”, “high rates of fixed overhead per patient revenue”, and poor rates of reimbursement. Insurance coverage is another problem. An example of this is the case of residents in farming communities who have switched to high-deductible health insurance policies, which is practically the same as no insurance for many local PCPs.⁷⁷ Further, because of economic specialization, many rural communities are more susceptible to economic slumps than those in urban areas.⁷⁶

The healthcare delivery systems in rural areas vary from those in urban areas in several ways. Rural areas generally have fewer PCPs and medical facilities and have smaller population bases with which to support local PCPs. This often requires rural residents to travel farther distances for medical care, many times resulting in delays in seeking care. Still, they tend to have as much contact with medical personnel as urban residents. The smaller population bases of remote towns also makes it challenging for local PCPs to balance meeting the needs of their patients with earning a sufficient income, which can cause local PCPs to seek work in other locations. Compounding the matter is the large amount of rural uninsured and underinsured patients, who have limited means with which to support local PCPs. Inadequate insurance can cause residents to delay seeking care, travel farther distances in seeking care, or avoid seeking medical attention altogether.⁷⁷ The variety of services offered in rural areas also differs by region. While generalists in rural areas are less likely to offer orthopedic or pediatric care,⁷⁹ more

populated rural towns may allow residents in surrounding areas to access specialist services.⁷⁶

Hospitals are frequently the centers of healthcare delivery in rural communities. They have less access to resources than do urban hospitals, but because of the integration of novel information technology, management techniques, and methods of healthcare delivery, they maintain their place as local centers of activity. They also may have a strong, positive influence on the economies of small, rural areas,⁷⁹ though they have higher rates of closure.⁷⁶

In efforts to help the healthcare problems characteristic of rural communities, most researchers agree that increasing the PCP supply is integral. This begins as early as in medical school and before; studies have shown that graduate medical education produces more rural physicians when more students of rural origin are admitted, the medical school has a separate department for family medicine, the school has faculty with experience in rural areas, there are advising programs to ease the transition into residency, and when the medical school has a larger portion of its curriculum devoted to family medicine. Location is also important, as public medical schools located in rural states graduate higher percentages of rural physicians per class. Talley has described four patterns in rural health to help PCP maldistribution: “(1) students with rural origins are more likely to train in primary care and return to rural areas, (2) residents trained in rural areas are more likely to choose to practice in rural areas, (3) family medicine is the key discipline of rural health care, and (4) residents practice close to where they train”. Hart listed several other factors that often lead physicians to practice in rural areas: “FP specialty, rural training, proximity to family, matches between personal interests and

local opportunities, professional opportunities that match aspirations, good local K-12 schools, and the like”.⁷⁷

One method of increasing the number of rural physicians is offering incentives, whether in the form of higher reimbursement rates or help in repaying graduate education loans.⁸⁰ One program, the National Health Service Corps, offers physicians financial aid in return for several years of service in disadvantaged rural communities.⁷⁷ According to the Rural Health Research Centers in Chapel Hill and Seattle, the NHSC led 1 out of 5 independent rural physicians practicing in the late 1980s to the communities in which they practiced.⁸⁰

Increasing the supply of rural physicians also requires the retention of current physicians. Hart noted that successful retention depended on “reduction in the number of rural uninsured, underinsured, and poor; creation of a stable and financially sound rural health care delivery system; and provision for physicians to have rewarding professional and personal lives”. Federal efforts facilitate the retention of current rural physicians through such programs as Medicare, Medicaid, the creation of Federally-Qualified Health Centers, support through grants, and other methods.⁷⁷

Current Shortages

According to the Health Resources and Service Administration, there were around 5,900 primary care HPSAs in the U.S. in January of 2013. HPSAs are areas characterized by a PCP:population rate of no more than 1:3,500, a common rate used to

pinpoint underserved regions. This translates into an extra 7,550 PCPs required to eradicate all HPSAs in the country.⁸¹

Approximately 56 million Americans, or 20% of the country's population, have no or insufficient access to care because of too few PCPs.⁸² Regions such as the South and Mountain West tend to have proportionately fewer PCPs, while the Northeast enjoys relatively more.⁸³

Primary Care in Mississippi

In 2012, Mississippi documented approximately 2,850 PCPs. Around a third were in FP, another third in IM, and the final third was closely split between physicians practicing OB/GYN and PED.⁸⁴ Despite statewide PCP shortages, physicians in primary care barely outnumbered those in specialty care.⁸⁵ Mississippi contains 140 primary care HPSAs,⁸⁶ and slightly over half of the state's population lives in these areas.⁸⁷ Working alongside PCPs are nurse practitioners, who provide care under physicians and help alleviate the PCP shortage in the state.⁸⁸

METHODS

Before data collection, the principal investigator received Institutional Review Board approval for the study's protocol and completed Social and Behavioral Responsible Conduct of Research training through the Collaborative Institutional Training Initiative program.

