
CAROLINA CROSSCUT:

Broadband and Telehealth in North Carolina's Appalachian Coal-Impacted Communities

North Carolina Department of Information Technology's Broadband Infrastructure Office
North Carolina Department of Health and Human Services

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Executive Summary

The rapid and widespread decline of the coal industry has negatively impacted many of North Carolina's Appalachian communities. For many families, generational dependence on coal extraction and related supply chains has resulted in personal and community economic devastation.

Long-term results of this impact have included a decline in the region's traditional resources, reduction in workforce opportunities, closures of local hospitals, and decreased tax bases.

This feasibility study investigated the broadband and telehealth assets and opportunities in addition to the health disparities and broadband gaps for the 20 counties in North Carolina's Appalachian region with the highest documented coal-impacts. The study revealed a stark economic, broadband, and health divide exists between those living in one of the 20 coal-impacted counties in North Carolina's Appalachian region and the average North Carolinian.

Deaths from cardiovascular disease, diabetes, stroke, opioid use, chronic obstructive pulmonary disease (COPD), and unintentional injury, are all significantly higher in rural areas than they are in North Carolina's metropolitan communities.ⁱ Health disparities such as these are often highly correlated with economic disparities.

Indeed, many of the 20 counties studied had both high rates of death due to diseases and a high percentage of their population who live in poverty. Increasing the local population's participation in the workforce, 21st century skills, and decreasing the poverty rate cannot occur if the region lacks adequate, affordable broadband and remains chronically ill.

Broadband access and adoption rates were also low in these counties, indicating that a relationship exists between the economic, physical, and broadband health of the counties. As such, increasing broadband access, adoption and use coupled with the implementation of telehealth solutions are urgent and multi-faceted tasks state and local leaders should undertake.

Access to adequate broadband and various telehealth services can

allow local and distant health care providers to address and provide appropriate clinical interventions for the region's primary health diseases such as cardiovascular disease, opioid use disorder, stroke and diabetes. Fostering an increase in broadband and telehealth adoption will improve health outcomes and create a healthier workforce, which will increase the health of the local economies and ensure the region flourishes.

Many leaders across the 20 counties have already begun working towards these goals. HCA Health care, previously known as Mission Health, in Buncombe county partners with hospitals in counties like Rutherford and Transylvania to provide virtual care to patients suffering from a stroke.

The Southwest Commission Council of Government, Land of Sky Council of Government, and the High Country Council of Government have all led efforts to collect data on which households in their counties do not have access to broadband and are using this data to incentivize internet service providers to expand broadband access to unserved areas.

However, for the region and other areas of the state to fully realize the benefits that broadband access, adoption and the use of telehealth services can bring to both individuals and communities, the state should design and implement strategic policies, programs, and tools to increase the availability and adoption of these technologies.

The purpose of this study was to gather data and best practices to inform the design of a comprehensive plan to simultaneously increase broadband access, adoption and use coupled with the implementation of telehealth services. Through the study, the project team identified the broadband, health care, and telehealth assets and gaps in the 20 high coal-impacted counties in the Appalachian region.

This provides essential information for the state and local stakeholders to design pilot programs that leverage technology to provide appropriate clinical interventions, improve the local population's health, increase local workforce participation and ultimately improve local economies.

Through the study, the project team gathered data on broadband access, broadband adoption, how many deaths occurred due to the region's most prevalent diseases, current telehealth usage, and the locations of community anchor institutions such as safety net sites, libraries, and schools who serve as anchors and trusted resources in their communities.ⁱⁱ

While many of the data points existed prior to this study, the compilation of the data provides a new and interesting lens through which state and local leaders can view the counties and identify new partners and areas ripe for piloting new technologies. The compiled data also identify areas leaders should target to expand broadband or provide technical assistance.

Major Findings and Recommendations

The feasibility study confirmed that a disproportionate number of individuals in the 20 counties live without access to basic health care services and access to specialists like cardiologists, because of distance and limited provider availability.

In addition, it confirmed where broadband and telehealth services exist health care

access is improved, patients are more aware of their conditions and equipped with self-management techniques to alert their health care professional when concerns arise.ⁱⁱⁱ

In addition to these global findings, the study revealed seven major findings that informed seven key recommendations for state and local leaders to undertake for increased broadband access and adoption to households and safety net sites.

Implementing the recommendations will ensure residents in the coal impacted counties have the access to health care they need to fully participate in the local economy.

While designed from this study's specific data and for the coal-impacted communities in the Appalachian region, these recommendations could be applied statewide to simultaneously increase broadband access, adoption and telehealth availability and use.

Findings & Recommendations

Finding 1: No two North Carolina counties are the same.

