

MAPPING HEALTHCARE DESERTS

80% of the Country Lacks
Adequate Access to Healthcare

September 2021

The GoodRx Research Team

Amanda Nguyen, Ph.D, Jeroen van Meijgaard,
Ph.D, Sara Kim, MS, and Tori Marsh, MPH

OVERVIEW

More than 80% of counties across the U.S. lack proper access to the services needed to maintain health, according to new research from GoodRx.

Access to healthcare can be defined as having an adequate supply of services to help people maintain or improve their health. These services span many dimensions of healthcare, including medications, primary care providers, hospitals, emergency services, and community health centers. Access is also affected by socioeconomic factors like affordability, internet access, and health literacy. In an ideal world, everyone would have equal access to necessary health services and the means to gain access to these services. But this just isn't the case.

The GoodRx Research team set out to identify areas that lack the proper infrastructure to ensure a healthy community and understand just how socioeconomic factors play a role in people's ability to take advantage of healthcare services.

We did this by identifying "healthcare deserts," or areas across the U.S. where people lack adequate access to six key healthcare services: (1) pharmacies, (2) primary care providers, (3) hospitals, (4) hospital beds, (5) trauma centers, and (6) low-cost health centers. We then looked at how personal and financial barriers can make it even harder to access care in a healthcare desert and perpetuate health disparities.

In this report, GoodRx Research dives into how healthcare infrastructure — or lack thereof — shapes access to healthcare.

OUR SEVEN KEY FINDINGS

Through our research, we identified seven key findings:

- 01** More than 80% of counties across the U.S. lack adequate healthcare infrastructure in some shape or form. That means that over a third of the U.S. population lives in a county where there is less than adequate access to pharmacies, primary care providers, hospitals, trauma centers, and/or low-cost health centers.
- 02** Over 40% of counties are pharmacy deserts, where most people have to drive more than 15 minutes to reach nearby pharmacies.
- 03** Over 9% of counties are primary care provider deserts, where there aren't enough healthcare professionals to provide primary care for most of the local population.

04 Over 20% of counties are hospital deserts, where most people have to drive more than 30 minutes to reach the closest hospital. On top of that, nearly 47% of counties have fewer than 2 hospital beds per 1,000 people.

05 Over 40% of counties are trauma center deserts, where most people have to drive over an hour to reach a hospital equipped to handle major traumatic injuries.

06 Over 45% of counties are low-cost health center deserts, where most people have to drive more than 20 minutes to reach a federally-funded community health center.

07 Healthcare deserts are more likely to affect those who face additional barriers to access, such as lower income, limited internet access, and lack of insurance. Together, these barriers can further widen disparities in health outcomes.

MORE THAN 80% OF COUNTIES LACK ADEQUATE HEALTHCARE INFRASTRUCTURE

To identify places that are potential “healthcare deserts,” it’s important to first understand what good access to healthcare looks like. In an ideal world, you’d probably want to have a few pharmacies nearby so you can fill your prescriptions as soon as possible and for the best price. You’d also want to be able to get a doctor’s appointment when you need it and in a reasonable amount of time, so you’d want enough primary care providers servicing your area and to live reasonably close to a hospital. And, in case of an emergency, you’d need to have enough hospital beds in your area and to live close to a hospital equipped to handle major traumatic injuries. Finally, if you are uninsured or need financial assistance, you’d want to have a low-cost community health center accessible nearby.

With this in mind, we defined five thresholds for “healthcare deserts” along each of these dimensions of healthcare infrastructure: pharmacies, providers, hospitals and hospital beds, trauma centers, and low-cost clinics. We looked at existing health services research to define how much is “enough” and how close is “reasonably close.”

- We identified pharmacy deserts by comparing the average driving distance to nearby pharmacies to the average time it takes to drive 10 miles in a rural area — about 15 minutes — based on the U.S. Department of Agriculture (USDA) [definition of food deserts](#).
- We leveraged data on [health professional shortage areas](#) (HPSAs) from the [Health Resources & Services Administration](#) (HRSA) to identify provider deserts, where there aren’t enough primary care providers to meet local demand.
- Finally, we identified [hospital](#) deserts, trauma center deserts, and [community health center](#) deserts based on numerous studies showing how long transportation times can negatively affect the probability of [timely diagnosis](#), [treatment](#), and [survival](#), especially in [underserved populations](#). For more details on how we identified healthcare deserts, see the methodology section.

Unfortunately, our research finds that millions of Americans lack adequate access to healthcare along at least one of the dimensions we studied. We find that nearly 82% of counties have at least one “healthcare desert,” with nearly 60% of those counties having more than one type of healthcare desert.

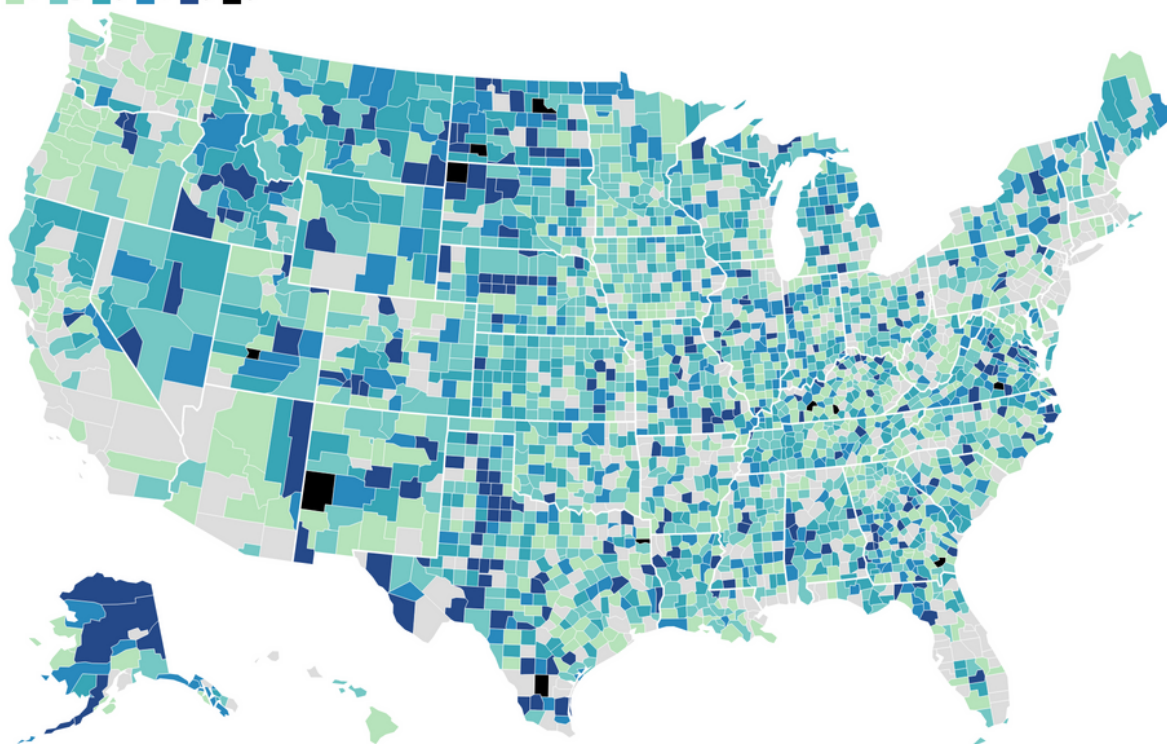
The number of people potentially impacted by healthcare deserts is substantial: We estimate roughly 121 million people currently live in a healthcare-desert county, accounting for over 37% of the U.S. population.