In order to assess county-wide relative need for PCPs, two groups of data were analyzed. The first was average and median PCP ages per county, with the assumption that counties with higher average and median ages would be in greater need of new physicians. The second was the PCP:population rate, which was calculated by dividing the number of PCPs in a county by its population and multiplying the result by 10,000 to find the number of PCPs per 10,000 residents. It was reasoned that lower PCP:population rates would be indicative of a higher need for PCPs. In order to determine physician ages, birthdates were collected from the Mississippi State Medical Association and the Mississippi State Board of Medical Licensure. The numbers of PCPs per county used for determining the PCP:population rates were collected from information obtained from the Mississippi Department of Health, as were specialty and practice information. Through the American Factfinder web portal, 2010 county populations were collected from the U.S. Census Bureau Decennial Census Program, and 2011 county population estimates were gathered from the US Census Bureau Population Estimates Program. As per Institutional Review Board regulations, data request letters were sent as necessary and all data, including identifiers, were accessible only to the PI and research advisors listed in the approved protocol.

Average and median ages were calculated in Microsoft Excel using 1/1/2011 to subtract birthdates from. Both average and median ages were used in order to avoid skewing data for counties with fewer PCPs. PCP:population rates were also found in Microsoft Excel using both 2010 US Census data and 2011 population estimates from the Census Bureau. Average and median ages and PCP:population rates were found for all 82 counties and for all four primary care specialties considered in the study: family practice (FP), internal medicine (IM), obstetrics and gynecology (OB/GYN), and pediatrics (PED).

The spectrum of ages and rates were separately divided into tertiles using the percentile function in IBM SPSS Statistics 20 (2011) with 33.33% and 66.66% as cutoffs. The lowest tertiles in the age categories were assigned a value of 1, the middle tertiles a value of 2, and the highest tertiles a value of 3. Counties with no physicians were assigned a value of 4. In this manner, greater values indicated greater need. For the PCP:population rates, the highest tertiles were assigned a value of 1, the middle tertiles a value of 2, and the lowest tertiles a value of 3. Again, counties with no physicians were assigned a value of 4 to indicate greatest need.

In order to combine the two variables and formulate what the researchers dubbed an index of need, both newly assigned values for each county were added together to create an index from 2-8 by creating a crosstabulation table of physician-to-population rate tertiles and physician average age tertiles. Lower and higher scores on the index were reflective of less and greater need, respectively. This index was then recoded to an index of 1-7 for more intuitive interpretation. Finally, scores of 7 were relabeled as scores of 6, since there were no counties with scores of 6 in any specialty. This process

was repeated for all four primary care specialties and counties were subsequently listed by need in table format. Because the correlation between raw average and median ages was not as high as desired ($r = 0.906$), index of need scores were calculated twice using average and then median age scores.

As a final measure, all four index of need specialty scores per county were averaged together to provide a bigger picture of PCP need between counties.

RESULTS

Table 1. Additional Analyses. When considering all PCPs, Mississippi counties averaged 3.74 physicians per 10,000 people. Physician-to-population rates per specialty were highest for family practice physicians at 2.04 per 10,000 and were lowest for OB/GYN and pediatric physicians, both around 0.45 per 10,000. The average PCP age for Mississippi counties was 53.29, though one county's physicians had an average age of 65.20. Average, minimum, and maximum ages were very similar when using each county's median PCP age. Though there were counties that scored the lowest and highest possible scores on the index of need, the average county score was 3.06.

Additional Analyses		
PCP:Population Rate (including all PCPs and using 2011 population estimates)	Average	3.74
	Median	3.44
	Mode	1.79
	Standard Deviation	1.82
	Minimum	0.61
	Maximum	10.55
PCP Age (using average PCP ages per county)	Average	53.29
	Median	52.88
	Mode	56.00
	Standard Deviation	5.04
	Minimum	40.66
	Maximum	65.20
PCP Age (using median PCP ages per county)	Average	52.70
	Median	53.00
	Mode	50.00
	Standard Deviation	5.45
	Minimum	40.00
	Maximum	65.00
Index of Need Scores (including all PCPs)	Average	3.06
	Median	3.00
	Mode	2.00
	Standard Deviation	1.33
	Minimum	1.00
	Maximum	6.00