The study confirmed a finding long understood by North Carolinians—no two counties in the Tar Heel state are the same.

While not a novel finding, it is important to recognize and understand that the state's geographic, cultural, ethnic, and economic diversity impacts both broadband and health care availability, as well as how their gaps should be addressed.

Understanding the unique aspects of each county impacts the specific way each of the following recommendations should be

implemented. While each county is unique, when combining broadband access with health disparities, the data reveal that most of the counties fall into one of four categories, as they do when looking at broadband adoption combined with health disparities.

As seen in Matrix 1 below, quadrant one contains four counties—Burke, Caldwell, Madison and Surry. These counties have high broadband availability when compared to the state average and high health disparities and thus could be ideal

sites for telehealth pilots designed to meet their largest health needs.

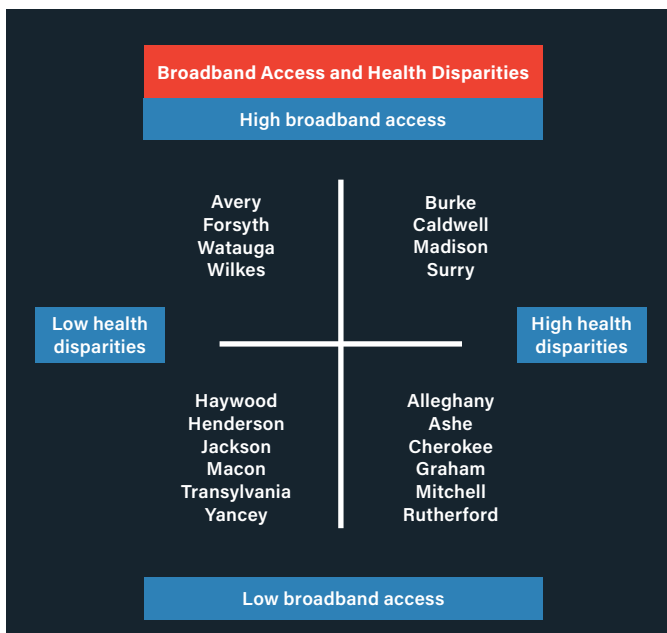
Strikingly, as seen in Matrix 2, no county has a combination of high broadband adoption and high health disparities. Instead, all the counties fall into quadrants two, three and four.

Matrix 2 indicates that for any telehealth pilot launched in the region, broadband adoption will need to be addressed for the population to fully participate and benefit from it.

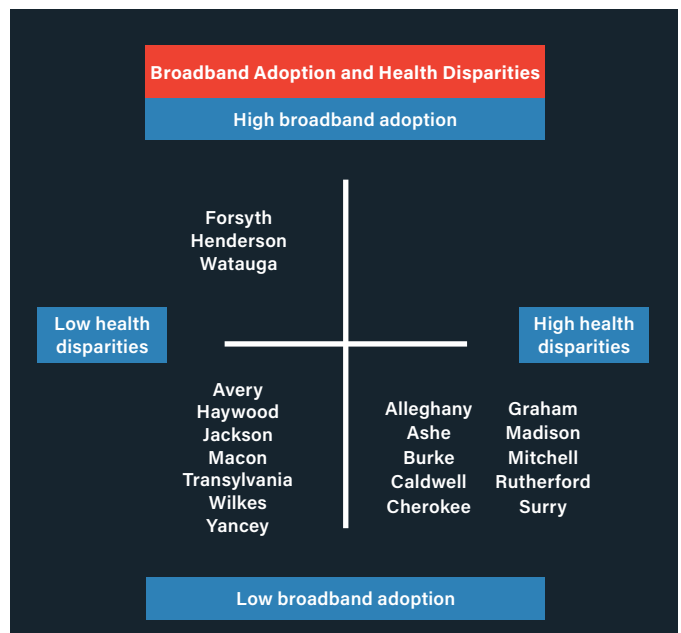
Recommendation

Programs and health interventions should be tailored to each community's specific needs.

Matrix 1



Matrix 2



Finding 2: A healthy workforce is a productive and competitive workforce, yet health disparities are high in the coal-impacted counties, and doctor shortages abound.

According to 'Healthy People 2020', an initiative of the federal government, improved health directly improves the workforce which then provides additional health care options for individuals.

Paid sick leave, health insurance, and protection from unexpected health care costs are just some of the advantages employed individuals have over those without employment.^{iv}

When individuals have a network in place that allows them to receive time and financial resources to access preventive care, they are more likely to engage in self-management of their diseases and have more productive days at work.

Healthy People 2020 also reveals that unemployed populations have a higher likelihood of stroke, heart disease, high blood pressure, and depression.