Healthcare Deserts, County by County

Counties where most people lack adequate access to pharmacies, primary care providers, hospitals, hospital beds, trauma centers, and/or low-cost health centers.

Number of healthcare deserts

1 2 3 4 5 6



Note: Pharmacy, hospital, trauma center, and low-cost health center deserts could not be calculated for the following counties due to missing data: Oglala Lakota, South Dakota; Shannon, South Dakota; Wade Hampton, Alaska; Kusilvak Census Area, Alaska; and Bedford, Virginia.

Source: GoodRx

GoodRx

Interact with the map: www.datawrapper.de//0HrLo/

Many areas lack adequate healthcare access along the majority of dimensions studied. Nearly 8.4 million people live in counties with at least four of the six types of healthcare deserts. Below, we dive into each type of healthcare desert in greater detail and identify socioeconomic factors that can prevent someone from accessing care.

OVER 40% OF COUNTIES ARE PHARMACY DESERTS, WHERE MOST PEOPLE HAVE TO DRIVE MORE THAN 15 MINUTES TO REACH NEARBY PHARMACIES

Pharmacies and pharmacists play a critical role in dispensing prescription and over-the-counter medications, providing immunizations, and counseling patients on side effects, interactions, and medication regimens. These essential services ensure patient safety and help patients take their medications as prescribed, ultimately improving the overall health of the community.

But, unfortunately, though there are more than 60,000 pharmacies across the U.S., they are dispersed unevenly. In over 40% of U.S. counties, a majority of people do not have adequate access to a pharmacy.

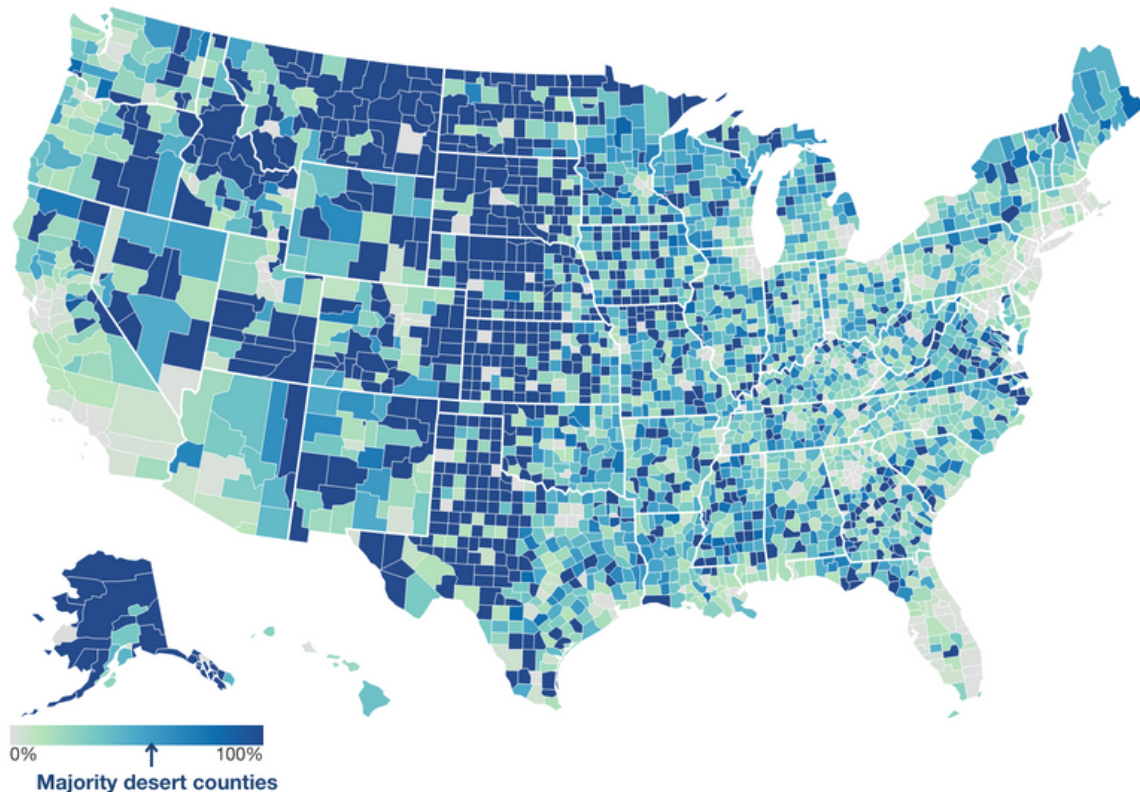
In total, we estimate that over 41 million Americans live in a pharmacy desert.

Previous GoodRx research identified pharmacy deserts in an effort to understand areas that may suffer from slow COVID-19 vaccine rollout due to strained pharmacy capacity. This research was based on pharmacy density and pharmacy capacity, defined as the number of local and chain pharmacies in a county per 10,000 people.

However, the below map identifies pharmacy deserts by something more tangible to consumers: driving time. It specifically calls out areas in which residents have to drive more than 15 minutes to local pharmacies, a distance that could make it difficult to fill a prescription if needed. Similar to the USDA's definition of food deserts, the farther a person lives from pharmacies, the less access they have to in-stock medications and different options for price shopping (since prices for the same medication often vary across pharmacies).

Population Living in a Pharmacy Desert

Percent of county's population living over 15 minutes from the three closest pharmacies.



Source: GoodRx

GoodRx

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In general, South Dakota, Montana, Nebraska, and Kansas have the largest number of counties that lack sufficient access to a pharmacy. In much of the state, residents have to drive more than 15 minutes to access a pharmacy. So while they may have access to a provider to obtain a prescription, filling that prescription may be more difficult.

OVER 9% OF COUNTIES ARE PRIMARY CARE PROVIDER DESERTS, WHERE THERE AREN'T ENOUGH PROVIDERS FOR THE MAJORITY OF THE POPULATION

One of the most important components of healthcare is having a primary care provider who can perform regular checkups, screenings, immunizations, and other preventive services. Primary care providers also serve as a starting point for healthcare, helping patients with non-emergency needs, common illnesses, and specialist referrals. In addition to preventing illness and death, better access to primary care providers has been shown to reduce health disparities and total healthcare costs.

To identify primary care provider deserts, we looked at areas where the supply of primary care providers is too low for the local population's healthcare needs. Using data from HRSA, we mapped regions designated as primary care health professional shortage areas. These areas have a low population-to-provider ratio, a high population share with incomes below 100% of the federal poverty level, high rates of infant mortality or low birth weight, and long travel times to the nearest source of care outside of the area. These criteria capture regions where the supply of primary care is low, as well as regions where the demand for primary care is high.