Map 1: Physician Need Index Scores in Mississippi Counties

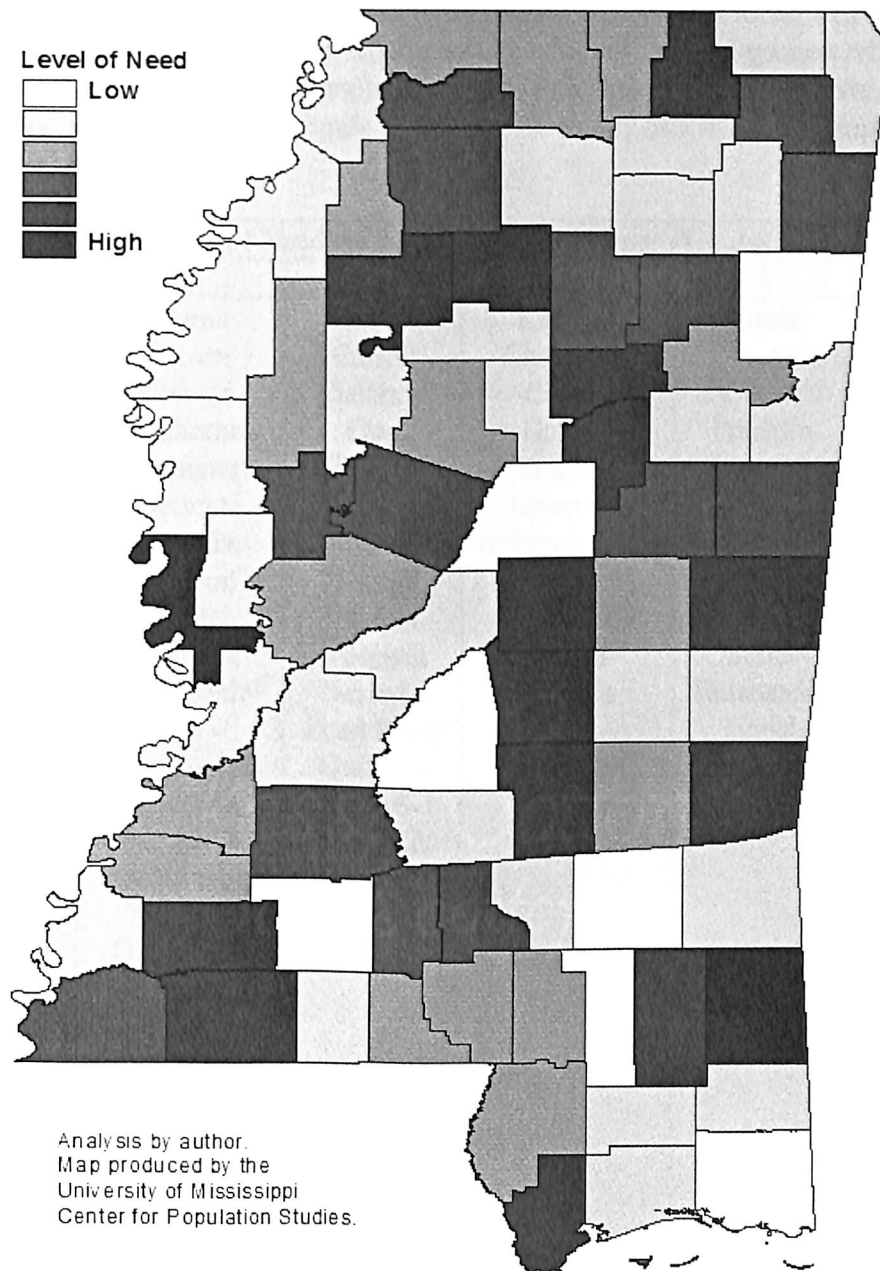


Figure 1. Physician Need Index Scores in Mississippi Counties. Counties are shaded according to their score on the Index of Need for all PCPs (see Table 1), with the lightest shade indicating scores of 1 up to the darkest shade representing scores of 6. Surprisingly, all counties with the maximum score of 6 are adjacent to at least one county with a score of 2. Otherwise, the map reveals no readily observable geographic patterns, though small blocks of adjacent counties with the same scores can be found. Five counties, Greene, Issaquena, Leake, Tallahatchie, and Yalobusha, scored a 5 or 6 across all four specialties.

Table 2. Index of Need for All PCPs using Average PCP Ages. A positively skewed distribution becomes evident when analyzing index of need scores for all PCPs per county. The only two counties to receive a score of 6, indicative of greatest relative need, are Greene and Issaquena counties, neither of which had any PCPs whatsoever at the time of analysis. As mentioned in Figure 1, there are no readily observable geographic patterns to be discerned.