Evidence shows that the correlation between employment and positive health outcomes is obvious. This aligns with the ARC strategic investment goal, "Building a competitive workforce."

To increase the expansion and adoption of telehealth, North Carolina should develop robust and data-driven policies to enable its expansion.

Currently, DHHS has an interdivisional Telehealth Workgroup to provide guidance

and subject matter expertise for policy makers as increasing telehealth use is an agency priority.^v

The department is working to develop standards; including scope of services, online prescribing, data transfer protocols and reimbursement standards.

The commitment to increasing telehealth access is also reflected in North Carolina's redesign of the Medicaid program officially known as Medicaid Transformation.

Finally, DHHS supports innovative approaches to utilize telehealth as evidenced in the current NC DHHS Strategic plan.^{vi}

Recommendation

Develop a cohesive state policy to enable telehealth expansion.

Finding 3 : Safety net sites feel ill-equipped to establish telehealth programs.

According to a survey of health care safety net sites conducted as part of this feasibility study, 70 percent of sites indicated they already use some form of telehealth in their practice.

Sixty-two percent of the safety net survey respondents currently utilizing telehealth are school based health centers in the region using telehealth as a tool to provide student's access to health care for acute illness.

This has been a tremendous benefit to working parents in the region, so that parents do not have to take off work to visit a health care provider. However, since telehealth is a new form of health care delivery, many providers are not familiar with the variety of ways it can be used.

Safety net sites in the 20-county study area

provided interesting feedback when asked about telehealth training benefits:

- 44 percent of sites would like additional resources and training about telehealth best practices.
- 41 percent of sites had interest in telehealth training through webinars

Sixty-six percent of sites believed that using telehealth would allow patients better access to health care providers and could mitigate patient transportation issues.

Research, studies, and clinical outcomes from across the country indicate that using telehealth can reduce hospital admissions, improve early intervention of chronic disease exacerbations, and reduce mortality rates by up to 30 percent.^{vii}

As such, the project partners recommend the Office of Rural Health (ORH) launch a technical assistance program for the region's safety net sites to share evidence-based research and findings on the correlation between using telehealth and improving patient outcomes.

In addition, ORH should equip local safety net site providers with the knowledge, processes, and information needed to establish and implement telehealth programs designed to address their population's specific health needs.

Doing so will allow safety net site health care providers to make informed decisions about the service and how they can integrate it into their clinical practice to improve the health of their communities and increase their ability to participate in the local workforce.

Recommendation

The state should provide specialized and comprehensive technical assistance to assist safety net sites as they institute telehealth programs to improve the health of workers in coal-impacted communities.

Finding 4: Broadband access in the coal-impacted counties is low.

To fully achieve the ARC's strategic investment goal of "enhancing access to and use of broadband services," the 71,637 households in the coal-impacted counties without access to broadband need to be served.

If telehealth services were widely available across the study area today, 71,637 households would not be able to access them simply because they do not have internet access in their homes.

Expanding broadband access to these households requires funding and partnerships. In addition to continuing to implement the recommendations made in Connecting North Carolina: The State Broadband Plan^{viii} state and local policymakers, governments, and stakeholders should consider implementing the following recommendations.

Increase and Modify Growing Rural Economies with Access to Technology (GREAT) Grant Program

- The state should consider appropriating additional funding to the GREAT grant to continue extending last-mile service to North Carolina's unserved households. Many of the estimated 71,637 unserved households in the 20 study counties will remain unserved unless

additional resources are dedicated to increasing service in the region.

- The state should also consider increasing the speed threshold by which unserved areas are defined for the purposes of the GREAT grant. Currently, locations with less than 10Mbps/1Mbps are considered unserved and any location with greater levels of service is an ineligible area and will not be an allowable site for a project funded by GREAT. Given that telehealth services require higher speeds to perform adequately, increasing the speed threshold for the GREAT grant would ensure more residents are equipped with the necessary technology to fully engage in telehealth opportunities as they are made available.

Leverage Federal and Outside Funding

- State, regional, and local governments should continue to coordinate and leverage federal funding to increase the region's broadband access and adoption. As additional federal funds such as the U.S. Department of Agriculture's ReConnect grant program are made available to increase residential broadband access, the State should continue to coordinate with local and regional governments, private internet service

providers, and the federal government to ensure North Carolina receives the funding necessary to increase access throughout the region and state.^{ix}

Continue Data Collection and Mapping Initiatives

- This study reinforces the oft-cited need for reliable, granular broadband access data. BIO has undertaken several initiatives to collect and refine datasets on where broadband is available, this study being one of them. However, the state should continue to collect address-level data on broadband availability to inform funding decisions for programs such as the GREAT grant, the USDA's ReConnect grant program, and the forthcoming Rural Digital Opportunity Fund (RDOF) program from the FCC. Accurate maps will ensure funding is directed where it is needed most.
- Finally, BIO has developed a statewide survey to identify unserved and underserved households. A standardized, statewide survey will provide a robust data set for planning and mapping use. The state should continue to undertake initiatives such as this and local governments and stakeholders should partner with the state to assist in collecting this type of data.