In areas with greater healthcare needs, HRSA targets having at least 1 full-time primary care provider for every 3,000 people.

On average, healthcare provider deserts have 1 full-time primary care provider for every 10,449 people — a potential patient caseload over three times the recommended level.

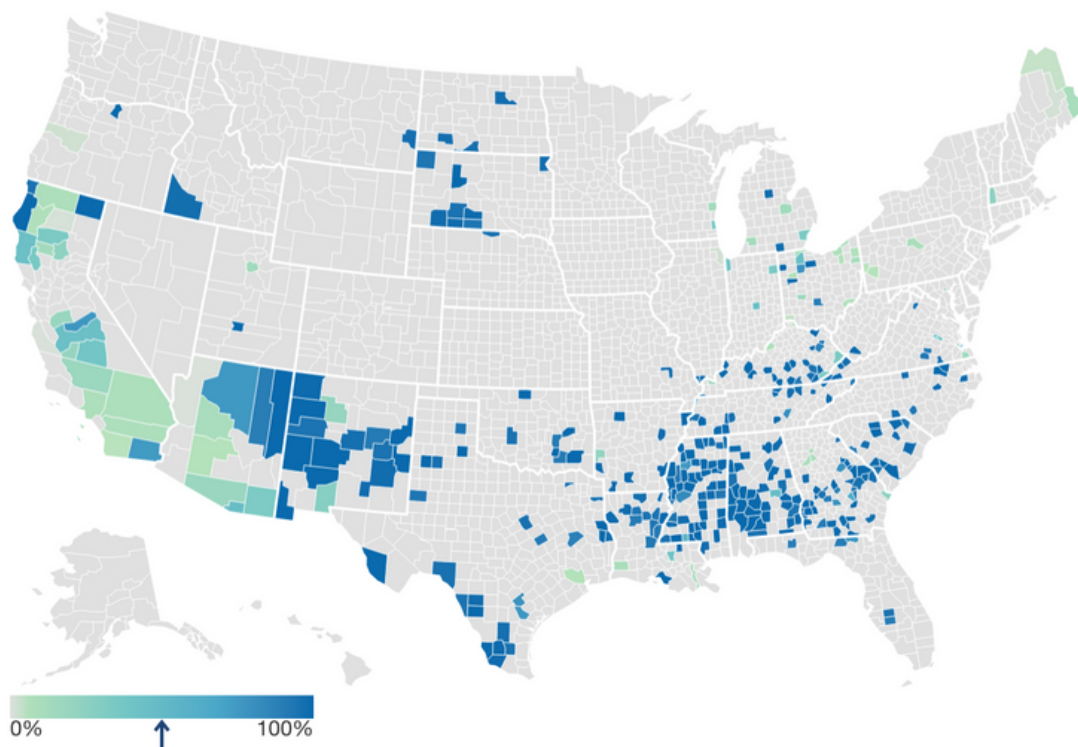
The larger the patient caseload per provider, the longer it takes for people to get an appointment and the more difficult it becomes to receive timely, quality care. More patients may end up relying on urgent care and the emergency room to diagnose their health issues, often after it's too late for preventive care and without a complete picture of their health history.

In total, roughly 13 million people live in a primary care provider desert.

In 294 counties — over 9% of all U.S. counties — the majority of residents live in an area with a primary care provider shortage.

Population Living in a Primary Care Provider Desert

Percent of county's population living in a designated health professional shortage area (HPSA).



Majority desert counties

Population-to-provider ratio is the ratio of HPSA-designated area population served per full-time provider equivalent. HRSA has a target population-to-provider ratio of 3,000 patients per full-time provider.

Source: Health Resources & Services Administration

GoodRx

Interact with the map: www.datawrapper.de/_/qlgCl/

Many healthcare provider shortages are concentrated in rural areas. In Mississippi, over 58% of counties — most of them rural — don't have enough primary care providers for the majority of local residents. In response, the Mississippi State Department of Health has a dedicated Primary Care Office tasked with increasing the supply of primary care providers in the state. Despite these efforts, roughly 30% of Mississippi residents still live in a primary care desert, and Mississippi ranks 49th out of 50 in terms of access to clinical care.

In New Mexico, where primary care doctors have the lowest pay and highest projected retirements, over 22% of residents live in a primary care desert. In response to these shortages, the state's government has invested in expanding its medical residency programs, estimating that 10 more primary care physicians per 100,000 people would reduce emergency room visits by 11%, hospital inpatient admissions by 6%, and avoidable surgeries by 7%.

OVER 20% OF COUNTIES ARE HOSPITAL DESERTS, WHERE MOST PEOPLE HAVE TO DRIVE OVER 30 MINUTES TO REACH THE CLOSEST HOSPITAL

Hospitals are another integral part of healthcare infrastructure. In order to maintain proper health, people not only need access to healthcare providers but also facilities where they can receive treatment from those providers.

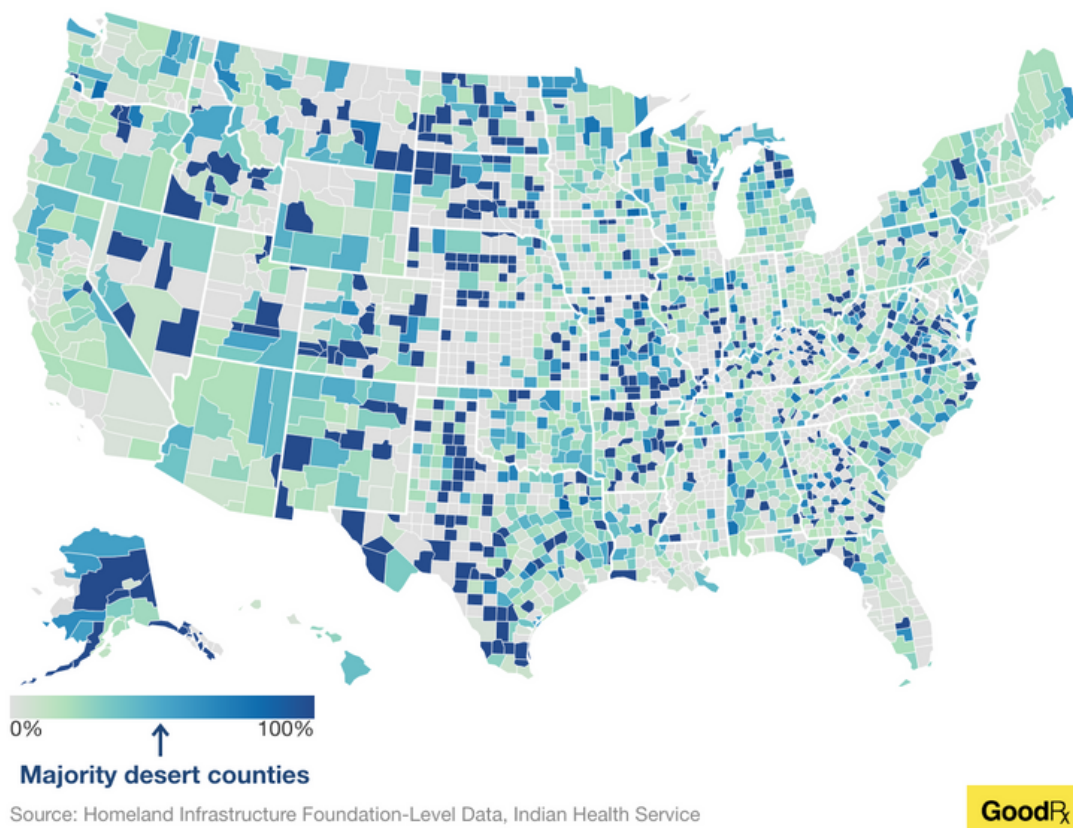
We looked at the distribution of 7,513 hospitals across the country, including general acute care hospitals, children's hospitals, psychiatric hospitals, critical access hospitals, military hospitals, and Indian Health Service hospitals. Following previous research documenting the impact of long travel times on treatment and quality of care, we set a hospital desert threshold of 30 minutes driving time to the closest hospital.