Index of Need for All PCPs using Average PCP Ages					
1	2	3	4	5	6
Attala	Adams	Benton	Calhoun	Amite	Greene Issaquena
Forrest	Alcorn	Carroll	Chickasaw	Choctaw	
Jackson	Bolivar	Claiborne	Copiah	Clarke	
Jones	Coahoma	Clay	Holmes	Franklin	
Lincoln	Covington	Desoto	Humphreys	Hancock	
Monroe	George	Jasper	Itawamba	Kemper	
Rankin	Grenada	Jefferson	Jefferson Davis	Leake	
	Harrison	Lamar	Lawrence	Perry	
	Hinds	Marion	Noxubee	Scott	
	Lafayette	Marshall	Panola	Smith	
	Lauderdale	Neshoba	Prentiss	Tallahatchie	
	Lee	Pearl River	Tate	Tippah	
	Leflore	Quitman	Wilkinson	Webster	
	Lowndes	Sunflower	Winston	Yalobusha	
	Madison	Walthall			
	Montgomery	Yazoo			
	Newton				
	Oktibbeha				
	Pike				
	Pontotoc				
	Sharkey				
	Simpson				
	Stone				
	Tishomingo				
	Tunica				
	Union				
	Warren				
	Washington				
	Wayne				

Table 3. Index of Need for All PCPs using Median PCP Ages. These scores were calculated following the same protocol as in Table 1, except that each county's median PCP age was used to determine relative need. This resulted in a similarly positive skew, though a greater proportion of counties received higher scores.

Index of Need for All PCPs using Median PCP Ages					
1	2	3	4	5	6
Adams	Bolivar	Benton	Chickasaw	Jefferson Davis	Greene
Alcorn	Coahoma	Calhoun	Claiborne	Tate	Issaquena
Attala	Covington	Carroll	Hancock	Amite	
Forrest	Desoto	Clay	Holmes	Choctaw	
Grenada	George	Copiah	Humphreys	Clarke	
Jackson	Harrison	Jasper	Itawamba	Franklin	
Jones	Hinds	Jefferson	Lamar	Kemper	
Lee	Lafayette	Madison	Lawrence	Leake	
Monroe	Lauderdale	Marion	Neshoba	Scott	
Rankin	Leflore	Marshall	Noxubee	Smith	
Pike	Lincoln	Pearl River	Panola	Tallahatchie	
	Lowndes	Prentiss	Perry	Tippah	
	Montgomery	Quitman	Tishomingo	Webster	
	Newton	Simpson	Wilkinson	Yalobusha	
	Oktibbeha	Sunflower	Winston		
	Pontotoc	Tunica			
	Sharkey	Washington			
	Stone	Walthall			
	Union	Yazoo			
	Warren				
	Wayne				

Table 4. Index of Need for Family Practice PCPs using Average Ages. The following calculations include only data on family practice physicians, a subset of all PCPs. Scores are slightly skewed, with more counties receiving lower scores. The distribution of scores for family practice physicians is similar to that for overall PCPs, and further analysis revealed a correlation of 0.483 between the two.

Index of Need for Family Practice PCPs using Average Ages					
1	2	3	4	5	6
Attala	Alcorn	Calhoun	Amite	Clay	Benton
Covington	Bolivar	Choctaw	Chickasaw	Coahoma	Greene
Forrest	Carroll	Clarke	Hancock	Leake	Humphreys
Montgomery	Quitman	Copiah	Harrison	Leflore	Issaquena
Pontotoc	Claiborne	Desoto	Hinds	Lincoln	
Sharkey	George	Franklin	Jackson	Newton	
Yazoo	Grenada	Holmes	Jefferson Davis	Tallahatchie	
	Lafayette	Itawamba	Kemper	Yalobusha	
	Lauderdale	Jasper	Lowndes		
	Lee	Jefferson	Noxubee		
	Monroe	Jones	Panola		
	Oktibbeha	Lamar	Scott		
	Simpson	Lawrence	Smith		
	Stone	Madison	Tate		
	Tishomingo	Marion	Washington		
	Tunica	Marshall	Webster		
	Union	Neshoba	Wilkinson		
	Walthall	Pearl River			
	Warren	Perry			
		Pike			
		Prentiss			
		Rankin			
		Adams			
		Sunflower			
		Tippah			
		Wayne			
		Winston			

Table 5. Index of Need for Family Practice PCPs using Median Ages. The same analyses using median PCP ages results in identical scores for almost all counties.

