

# REGIONAL HEALTHCARE DISPARITIES: ANALYZING THE SERVICE RADII FOR SELECT PHYSI- CIAN SPECIALITIES ACROSS ARIZONA

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## Abstract:

There is a great disparity between healthcare access in urban and rural areas nationally. Arizona is no stranger to this crisis, with 7 out of 15 counties considered rural. One of the driving factors of this disparity is the large difference in the number of physicians practicing in rural versus urban counties. To quantify the crisis, this paper analyzes the numbers of primary care physicians (internists, family medicine specialists, and pediatricians), cardiologists, and psychiatrists practicing in each Arizona county. The more physicians serving in an area, the smaller their service radii. As the radius grows, accessibility declines due to factors like travel time. Given the scale of the crisis, there are current efforts to mitigate it. These include monetary incentives for practicing and training physicians and increased rural training programs. But these efforts need to be implemented at a larger scale if this growing crisis is going to be alleviated for future generations.

# Introduction & Relevance:

The United States is one of the richest countries in the world and plays a major role in international politics. Its innovations, from Ford's affordable car to Facebook, have changed the world, but the country has its shortcomings as well. Nationalized health insurance has been a conversation for the last decade, and health-care access is a mounting issue. The disparity between rural and urban centers is daunting. Some rural patients, for instance, have to travel hours for a short fifteen-minute appointment. While visits utilizing telemedicine have increased during the COVID-19 pandemic, the permanence of telemedicine access is unknown since initial legislation was temporary.

Arizona is not at the bottom of rural healthcare access nationally; however, healthcare access remains insufficient across the state. Arizona ranks 31st in the physician-to-people ratio across the U.S. (Koch, et al., 2019). Nationally, there are approximately 237 physicians for every 100,000 people (92 PCPs for every 100,000). Arizona reflects the national average with 236 physicians for every 100,000, but is significantly below the national average for PCPs, with only 78 physicians per 100,000 people. The PCP to population ratio is the highest in urban areas (80.1 PCPs/100,000 people) compared to rural areas (10.1 PCPs/100,000 people). This disparity is one of the driving factors why Arizona only meets 40% of its PCP needs (Vaidya, 2020). When reviewing the number of hospital beds per 1,000 people, Arizona is a whole bed below the national average (with ~2 beds/1,000 population versus the national average of ~3 beds/1,000 population) (Vaidya, 2020 & World Bank). Thus, Arizona ranks 21st nationally in this category (World Bank).

During my time as an undergraduate student, I have had a chance to further explore this issue and work with several mentors, including the director of the Arizona Telemedicine Program, Dr. Ronald S. Weinstein. The rural-urban divide in healthcare access is national, and federal and state governments are working in parallel to tackle this issue at both levels. In the last 30 years, Arizona has taken steps to alleviate this issue, for example, with the creation of the of the Arizona Telemedicine Program and broadband legislation, but there is still much work to be done. This paper attempts to quantify the current crisis by looking at the following specialties throughout Arizona and comparing their numbers between counties and cities:

- (i) Cardiologists
- (ii) Psychiatrists
- (iii) Primary Care Providers (PCPs)
  - Internists
  - Family Medicine Specialists
  - Pediatricians

## Generalists Versus Specialists

Primary Care Providers (PCPs), including internists, family medicine specialists, and pediatricians, are generalists. Generalists are crucial to triaging non-emergency patients and performing preventive care. If generalists are not easily accessible, many people forgo wellness and preventive care appointments. The Centers for Disease Control and Prevention (CDC) notes that over 100,000 lives a year could be saved if each person were to receive the recommended preventive clinical care (Clarke, 2017). Not only can treatable issues mount to something more, but skipping preventive and wellness care is more expensive. As of right now, 75% of the nation's healthcare spending is going toward preventive care, and it is saving \$260 billion dollars a year (Beaton, 2017).