Our analysis shows that in over 20% of counties, most people have to drive more than 30 minutes to get to the nearest hospital of any kind. The map below shows how many people in each county across the U.S. are living in a hospital desert.

Overall, roughly 29 million people lack adequate access to hospitals and must travel over 30 minutes from their home to the nearest hospital.

Population Living in a Hospital Desert

Percent of county's population living over 30 minutes from the closest hospital.



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As with healthcare provider deserts, many hospital deserts are located in rural areas. Vermont, Alaska, Arkansas, Alabama, and Maine have the largest share of the state population living in a hospital desert, many of which are concentrated in rural areas. In Essex County, Vermont — where there is only one health center and a lack of specialty services — patients recount driving hours to get the care they need.

Hospitals also tend to operate where the local economic conditions are favorable, so many hospital deserts are located in neighborhoods with lower income and higher rates of uninsurance. Even in large cities like Houston, hospital closures can lead to hospital deserts.

Once a patient arrives at the hospital, there's also the question of hospital capacity. Even if it doesn't take long to get to the hospital, many people may still lack access because there aren't enough hospital beds for everyone who needs one.

The ideal number of hospital beds depends on various factors, including hospital size and local demand. To map hospital bed deserts, we set a simple threshold at 2 hospital beds per 1,000 people. Even though this threshold is below World Health Organization (WHO) standards, we still find a stark number of hospital bed deserts.

Nearly 47% of counties are hospital bed deserts, where over 80 million people don't have access to enough hospital beds.

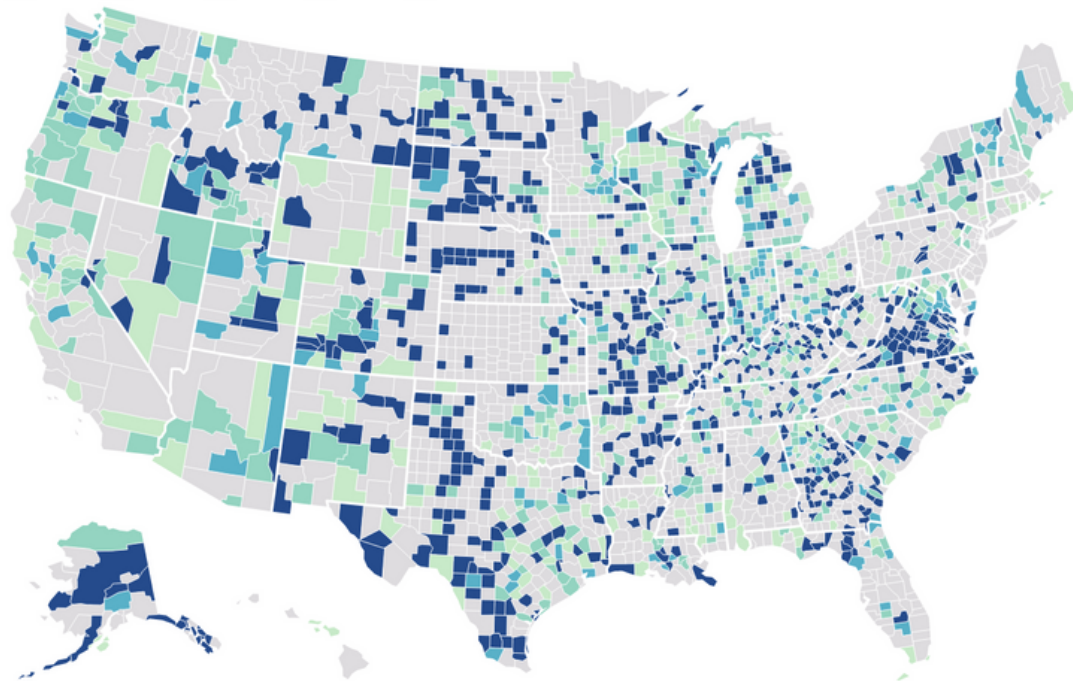
The map below breaks down which areas have the worst hospital bed shortages.

Hospital Bed Deserts, County by County

Counties where there are fewer than 2 beds per 1,000 people.

Number of hospital beds per 1,000 population

■ < 0.5 ■ 0.5-1 ■ 1-1.5 ■ 1.5-2 ■ ≥ 2



Source: Homeland Infrastructure Foundation-Level Data, Indian Health Service

GoodRx

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As the COVID-19 pandemic has demonstrated, having sufficient hospital bed capacity can mean the difference between life or death. In states like South Dakota, where over 22% of the population lives in a hospital bed desert, a surge in hospitalizations with limited bed capacity can force patients to be flown out of state for care.

OVER 40% OF COUNTIES ARE TRAUMA CENTER DESERTS, WHERE MOST PEOPLE HAVE TO DRIVE OVER AN HOUR TO REACH A HOSPITAL EQUIPPED TO HANDLE MAJOR TRAUMATIC INJURIES

Trauma centers, typically housed in the emergency room of a hospital, exist to treat the most severe and life-threatening cases like gunshot wounds, blunt trauma, traumatic car crash injuries, and/or major burns. There are currently 2,020 Level I through Level V trauma centers scattered throughout the U.S. But, like all healthcare services, they are distributed unevenly.