Index of Need for Family Practice PCPs using Median Ages					
1	2	3	4	5	6
Alcorn	Calhoun	Adams	Amite	Clay	Benton
Attala	Carroll	Bolivar	Chickasaw	Leake	Greene
Covington	Copiah	Choctaw	Clarke	Leflore	Humphreys
Grenada	Forrest	Franklin	Coahoma	Lincoln	Issaquena
Montgomery	George	Holmes	Hancock	Newton	
Pontotoc	Lafayette	Itawamba	Harrison	Tallahatchie	
Sharkey	Lee	Jackson	Hinds	Yalobusha	
Yazoo	Monroe	Jasper	Jefferson		
	Oktibbeha	Jefferson	Davis		
	Quitman	Jones	Kemper		
	Simpson	Lauderdale	Lamar		
	Stone	Lawrence	Noxubee		
	Tishomingo	Perry	Panola		
	Tunica	Lowndes	Scott		
	Walthall	Madison	Smith		
	Warren	Marion	Tate		
		Marshall	Washington		
		Neshoba	Webster		
		Pearl River	Wilkinson		
		Pike			
		Prentiss			
		Rankin			
		Sunflower			
		Tippah			
		Union			
		Claiborne			
		Wayne			
		Desoto			
		Winston			

Table 6. Index of Need for Internal Medicine PCPs using Average Ages. A large minority of Mississippi counties received a score of 6 in this table, which means that they had no internal medicine PCP at the time of analysis.

Index of Need for Internal Medicine PCPs using Average Ages					
1	2	3	4	5	6
Benton Forrest Newton	Alcorn Bolivar Grenada Hinds Jefferson Davis Lee Lincoln Noxubee Panola Quitman Tishomingo Tunica Union Wilkinson	Adams Chickasaw Clay Coahoma Copiah Desoto George Harrison Holmes Jackson Jefferson Jones Lafayette Lauderdale Leflore Lowndes Marion Neshoba Pearl River Prentiss Rankin Stone Sunflower Wayne	Hancock Humphreys Jasper Madison Marshall Monroe Warren Washington	Leake Oktober Pike Tallahatchie Tate Walthall	Amite Attala Calhoun Carroll Choctaw Claiborne Clarke Covington Franklin Greene Issaquena Itawamba Kemper Lamar Lawrence Montgomery Perry Pontotoc Scott Sharkey Simpson Smith Tippah Webster Winston Yalobusha Yazoo

Table 7. Index of Need for Internal Medicine PCPs using Median Ages.

Index of Need for Internal Medicine PCPs using Median Ages					
1	2	3	4	5	6
Benton Forrest Newton Union	Alcorn Bolivar Harrison Hinds Jackson Jefferson Davis Lee Lincoln Marion Noxubee Prentiss Quitman Tishomingo Tunica Wilkinson	Adams Chickasaw Clay Coahoma Copiah Desoto Grenada Hancock Holmes Jasper Jefferson Jones Lafayette Lauderdale Leflore Lowndes Neshoba Panola Pearl River Stone Sunflower Washington	George Humphreys Madison Marshall Monroe Rankin Warren Wayne	Leake Tallahatchie Oktibbeha Pike Tate Walthall	Amite Attala Calhoun Carroll Choctaw Claiborne Clarke Covington Franklin Greene Issaquena Itawamba Kemper Lamar Lawrence Montgomery Perry Pontotoc Scott Sharkey Simpson Smith Tippah Webster Winston Yalobusha Yazoo

Table 8. Index of Need for OB/GYN PCPs using Average Ages. Scores calculated using data on OB/GYN PCPs only are significantly skewed. In this primary care specialty, over half of the counties in the state were without OB/GYN physicians. When these counties are ignored, however, scores are almost normally distributed.

Index of Need for OB/GYN PCPs using Average Ages					
1	2	3	4	5	6
Coahoma Forrest Rankin Union	Bolivar Hinds Jones Lee Leflore Oktibbeha Panola Pike Warren	Clay Copiah Covington Grenada Harrison Jefferson Lafayette Lincoln Lowndes Wayne	Adams Alcorn Desoto Jackson Lauderdale Monroe Washington	Hancock Madison Pearl River Prentiss Stone	Amite Attala Benton Calhoun Carroll Chickasaw Choctaw Claiborne Clarke Franklin George Greene Holmes Humphreys Issaquena Itawamba Jasper Jefferson Davis Kemper Lamar Lawrence Leake Marion Sunflower Marshall Montgomery Neshoba Newton Noxubee Perry Pontotoc Quitman Scott Sharkey Simpson Smith Tallahatchie Tate Tippah Tishomingo Tunica Walthall Webster Wilkinson Winston Yalobusha Yazoo

Table 9. Index of Need for OB/GYN PCPs using Median Ages.

Index of Need for OB/GYN PCPs using Median Ages					
1	2	3	4	5	6
Forrest Union Rankin	Bolivar Coahoma Hinds Jones Lee Leflore Lowndes Panola Pike Warren	Clay Copiah Covington Grenada Harrison Jackson Jefferson Lafayette Lincoln Oktibbeha Wayne	Adams Alcorn Desoto Lauderdale Monroe Washington	Hancock Madison Pearl River Prentiss Stone	Amite Attala Benton Calhoun Carroll Chickasaw Choctaw Claiborne Clarke Franklin George Greene Holmes Humphreys Issaquena Itawamba Jasper Jefferson Davis Kemper Lamar Lawrence Leake Marion Sunflower Marshall Montgomery Neshoba Newton Noxubee Perry Pontotoc Quitman Scott Sharkey Simpson Smith Tallahatchie Tate Tippah Tishomingo Tunica Walthall Webster Wilkinson Winston Yalobusha Yazoo

Table 10. Index of Need for Pediatrics PCPs using Average Ages. The distribution of scores determined using data on pediatricians mimics that of the distribution for OB/GYN PCPs. Further analysis found a correlation of 0.619 between the two variables.