Preventive care includes screenings and tests for cholesterol, diabetes, cancers, age related diseases, immunizations, and more. Catching certain pathologies, like cancer, early is critical to survival. For example, women over 50 years old are screened for breast cancer annually at their wellness visit with their provider. Breast cancer is a very common type of cancer. In fact, it is the second most common type of cancer diagnosed in women after skin cancer. However, breast cancer has several subtypes resulting from different types of mutations. The degree of aggressivity is determined by the level of metastases, which is the migration of the breast tumor from the breast tissue. The migration is quantified via stages. Stage 1 breast cancer is localized in the primary tumor location (where the initial tumor was found). Stages 2-4 refer to the severity of metastasis. Stage 4 implies it has migrated to distant locations. Early detection of the primary breast tumor gives the patient more options for therapy (localized surgery, immunotherapy, radiation, chemotherapy, etc.) and better chances of survival. Without accessible healthcare, many older women forgo this critical screening, leading to more late-stage and lethal diagnoses.

As the gatekeepers of preventive care, ideally PCPs should be accessible throughout the state. But when analyzing the numbers, there is an unequal distribution of internists, family medicine specialists, and pediatricians in Arizona (Figure 1):

**Figure 1:** (Source: Arizona Medical Board, 2021)

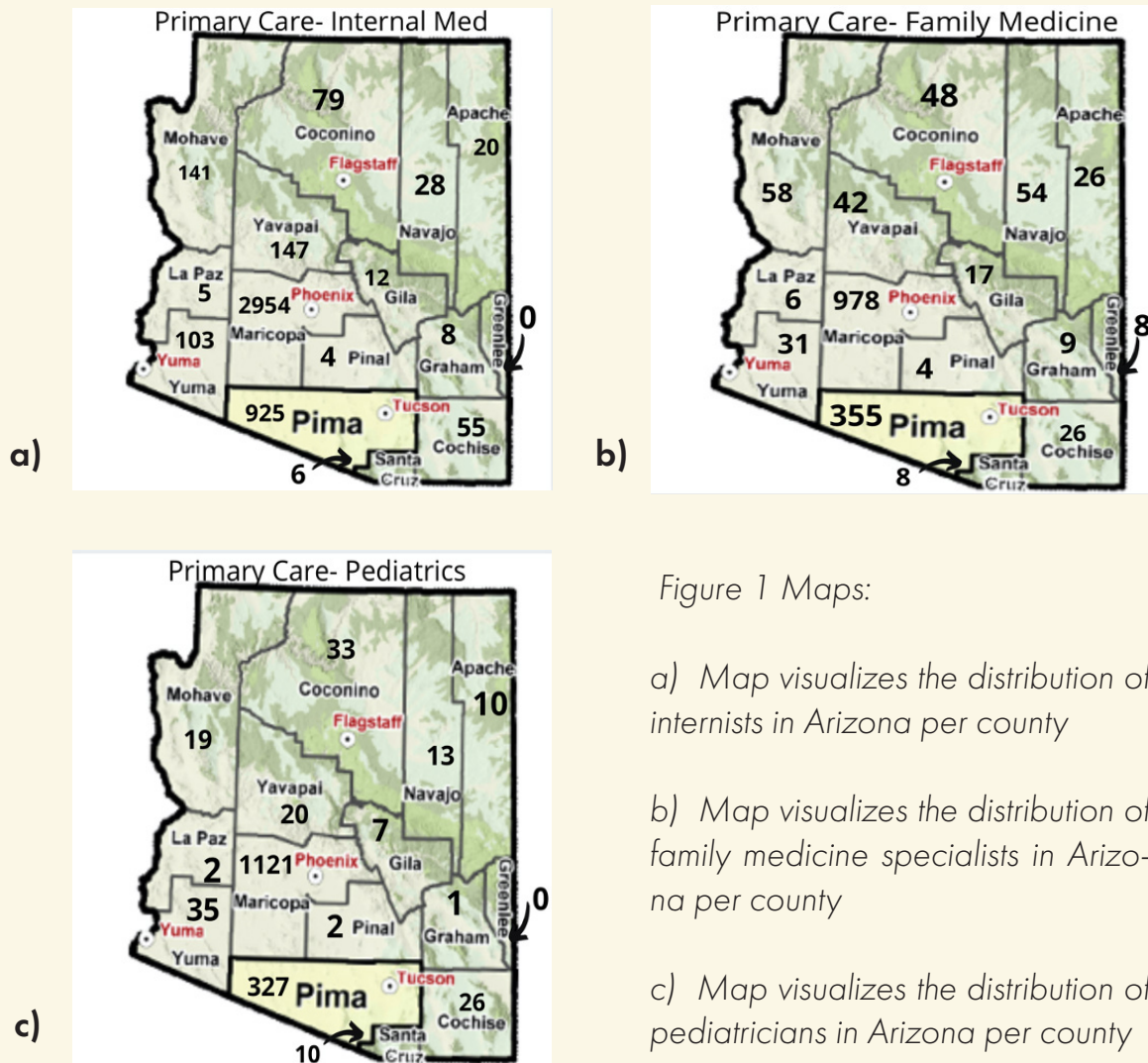


Figure 1 Maps:

a) Map visualizes the distribution of internists in Arizona per county

b) Map visualizes the distribution of family medicine specialists in Arizona per county

c) Map visualizes the distribution of pediatricians in Arizona per county

Each of these generalists plays a crucial role in providing preventative care in their area. The distribution of internists in Arizona is the highest in Maricopa County. Approximately 45% of internists in Maricopa County are in Phoenix. Pima county has the second largest concentration of internists, but 94% of Pima county internists are concentrated in Tucson.

Family Medicine specialists, similarly, are mostly concentrated in Phoenix (with almost 1,000 specialists). And again, Pima is second in the state. Focusing on concentrations in major cities, Yuma has 100% of its family medicine specialists of the county (Yuma) in its urban center of Yuma city (31 family medicine specialists). According to the data, Phoenix has the highest number of family medicine specialists, with Tucson coming in a close second. But when comparing the percentage of family medicine specialists available in the county versus the city, Tucson has a higher concentration. Phoenix only has 41% of the family medicine specialists in Maricopa County, while Tucson has 91% of the family medicine specialists in Pima county. This implies Maricopa County has a more even spread, leading to better access to family medicine specialists than in Pima County.