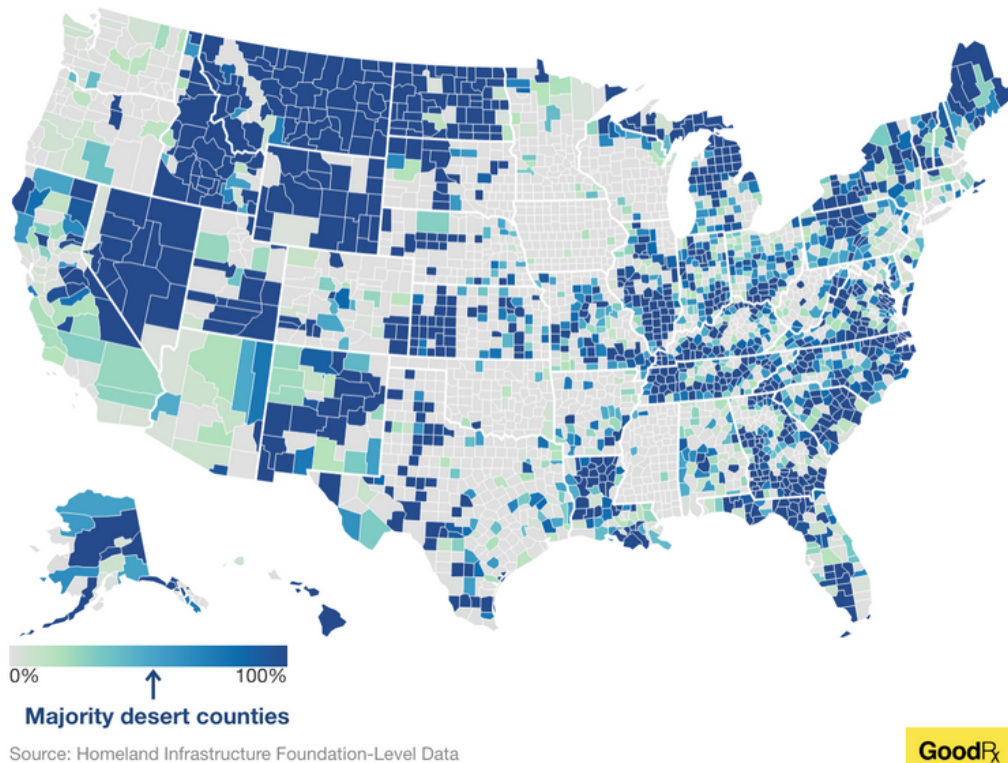
When accessing a trauma center, every second counts. Doctors often refer to the “golden hour,” which is the concept that a patient needs to receive definitive care within an hour of injury to increase their chances of survival. However, residents in 40% of counties throughout the U.S. live in a trauma care desert, meaning they have to drive more than 60 minutes to get to the nearest trauma center.

Nearly 49 million people live over an hour away from a hospital equipped to handle major traumatic injuries.

For these Americans, a trauma center may be too far away to survive a serious injury. With regards to gun shot wounds specifically, even 5 miles can have an impact on a patient’s chance of survival.

Population Living in a Trauma Center Desert

Percent of county's population living over 1 hour from the closest trauma center.



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Montana, North Dakota, Wyoming, Nevada, and Idaho currently have the most trauma desert counties. In these states, the majority of residents will not be able to access a trauma center within the “golden hour.”

In Idaho, there is currently no Level I trauma center that is equipped to provide the most comprehensive trauma care. So, for complicated cases, patients may even need to be airlifted to a center in a nearby state, which can be expensive and life-threatening.

Similarly, Nevada only has one Level I trauma center — University Medical Center — which has a survival rate of 96% for patients who arrive within an hour. But few live close enough to get this necessary care.

San Bernardino County, in California, has a population of more than 2 million residents, but not all have equal access to trauma care. Currently, there are two adult trauma centers throughout the county. However, these centers are unevenly distributed throughout the sprawling county, and over half a million residents (25% of the county’s population) still live more than 60 minutes from the closest trauma center.

OVER 45% OF COUNTIES ARE LOW-COST HEALTH CENTER DESERTS, WHERE MOST PEOPLE HAVE TO DRIVE OVER 20 MINUTES TO REACH A FEDERALLY FUNDED COMMUNITY HEALTH CENTER

There are nearly 12,000 federally funded community health centers across the U.S., which include [HRSA-funded health centers](#) and [Indian Health Service](#) facilities. But these centers, aimed at providing primary care in underserved communities, are unevenly distributed throughout the country.

Federally funded community health centers are critical, especially in underserved communities. In [2019](#), nearly 30 million people across the U.S. visited a HRSA health center. Of that group, 91% were at or below 200% of the federal poverty level, 48% were enrolled in Medicaid or the Children's Health Insurance Program (CHIP), 23% had no insurance, and 5% were homeless. Moreover, 31% of all patients were children, and 63% were of a racial and/or ethnic minority group.

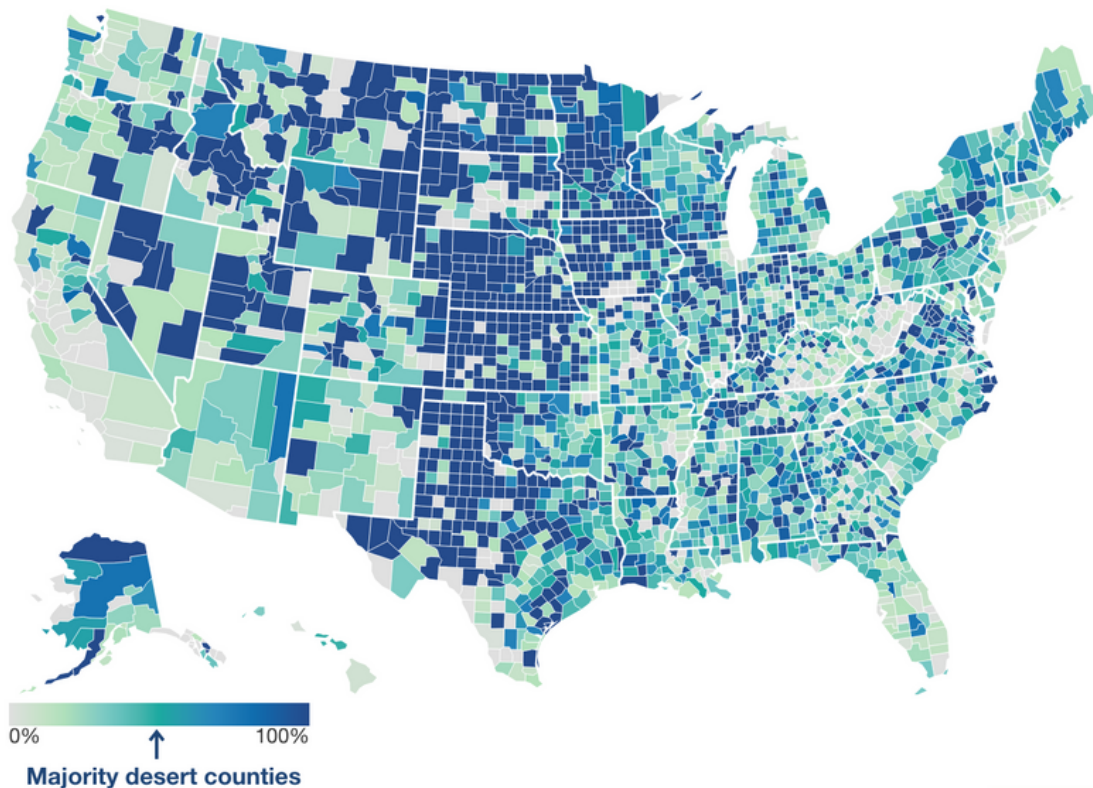
But at present, residents in 45% of counties across the country lack proper access to a federally funded community health center, and they may find it difficult to access affordable care.