Index of Need for Pediatrics PCPs using Average Ages					
1	2	3	4	5	6
Adams Alcorn Forrest Humphreys Jones	Bolivar Harrison Lafayette Lauderdale Lee Monroe Tunica Washington	Clay Coahoma George Jackson Leflore Lincoln Neshoba Newton Pearl River Pike Prentiss Rankin Union Warren Wayne	Desoto Grenada Hinds Jasper Lowndes Madison Oktoberfest Tate	Attala Chickasaw Hancock Panola Tishomingo	Amite Benton Calhoun Carroll Choctaw Claiborne Clarke Copiah Covington Franklin Greene Holmes Issaquena Itawamba Jefferson Jefferson Davis Kemper Lamar Lawrence Leake Marion Sunflower Marshall Montgomery Noxubee Perry Pontotoc Quitman Scott Sharkey Simpson Smith Stone Tallahatchie Tippah Walthall Webster Wilkinson Winston Yalobusha Yazoo

Table 11. Index of Need for Pediatrics PCPs using Median Ages.

Index of Need for Pediatrics PCPs using Median Ages					
1	2	3	4	5	6
Adams Alcorn Forrest Humphreys Jones	Bolivar Harrison Lee Monroe Tunica Washington	Clay Coahoma Desoto George Jackson Lafayette Lauderdale Leflore Lincoln Neshoba Newton Pearl River Pike Prentiss Rankin Union Warren Wayne	Grenada Hinds Jasper Lowndes Madison Oktribbeha Tate	Attala Chickasaw Hancock Panola Tishomingo	Amite Benton Calhoun Carroll Choctaw Claiborne Clarke Copiah Covington Franklin Greene Holmes Issaquena Itawamba Jefferson Jefferson Davis Kemper Lamar Lawrence Leake Marion Sunflower Marshall Montgomery Noxubee Perry Pontotoc Quitman Scott Sharkey Simpson Smith Stone Tallahatchie Tippah Walthall Webster Wilkinson Winston Yalobusha Yazoo

DISCUSSION

It is important to note that this study did not calculate direct need for PCPs, but instead determined relative need among all Mississippi counties. It can only be concluded, therefore, that certain counties are in greater need of PCPs than other counties per these calculations. Still, many counties received scores of 6 on their indices of care, indicative of no PCPs at all in the county. Five counties, Greene, Issaquena, Leake, Tallahatchie, and Yalobusha, scored a 5 or 6 across all four specialties. Doubtless, these counties are in both relative and absolute need. Furthermore, over half of Mississippi counties lacked a single OB/GYN physician whatsoever. Almost half were unable to claim a pediatrician. Many of the counties found to be deficient in one specialty were also lacking in other specialties, though need for FP physicians tended to be less for most counties. Interestingly, the map showing relative need for all PCPs (Figure 1) reveals no readily observable geographic patterns, though small blocks of adjacent counties with the same scores can be found.

Given that an estimated 159 PCPs are needed in order to adequately serve all HPSAs in the state,⁸⁷ Mississippi's healthcare system still has room for improvement. For this to occur, more PCPs will need to be cultivated, recruited, and retained, particularly in underserved areas. Several forces, such as the National Health Service Corps, the Affordable Care Act, and the recently established Office of Mississippi Physician Workforce, are already working toward this end.

This study was unique in that it endeavored to accurately gauge relative need among counties in the state using both physician-to-population rates and PCP age, but given the significant presence of nurse practitioners and physicians assistants helping to

bear the burdens of primary care. future research is needed to incorporate their impact into relative need calculations. In addition, greater consideration should be given to the unique demographics and physical and cultural environments of each county, as these impact need for PCPs as well. Further, future research could control for population density and how urban or rural counties are.

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APPENDIX

Table A-1. PCP:Population Rate Scores per County. The index of need scores listed in the tables in the Results section were determined by combining PCP:population rate scores with PCP age scores (Tables A-2 and A-3). Because the correlation between raw average and median ages was not as high as desired ($r = 0.906$), index of need scores were calculated twice using average and then median age scores.