Similarly, pediatricians in Arizona are concentrated in Maricopa County by a large margin (1121), with Pima County coming in second, once again. In this case, over half the pediatricians (approximately 62%) are in Phoenix. In contrast, 89% of Yuma County's pediatricians are in Yuma, its urban center. In Tucson, as with other specialties reviewed above, a high percentage, 96%, in this case, are concentrated within the city.

The table below (Table 1) indicates the concentration of each type of generalist in major Arizona urban centers in comparison to the county they reside in.

**Table 1:** (Source: Arizona Medical Board, 2021)

	Internists	Family Medicine Specialist	Pediatrician
City/County Ratio			
Tucson/Pima	867/925 (94%)	324/355 (91%)	315/327 (96%)
Yuma/Yuma	102/103 (99%)	31/31 (100%)	31/35 (89%)
Phoenix/Maricopa	1339/2954 (45%)	399/978 (41%)	692/1121 (62%)
Flagstaff/ Coconino	69/79 (87%)	38/48 (79%) <sup>77</sup>	31/33 (94%)

The columns are the calculated City/County ratio for the generalist specialty outlined in the top row. The ratios reflect the number of physicians of that generalist specialty concentrated in the city versus the whole county. While a physician present in the same area as the patient does not guarantee access to care due other socio-economic barriers, this analysis attempts outline probability using one determinant.

Although, it makes sense that physicians would be more concentrated in more populated areas where there is more demand, the analysis re-enforces the fact that many rural community members have to travel into urban centers to receive care, even basic care at times. As a state we should be striving for a more equitable, not equal, spread of physicians across population centers.

Specialists, on the other hand, focus on one organ or organ system. Out of the countless specialties and subspecialties present in medicine, I chose to examine cardiologists and psychiatrists and their concentrations throughout Arizona. One of my focuses is cardiology because cardiovascular disease (CVD) is one of the top causes of death in the U.S. For that reason, many Americans need to visit a cardiologist at least once in their lifetime.

I picked psychiatry as the other specialty because psychiatrists play an integral role in providing mental health services for all sectors of society. Nationally, mental health seems to be most accessible in urban areas, with minimal access in rural communities. I wanted to examine Arizona's trend more closely, especially since mental health issues are now becoming more commonly accepted as illnesses needing specialty care.