All told, over 78 million people don't have a low-cost health center nearby and would need to drive over 20 minutes to reach the nearest clinic.

For many patients from vulnerable populations, who may not own a vehicle or be able to take time off from work, that 20 minutes can mean skipping a checkup, a screening, or a refill. Lack of access to affordable healthcare can then result in relying on the emergency room to diagnose and treat issues, experiencing worse health outcomes, and seeing higher medical bills down the line.

Population Living in a Low-Cost Health Center Desert

Percent of county's population living over 20 minutes from the closest federally funded community health center.



Source: Health Resources & Services Administration, Indian Health Service

GoodRx

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Residents in much of the central part of the U.S. live in low-cost health center deserts. Specifically, in Nebraska, Kansas, North Dakota, and Texas, much of the population has to drive more than 20 minutes to access affordable primary care. Tragically, these states may need federally funded clinics the most.

Texas, for instance, has the highest uninsured population in the country, with 18.4% of residents lacking health insurance. Car ownership in Texas is also lower than average, with only 28.7 per 100 residents owning a registered vehicle. Without a car, a 20-minute drive, or longer, may prohibit many from accessing the care they need.

HEALTHCARE DESERTS ARE MORE LIKELY TO AFFECT THOSE WHO FACE ADDITIONAL BARRIERS TO ACCESS, SUCH AS LOWER INCOME, LIMITED INTERNET ACCESS, AND LACK OF INSURANCE

Accessing healthcare involves many factors besides simply having the physical infrastructure in place. People may have difficulty actually using existing healthcare infrastructure because of personal or financial barriers. As a result, health disparities may persist even in places that aren't considered "healthcare deserts," simply because some groups still struggle to access the resources that are available. In essence, socioeconomic factors often determine whether you can gain access to healthcare.

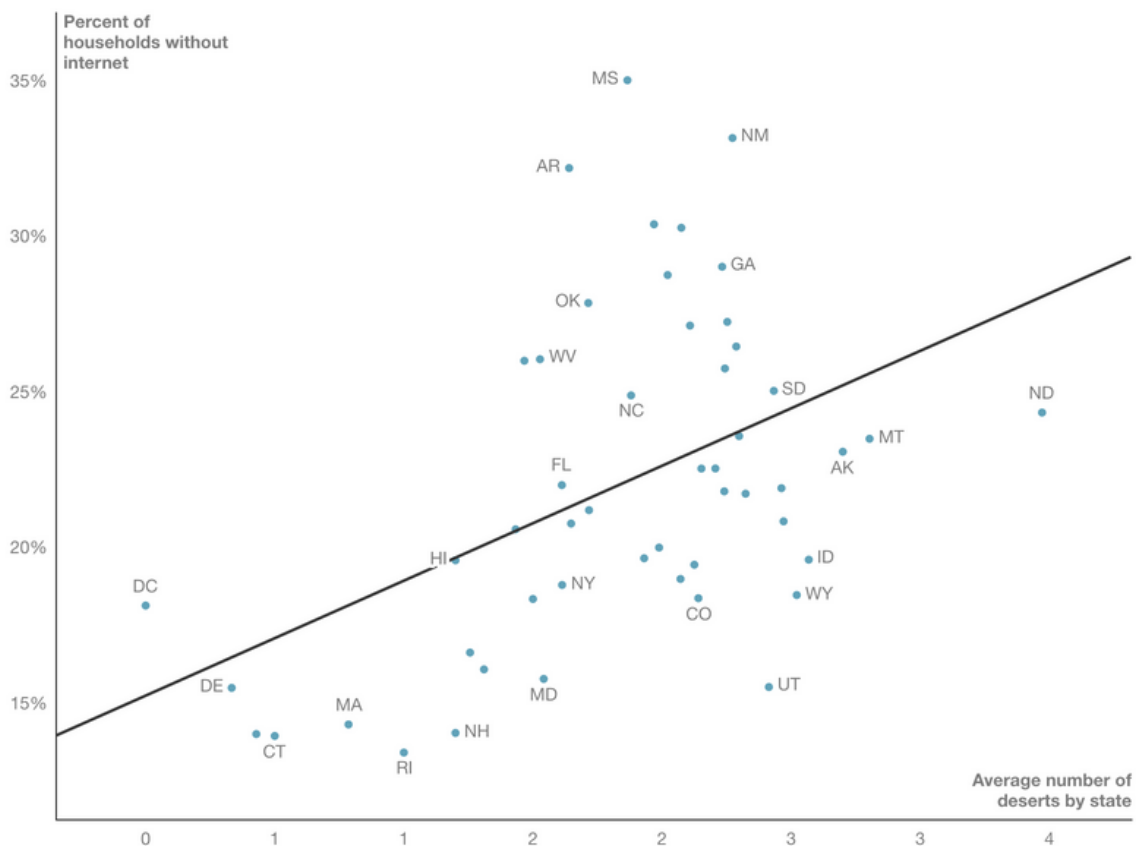
Below we walk through three factors that are more common in states with a higher number of healthcare deserts: (1) poor internet access, (2) low household income, and (3) lack of health insurance. In all of these cases, residents in states with more barriers and more deserts will have an even harder time accessing the care they need.

Internet access and healthcare deserts

Let's start with internet access. States with a higher rate of the population lacking internet access according to the census tend to have more healthcare deserts. In this analysis, North Dakota, New Mexico, and Mississippi stand out as having both poor access to healthcare services and internet access.

In North Dakota, nearly one-quarter of the population is without internet, and counties have an average of 3.5 healthcare deserts across the state. New Mexico has similar trends with 33% of the population without internet and 2.3 deserts per county on average. In contrast, more connected states tend to have better access to healthcare services. New Jersey, for instance, has few counties with any sort of healthcare desert, and only 14% of the population is without access to the internet.

Healthcare Deserts and Percent of Households Without Internet



GoodRx

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Reliable internet is essential for accessing nearly every aspect of healthcare, from researching and understanding a medical condition, to even accessing a COVID vaccine or a specialist. Back in March, during the height of the COVID-19 vaccine rollout, areas with a lower access to internet and modern technology found it difficult to access a vaccine, which placed these areas at risk of COVID-19 for longer than necessary.

Poor healthcare infrastructure, coupled with a lack of internet access, can only deepen health disparities. On top of that, a majority of the U.S. population that lacks internet is 65 years of age or older — an age group that typically needs more medical services than others.

Household income and healthcare deserts

Income is also, not surprisingly, associated with healthcare infrastructure. Montana, Idaho, and New Mexico, for instance, have lower median household income (according to the census) as well as more healthcare deserts. Many Southern states also suffer from both low median income and inadequate access to healthcare.