County	All PCPs	FP	IM	OB/GYN	PED
Adams	1	1	1	2	1
Alcorn	1	2	2	2	1
Amite	3	3	4	4	4
Attala	1	1	4	4	3
Benton	3	4	1	4	4
Bolivar	1	1	2	2	2
Calhoun	2	3	4	4	4
Carroll	3	1	4	4	4
Chickasaw	2	3	2	4	3
Choctaw	3	2	4	4	4
Claiborne	2	2	4	4	4
Clarke	3	2	4	4	4
Clay	1	3	1	2	3
Coahoma	1	3	1	1	1
Copiah	2	3	3	3	4
Covington	2	1	4	3	4
Desoto	2	1	2	3	2
Forrest	1	1	1	1	1
Franklin	3	3	4	4	4
George	2	1	2	4	2
Greene	4	4	4	4	4
Grenada	1	2	1	1	2
Hancock	3	2	3	3	3
Harrison	1	2	1	2	1
Hinds	1	2	1	1	2
Holmes	2	3	1	4	4
Humphreys	3	4	2	4	1
Issaquena	4	4	4	4	4
Itawamba	2	3	4	4	4
Jackson	1	3	2	3	2
Jasper	3	1	3	4	3
Jefferson	1	3	1	1	4
Jefferson Davis	3	2	2	4	4

Jones	1	2	2	2	1
Kemper	3	3	4	4	4
Lafayette	2	1	3	2	1
Lamar	3	1	4	4	4
Lauderdale	1	2	2	2	1
Lawrence	2	3	4	4	4
Leake	3	3	3	4	4
Lee	1	2	1	1	1
Leflore	1	3	1	1	3
Lincoln	1	3	1	2	2
Lowndes	1	2	1	1	2
Madison	2	1	3	3	2
Marion	2	2	2	4	4
Marshall	3	1	3	4	4
Monroe	1	1	3	3	1
Montgomery	2	1	4	4	4
Neshoba	2	3	3	4	3
Newton	2	3	1	4	2
Noxubee	2	3	2	4	4
Oktibbeha	1	2	3	1	3
Panola	2	3	2	2	3
Pearl River	3	1	3	3	3
Perry	3	2	4	4	4
Pike	1	2	3	1	1
Pontotoc	2	1	4	4	4
Prentiss	2	1	1	3	3
Quitman	3	1	2	4	4
Rankin	1	1	3	1	2
Scott	3	3	4	4	4
Sharkey	1	1	4	4	4
Simpson	1	2	4	4	4
Smith	3	2	4	4	4
Stone	2	1	3	3	4
Sunflower	2	2	3	4	4
Tallahatchie	3	3	3	4	4
Tate	3	2	3	4	2
Tippah	3	2	4	4	4
Tishomingo	2	1	2	4	3
Tunica	2	2	2	4	2

Union	1	2	1	1	2
Walthall	2	1	3	4	4
Warren	1	2	2	2	1
Washington	1	2	2	2	1
Wayne	2	1	2	3	3
Webster	3	3	4	4	4
Wilkinson	2	3	1	4	4
Winston	2	3	4	4	4
Yalobusha	3	3	4	4	4
Yazoo	3	1	4	4	4

Table A-2. PCP Age Scores per County (Using Average Ages).

County	All PCPs	FP	IM	OB/GYN	PED
Adams	2	1	3	3	1
Alcorn	2	2	1	3	1
Amite	3	3	4	4	4
Attala	1	1	4	4	3
Benton	1	4	1	4	4
Bolivar	2	1	1	1	1
Calhoun	3	3	4	4	4
Carroll	1	1	4	4	4
Chickasaw	3	3	2	4	3
Choctaw	3	2	4	4	4
Claiborne	2	2	4	4	4
Clarke	3	2	4	4	4
Clay	3	3	3	2	1
Coahoma	2	3	3	1	3
Copiah	3	3	1	1	4
Covington	1	1	4	1	4
Desoto	2	1	2	2	3
Forrest	1	1	1	1	1
Franklin	3	3	4	4	4
George	1	1	2	4	2
Greene	4	4	4	4	4
Grenada	2	2	2	3	3
Hancock	3	2	2	3	3
Harrison	2	2	3	2	2
Hinds	2	2	2	2	3
Holmes	3	3	3	4	4
Humphreys	2	4	3	4	1
Issaquena	4	4	4	4	4
Itawamba	3	3	4	4	4
Jackson	1	3	2	2	2
Jasper	1	1	2	4	2
Jefferson	3	3	3	3	4
Jefferson Davis	2	2	1	4	4
Jones	1	2	2	1	1
Kemper	3	3	4	4	4
Lafayette	1	1	1	2	2
Lamar	1	1	4	4	4