Looking at the distribution of cardiologists and psychiatrists across Arizona counties we can see the following trends:

**Figure 2:** (Source: Arizona Medical Board, 2021)

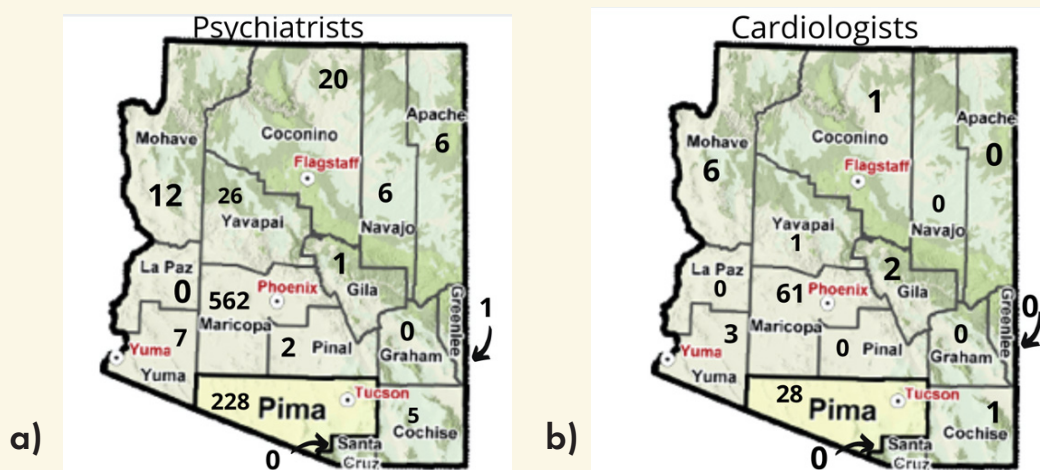


Figure 2 Maps:

- a) Map visualizes the distribution of psychiatrists in Arizona per county
- b) Map visualizes the distribution of cardiologists in Arizona per county

Psychiatrists in Arizona clearly outnumber cardiologists throughout the state looking at Figure 2. This was surprising because mental healthcare is notorious for being inaccessible. Even though there are still clear differences in accessibility between urban and rural centers, it is reassuring to see the high numbers of psychiatrists across the state. Similar to all the other trends analyzed in this paper, Maricopa County has the highest number of psychiatrists with 562, and Pima County in second with 228 (Figure 2a). In reference to psychiatrists, only La Paz and Graham have none practicing within the counties. Although psychiatrists outnumber cardiologists in the state, the fact that there are none practicing in two counties emphasizes the state's need for psychiatrists in rural areas.

According to Figure 2b, the distribution of cardiologists across the state, as expected, demonstrates a similar trend to that of primary care providers. Maricopa County has the highest concentration of cardiologists, followed by Pima County. Although there is a stark difference between the graphs in Figure 1 (Primary Care) above and the distribution of cardiologists, several counties throughout Arizona (Apache, Navajo La Paz, Santa Cruz, Graham, Greenlee, Pinal) have no cardiologists at all. Regarding primary care providers (Figure 1), only Greenlee had zero pediatricians or internal medicine specialists, although there are eight family medicine specialists. Since Greenlee is an extremely small county, oftentimes, hospitals in Graham County (west of Greenlee) are utilized by its citizens. Thankfully, when looking at internists, there are eight in Graham County and one pediatrician. But, when reviewing the distribution of cardiologists, Apache County, which is north of Greenlee County, has none; west of Graham and Pinal Counties there are also none; and Navajo County, north of Graham County, also has no cardiologists. Table 2 below details the distribution. The low numbers of cardiologists across the state means that people have to travel to major cities, such as Tucson and Phoenix, to visit a cardiologist. With the growing prevalence of cardiovascular disease and other cardiothoracic issues, this indicates a large disparity between urban and rural centers in terms of access to specialized cardiology care.

The exact distribution of the specialists (cardiologists and psychiatrists) analyzed throughout the state and major cities is detailed in Table 2 below.