Healthcare Deserts and Median Household Income

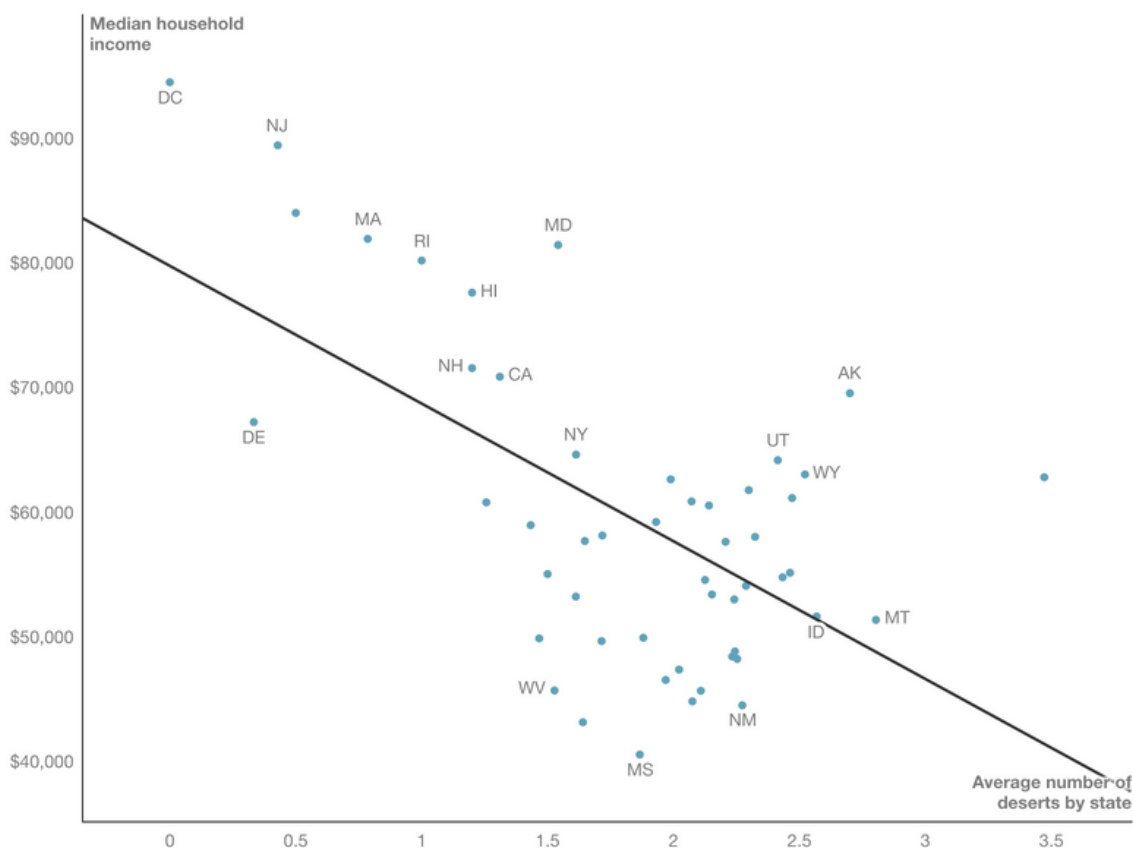


Chart: GoodRx

GoodRx

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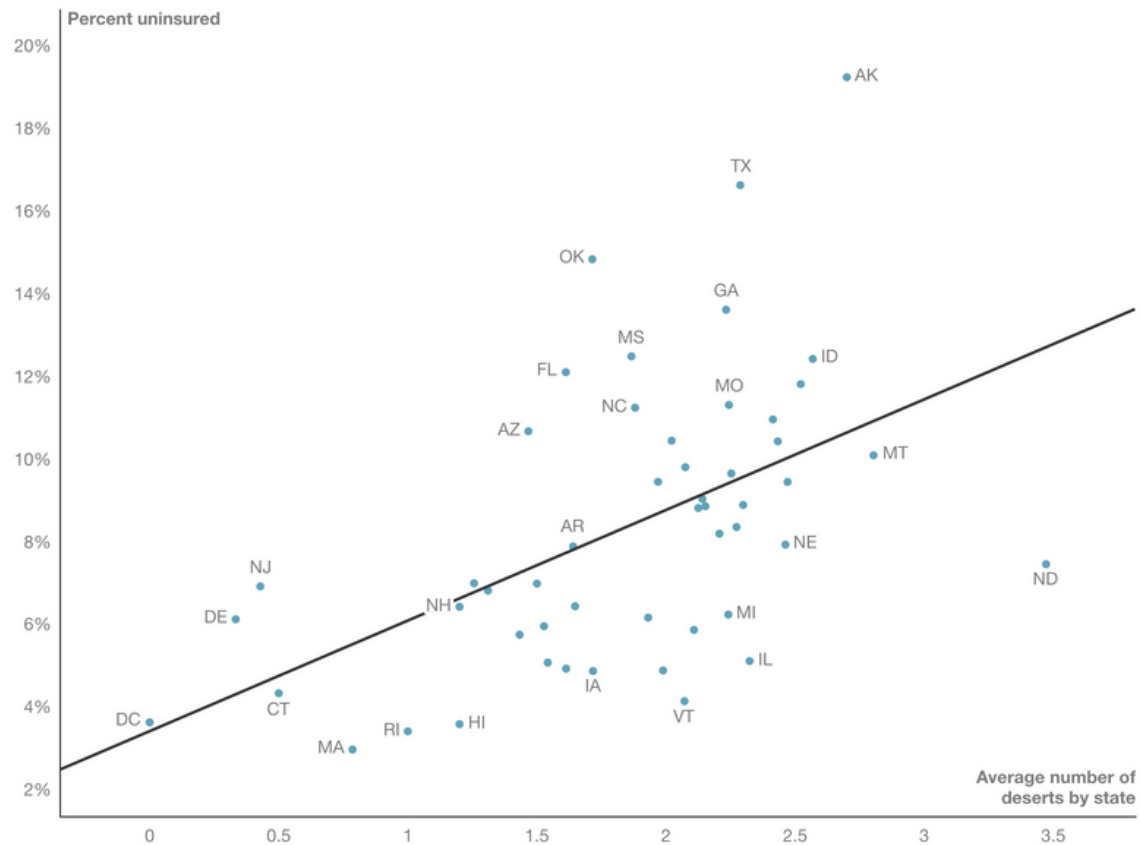
Income is a notorious, and well-researched, determinant of healthcare access for many reasons. Without a reliable and adequate stream of income, affording care can become difficult. For example, nearly 1 in 3 families report skipping some form of medical care due to cost. When people can't afford their healthcare, they may be forced to make decisions between paying for food and rent or paying for their prescriptions. So it's no surprise that cost is one of the top barriers to gaining access to healthcare.

The relationship between income and healthcare deserts is concerning, as low-income patients are precisely the group that needs healthcare infrastructure such as low-cost health centers nearby. Similarly, having multiple pharmacies and enough primary care providers nearby would help low-income patients find the most affordable treatments and invest in preventive care. The prevalence of healthcare deserts in low-income neighborhoods only exacerbates the issues of healthcare affordability.