Lauderdale	2	2	2	3	2
Lawrence	3	3	4	4	4
Leake	3	3	3	4	4
Lee	2	2	2	2	2
Leflore	2	3	3	2	1
Lincoln	1	3	2	2	2
Lowndes	2	2	3	3	3
Madison	1	1	2	3	3
Marion	2	2	2	4	4
Marshall	1	1	2	4	4
Monroe	1	1	2	2	2
Montgomery	1	1	4	4	4
Neshoba	2	3	1	4	1
Newton	1	3	1	4	2
Noxubee	3	3	1	4	4
Oktibbeha	2	2	3	2	2
Panola	3	3	1	1	3
Pearl River	1	1	1	3	1
Perry	3	2	4	4	4
Pike	2	2	3	2	3
Pontotoc	1	1	4	4	4
Prentiss	3	1	3	3	1
Quitman	1	1	1	4	4
Rankin	1	1	1	1	2
Scott	3	3	4	4	4
Sharkey	2	1	4	4	4
Simpson	2	2	4	4	4
Smith	3	2	4	4	4
Stone	1	1	1	3	4
Sunflower	2	2	1	4	4
Tallahatchie	3	3	3	4	4
Tate	2	2	3	4	3
Tippah	3	2	4	4	4
Tishomingo	1	1	1	4	3
Tunica	1	2	1	4	1
Union	2	2	2	1	2
Walthall	2	1	3	4	4
Warren	2	2	3	1	3
Washington	2	2	3	3	2

Wayne	1	1	2	1	1
Webster	3	3	4	4	4
Wilkinson	3	3	2	4	4
Winston	3	3	4	4	4
Yalobusha	3	3	4	4	4
Yazoo	1	1	4	4	4

Table A-3. PCP Age Scores per County (Using Median Ages).

County	All PCPs	FP	IM	OB/GYN	PED
Adams	1	1	3	3	1
Alcorn	1	1	1	3	1
Amite	3	3	4	4	4
Attala	1	1	4	4	3
Benton	1	4	1	4	4
Bolivar	2	2	1	1	1
Calhoun	2	2	4	4	4
Carroll	1	1	4	4	4
Chickasaw	3	3	2	4	3
Choctaw	3	2	4	4	4
Claiborne	3	3	4	4	4
Clarke	3	3	4	4	4
Clay	3	3	3	2	1
Coahoma	2	2	3	2	3
Copiah	2	2	1	1	4
Covington	1	1	4	1	4
Desoto	1	1	2	2	2
Forrest	1	2	1	1	1
Franklin	3	3	4	4	4
George	1	1	3	4	2
Greene	4	4	4	4	4
Grenada	1	1	3	3	3
Hancock	2	2	1	3	3
Harrison	2	2	2	2	2
Hinds	2	2	2	2	3
Holmes	3	3	3	4	4
Humphreys	2	4	3	4	1
Issaquena	4	4	4	4	4
Itawamba	3	3	4	4	4
Jackson	1	2	1	1	2
Jasper	1	1	1	4	2
Jefferson	3	3	3	3	4
Jefferson Davis	3	2	1	4	4
Jones	1	2	2	1	1
Kemper	3	3	4	4	4
Lafayette	1	1	1	2	3
Lamar	2	2	4	4	4

Lauderdale	2	3	2	3	3
Lawrence	3	3	4	4	4
Leake	3	3	3	4	4
Lee	1	2	2	2	2
Leflore	2	3	3	2	1
Lincoln	2	3	2	2	2
Lowndes	2	1	3	2	3
Madison	2	1	2	3	3
Marion	2	2	1	4	4
Marshall	1	1	2	4	4
Monroe	1	1	2	2	2
Montgomery	1	1	4	4	4
Neshoba	3	3	1	4	1
Newton	1	3	1	4	2
Noxubee	3	3	1	4	4
Oktibbeha	2	2	3	3	2
Panola	3	3	2	1	3
Pearl River	1	1	1	3	1
Perry	2	2	4	4	4
Pike	1	2	3	2	3
Pontotoc	1	1	4	4	4
Prentiss	2	1	2	3	1
Quitman	1	1	1	4	4
Rankin	1	1	2	1	2
Scott	3	3	4	4	4
Sharkey	2	1	4	4	4
Simpson	3	2	4	4	4
Smith	3	2	4	4	4
Stone	1	1	1	3	4
Sunflower	2	2	1	4	4
Tallahatchie	3	3	3	4	4
Tate	3	2	3	4	3
Tippah	3	2	4	4	4
Tishomingo	3	1	1	4	3
Tunica	2	2	1	4	1
Union	2	3	1	1	2
Walthall	2	1	3	4	4
Warren	2	2	3	1	3
Washington	3	2	2	3	2

Wayne	1	1	3	1	1
Webster	3	3	4	4	4
Wilkinson	3	3	2	4	4
Winston	3	3	4	4	4
Yalobusha	3	3	4	4	4
Yazoo	1	1	4	4	4