**Table 2:** (Source: Arizona Medical Board, 2021)

	<i>Cardiologists</i>	<i>Psychiatrists</i>
<b>City/County</b>		
<i>Tucson/Pima</i>	27/28 (96%)	219/228 (91%)
<i>Yuma/Yuma</i>	3/3 (100%)	5/7 (100%)
<i>Phoenix/Maricopa</i>	24/61 (39%)	289/562 (51%)
<i>Flagstaff/ Coconino</i>	1/1 (100%)	20/20 (100%)

The columns are the calculated City/County ratio for the specialty outlined in the top row. The ratios reflect the number of the physicians of that specialty concentrated in the city versus the whole county.

## The People

Given the population distribution, it makes sense that the physician specialties described above are concentrated in Maricopa and Pima Counties. Maricopa County has the highest population concentration, approximately 4.4 million, in the state. Over 60% of the population in Arizona resides in Maricopa. Pima County comes in second with a little over 1 million people. Although the state's population is concentrated in these two areas, it does not discount the fact that the rest of the population outside of these centers needs reliable, accessible medical care. Unfortunately, the more sparsely populated counties, such as Greenlee (almost 10,000 people), are representative of other counties that have a low number of physicians. Population density throughout the state follows a similar trend. Table 3 below summarizes these trends:

<b>County</b>	<b>Population</b>	<b>Population Density (People/Sq. Mile)</b>
Apache	71,887	11,218
Cochise	125,922	6,219
Coconino	143,476	18,661
Gila	54,018	4,795
Graham	38,837	4,641
Greenlee	9,498	1,848
La Paz	21,108	4,514
Maricopa	4,485,414	9,224
Mohave	212,181	13,461
Navajo	110,924	9,960
Pima	1,047,279	9,189
Pinal	462,789	5,374
Santa Cruz	46,498	1,238
Yavapai	235,099	8,128
Yuma	213,787	5,519

**Table 3:**

(Source: Census Bureau Quick Facts)



Focusing on the population concentration in urban areas compared to counties, Maricopa County had the highest number of people living outside of Phoenix — its urban center. Surrounding Phoenix, there are several suburban areas such as Chandler, Tempe, Scottsdale, etc. This aligns with the finding discussed above that many physicians in Maricopa County practice outside Phoenix in its surrounding areas. In contrast, when comparing Yuma County with the city of Yuma, there is no difference in population density. This suggests that the vast majority of Yuma County’s residents live within Yuma city proper. In the case of Pima County, almost half a million people live outside its main urban center of Tucson. And, lastly, in Coconino County, approximately 68,438 people live outside the city of Flagstaff. Table 4 below outlines these numbers.

**Table 4:** (Source: Census Bureau Quick Facts)

Difference between:		
	Pima - Tucson Population	499,206 people
	Yuma County - Yuma Population	0 people
	Maricopa - Phoenix Population	2,804,422 people
	Coconino - Flagstaff Population	68,438 people

*Population differences between County and its main Urban Center*

The data above in Table 4 can be used to determine the need for more physicians outside urban centers. For example, the fact that 100% of family medicine physicians in Yuma County are in the city of Yuma may not be a problem since nearly all of the population of Yuma County resides within Yuma city. But the fact that 91% of family medicine physicians in Pima County are in Tucson is a hindrance to healthcare access since there are close to half a million people in Pima County living outside of Tucson who need accessible primary care physicians. Within Pima County the west most town is about two hours and fifteen minutes away. So patients may need to travel upwards of two hours to receive preventive care in Tucson within Pima County.

## What Does This Mean?

The lack of physicians outside of urban centers goes hand in hand with the number of hospitals available. There are seven rural counties in Arizona including Apache, Gila, Graham, Greenlee, La Paz, and Navajo Counties. All of these rural counties have less than three hospitals each. In contrast, the urban centers of Phoenix and Tucson have 22 and 18 hospitals, respectively. The extremes across the counties in the state are zero hospitals in Greenlee County compared to 78 hospitals in Maricopa County. Table 5 outlines this information.