Health insurance and healthcare deserts

Insurance status is also correlated with access to healthcare. Texas, Idaho, Georgia, and Alaska, for instance, have a large number of uninsured individuals (according to the census) on top of more healthcare deserts. In Idaho, 12% of the population lacks insurance, and, in Georgia, 14% of the population lacks insurance. In both of these states, healthcare deserts are widespread.

Healthcare Deserts and Percent Uninsured



Source: GoodRx

GoodRx

Interact with the chart: <https://datawrapper.dwcdn.net/DBoVC/3/>

A lack of insurance is linked to a host of healthcare outcomes. In general, uninsured individuals are more likely to skip care including doctor visits, prescriptions, and routine labs and screenings because they have to shoulder the cost of their care. In fact, a survey by Kaiser Family Foundation found that 50% of uninsured individuals do not have a “regular source of care” for their healthcare needs.

A lack of insurance, coupled with the lack of adequate healthcare infrastructure, is a double whammy that will certainly sway people away from the care they need. If someone has to drive a long distance for their healthcare and then shoulder the full cost, they aren’t likely to get all of the healthcare they need.

Finally, as discussed earlier, higher rates of uninsurance may feed a vicious cycle of perpetuating healthcare deserts. When more people struggle to pay their medical bills without insurance, resources like providers and hospitals flow out of the neighborhood, further exacerbating disparities in healthcare access.

SUMMING IT ALL UP

For years, research has sought to identify individual healthcare deserts on their own — from pharmacy deserts, to hospital deserts, and even food deserts. And while this research is essential, it is often just a snapshot of a community's access to healthcare.

Caring for one's health is multidimensional and includes an array of healthcare services. As we described above, in order to stay healthy, a community will need providers, hospitals, trauma centers, pharmacies, and community health centers. On top of that, people need to be able to access these facilities. Without insurance, or access to the internet for example, it will be difficult to gain access to these facilities, no matter how close they are to one's home.

From this perspective, few actually have adequate access to all aspects of healthcare services. So, while someone may live close to a pharmacy, they may have to drive over an hour to a trauma center if they get in a serious accident. Or if their doctor is just down the street, filling a prescription from said doctor may be a longer drive. Lacking just one dimension of healthcare can be detrimental to the health of the whole community.

On the flip side, investing in healthcare infrastructure and providing the means to access said infrastructure can have a multiplier effect on eliminating healthcare deserts and improving health outcomes. For example, helping the uninsured get insured and afford healthcare can attract investment in hospitals, which can then attract more healthcare providers. Likewise, increasing access to low-cost health centers reduces the financial burden of healthcare and encourages preventive care, building a healthier community and alleviating the demand for hospital beds and healthcare providers. There are many dimensions to healthcare access, and thus many opportunities to improve.

METHODOLOGY

Data sources

Data on 60,249 community retail pharmacies were sourced from [DataQ](#) and the GoodRx database.

Data on primary care providers were sourced from Health Resources & Services Administration (HRSA) primary care [health professional shortage areas](#) (HPSAs).

Data on 7,513 hospitals and 2,020 trauma centers were sourced from [Homeland Infrastructure Foundation-Level Data](#) (HIFLD) and the [Indian Health Service](#) (IHS).

Data on 11,643 federally funded community health centers were sourced from HRSA and IHS. Demographic data on county population, internet access, household income, and insurance coverage were sourced from the [2019 American Community Survey 5-year data](#).

Calculating driving time

We calculated driving time to the nearest pharmacy, hospital, trauma center, and community health center based on the straight-line distance from each [census tract population centroid](#). We applied a [detour index](#) of 1.417 to each driving distance. Driving time was estimated using [average driving speed](#) in urban, suburban, and rural areas. For driving time to trauma centers, we used [ambulance driving speed](#).

We note that five counties — Oglala Lakota, South Dakota; Shannon, South Dakota; Wade Hampton, Alaska; Kusilvak Census Area, Alaska; and Bedford, Virginia — were excluded from geographical deserts calculation due to missing data. The Federal Information Processing Standards (FIPS) codes for these counties were assigned after 2010 and did not have census tract population centroid information.

Defining healthcare desert thresholds

Pharmacy, hospital, and trauma center deserts are geographical deserts based on driving time thresholds from each census tract population centroid. At the county level, a county is considered a healthcare desert if more than 50% of the county's population lives in healthcare desert census tracts.

For pharmacy deserts, a census tract is considered a desert if the average driving time to the three closest pharmacies exceeds 15 minutes. We use the average distance to the three closest pharmacies in order to account for pharmacies' inventory, insurance preferred networks, and patients' ability to price shop. The threshold of 15 minutes was based on the concept of "food deserts," defined by the U.S. Department of Agriculture (USDA) as at least 500 people and/or 33% of a tract population residing more than 1 mile from a supermarket or large grocery in urban areas and more than 10 miles in rural areas. We derived 15 minutes by applying the average driving speed in rural areas to 10 miles.

For hospital, low-cost health center, and trauma center deserts, a census tract is considered a desert if the driving time exceeds 30, 20, or 60 minutes to the nearest hospital, health center, and trauma center, respectively. Based on previous studies, driving time exceeding 30 minutes to a hospital is considered a travel burden that can negatively affect timely diagnosis and quality of treatment (see Probst et al. (2007), Bosanac et al. (1976), and Ambroggi et al. (2015)). The driving threshold to community health centers was reduced in order to account for increased use by underserved minorities and vulnerable populations, which have been shown to be more impacted by travel burden (see Martinez et al. (2003), Fitzpatrick et al. (2004), and Syed et al. (2014)). For trauma centers, we set a driving threshold at 60 minutes, as travel times over 1 hour have been associated with increased patient mortality among severely injured patients (see Sampalis et al. (1993)).

For primary care provider deserts, we define a county as a desert if more than 50% of the population lives in primary care geographic HPSAs.

These areas are scored based on having a low population-to-provider ratio, high population share with income below 100% of the federal poverty level, high rates of infant mortality or low birthweight, and long travel times to the nearest source of care outside of the area.

For hospital bed deserts, we define a county as a desert if there are fewer than 2 beds per 1,000 population. According to 2020 data, the median number of hospital beds per 1,000 population among Organisation for Economic Co-operation and Development (OECD) countries is 3.5. As the U.S. ranks in the bottom quartile with 2.8 beds per 1,000 people, we chose a conservative desert threshold of fewer than 2 beds per 1,000 population. We note that this hospital bed threshold is also below World Health Organization (WHO) recommendations. We include hospital beds from all U.S. hospitals, including general acute care, long-term care, critical access, and psychiatric hospitals.

To count the total number of deserts per county, we sum the number of healthcare desert categories where the majority of the county's residents live in a desert.

Healthcare deserts and socioeconomic barriers to access

We compare socioeconomic data from the 2019 American Community Survey 5-year data to the simple average number of healthcare deserts by state.

Socioeconomic data is rolled up from the census tract-level by taking a population-weighted average at the county level and a simple average at the state level. The slope of the fitted line is estimated using ordinary least squares regression. All slopes shown are statistically significant at the 1% level.