**Table 5:** (Sources: Arizona Hospital Facility ID & List of Rural Counties And Designated Eligible Census Tracts in Metropolitan Counties)

County	Number of Hospitals
Apache ( <i>RURAL</i> )	2
Cochise	5
Coconino	4
Gila ( <i>RURAL</i> )	2
Graham ( <i>RURAL</i> )	1
Greenlee ( <i>RURAL</i> )	0
La Paz ( <i>RURAL</i> )	1
Maricopa	78
Mohave	6
Navajo ( <i>RURAL</i> )	3
Pima	20
Pinal	5
Santa Cruz ( <i>RURAL</i> )	1
Yavapai	7
Yuma	2
<b>TOTAL</b>	<b>137</b>

*Number of Hospitals in each AZ County*

Comparing the distribution of hospitals within counties, we see most hospitals are located within urban centers. This is possibly due to the cost of running a hospital. For example, 90% of Pima County’s hospitals are in Tucson. 100% of the hospitals of Yuma County are in Yuma. And 75% of the hospitals of Coconino County are in Flagstaff. In contrast, 28% of the hospitals of Maricopa County are in Phoenix. This exception is most likely due to the fact that Phoenix is surrounded by densely populated suburban areas that are all interconnected.

## Conclusion

While, thankfully, Arizona is not the worst state in the country regarding healthcare access, the current numbers are not reassuring, either. Due to a lack of resources and funding associated with the ongoing pandemic, many rural hospitals are closing, and healthcare workers are overwhelmed and suffering from burn out.

The COVID-19 pandemic has served as a reminder that it is vital that we come together to address this situation as a state. It is imperative that the state leadership takes the toll of the pandemic on the healthcare industry seriously.

It is critical Arizona invites and trains new physicians, while facilitating the construction of infrastructure so more physicians are able to practice across the state. The onus for this change is not only on physicians but also legislators, who need to realize this issue and promote concrete change. Arizona's rural counties and tribal nations need access to physicians and hospitals, generalist and specialty care, and they require this access at a reasonable distance, not hours or expensive helicopter rides away.

## Looking Forward...

While telemedicine implementation may be a part of the answer, especially since some COVID-era telemedicine policy changes are likely here to stay, it has its limitations. Working actively to address those obstacles with increased technological access in clinics and broadband access is important, but the decreased healthcare workforce in the rural areas also needs to be addressed. Fortunately, the Arizona State Legislature has realized this issue and is working in conjunction with the University of Arizona to alleviate it; namely through the University of Arizona Primary Care Scholarship Program. This program awards a full tuition scholarship to current medical students who commit to serve as a primary care physician (which encompasses family medicine, general internal medicine, geriatric medicine, general pediatrics, general surgery, psychiatry, obstetrics and gynecology, and recently general surgery) in rural Arizona after residency (Arizona Primary Care Physician Scholarship). This incentivizes the next generation of physicians to serve in areas that have a disparity in access. A similar federal program also exists. These types of programs also ease the monetary consequences of choosing a less lucrative field, like primary care, since these students graduate with less debt. Some programs focus on recruiting practicing doctors (either residents or attendings) by offering student loan payments, monthly stipends, or student loan forgiveness if they practice in a medically underserved area for a certain period of time (Fenyanova, 2018). Additionally, rural physician salaries tend to be five to ten percent higher than urban physicians (Carey, 2020). Coupled with the lower cost of living in rural areas, this greatly increases the income of rural physicians compared to urban. There have also been efforts to create more training programs, whether that be medical school clerkships or residencies, in medically underserved areas. This allows for these areas to retain physicians early in their career. The University of Arizona, for example, has the Rural Health distinction track, which gives students the opportunity to rotate at a rural health center with a mentor during the summer after their first year. This provides rising second year medical students' with immersive clinical experience along with insight on where they would like to serve in the future.

These efforts have made a difference, but to make the change needed, all these programs need to be rolled out at a larger scale. It is critical we act in a timely manner so the gap between urban and rural healthcare doesn't continue to widen.

More schools should continue to waive tuition in exchange for service in rural areas and offer opportunities to experience rural medicine. More rural areas should incentivize physicians with loan forgiveness, stipends, higher income, etc. Finally, the government should provide more infrastructure to ensure schools and health centers are able to attract and retain physicians to work in underserved areas.

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