Recommendation

The state, federal government, partners and stakeholders should dedicate resources to increase broadband availability to unserved households in the coal-impacted counties.

Finding 5: Broadband adoption rates are low in the coal-impacted counties.

Research shows that the sheer availability of or access to broadband is not enough to positively impact a local economy.

Rather it is the adoption of it, when people have it in their homes, and use it in ways that positively impact their economic outlooks—that a positive relationship between broadband and a community's economic health is established.

Yet, broadband subscription rates and computer ownership rates are lower than the state average in 17 of the 20 counties. Meanwhile, 15 of the counties also have

fewer worker aged residents with a bachelor's degree and 16 of the counties have higher rates of their population living in poverty than the rest of the state.

The state and local governments should partner to implement innovative and comprehensive broadband adoption and digital inclusion programs. Programs should be comprehensive and holistic in scope or leverage partners so that all facets of the digital divide—affordable internet access, access to computers, and access to digital skills education resources—are simultaneously addressed. They should

also leverage each community's and unique assets and address their specific needs.

In addition, few funding opportunities exist that support digital inclusion and broadband adoption initiatives. As such, dedicated funding for increasing digital equity through digital inclusion programs is needed.

All levels of government should allot funding to pilot, support, and sustain digital inclusion programs, and other stakeholders such as foundations and private donors should consider investments in digital inclusion and broadband adoption initiatives.

Recommendation

The state, partners and stakeholders should implement innovative and comprehensive broadband adoption and digital inclusion programs.

Finding 6: Most safety net sites have broadband, but the reliability of their connection, and affordability are unknown.

To achieve the ARC's strategic investment goal of "enhancing access to and use of broadband services," safety net site locations need to have the internet service required to ensure they will meet the capacity demands telehealth applications require.

As such, these sites should evaluate their broadband subscription and the speeds they receive. The safety net site survey revealed that 94 percent of the sites have reliable, high speed internet.

Reliable internet was described to them as high-speed, high quality access delivered by a wire or fiber optic cable not to include cellular hotspots, satellite, dial-up or site to site microwave.

Of the 94 percent that indicated they had reliable internet, 47 percent of the sites

were unsure of what type of internet they had, and 32 percent indicated they have a fiber connection, but 71 percent indicated they are extremely satisfied with their internet service.

Although this information indicated that most sites have the broadband access they require, and some knowledge of existing services, it does not necessarily indicate a knowledge of the full bandwidth and broadband needed to support and sustain growing telehealth capabilities. In addition, many sites were unaware of the speeds and technologies they are subscribed to.

Finally, it is unclear how many sites are aware of the FCC's funding program that provides discounts for broadband connectivity for rural health providers called the Health care Connect Fund (HCF) administered by the Universal Service

Administration Co. (USAC).^x

In North Carolina, the North Carolina Telehealth Network (NCTN) is the consortia through which eligible health care sites can receive discounted internet service through the FCC's HCF program.^{xi}

As such, the project team recommends safety net sites investigate their current internet connectivity to determine whether their subscription will meet their future needs and investigate whether they are eligible for the HCF program and serviceable by the NCTN.

Should any safety net site in the region or the state not have adequate, reliable broadband service, or understand how to investigate their current options, the site should contact BIO who can provide technical assistance.

Recommendation

Encourage safety net sites to evaluate their broadband subscription before launching telehealth programs.



Finding 7: Increased demand for telehealth services could lead to the creation of a telehealth technology cluster.

Increasing the use of telehealth could contribute to the creation of a telehealth industry cluster and could also foster the growth of entrepreneurial activities in the region. One Wilmington-based startup, OpiAID, is developing a wearable device using machine learning and artificial intelligence designed for those suffering from Opioid Use Disorder.^{xii}

When complete, the wearable device will be able to detect cravings, contact the wearer's support network, collect and share data with partners, and even deliver naloxone in the event of an overdose.

The company's goal is to have the first commercial-grade version of OpiAID available in by summer 2020.^{xiii}

New telehealth technologies such as this could prove to be effective methods for addressing the opioid epidemic in the study area.

However, as the technology will rely on mobile broadband services, spotty mobile coverage in the region could prove to inhibit its efficacy.

However, of North Carolina's estimated

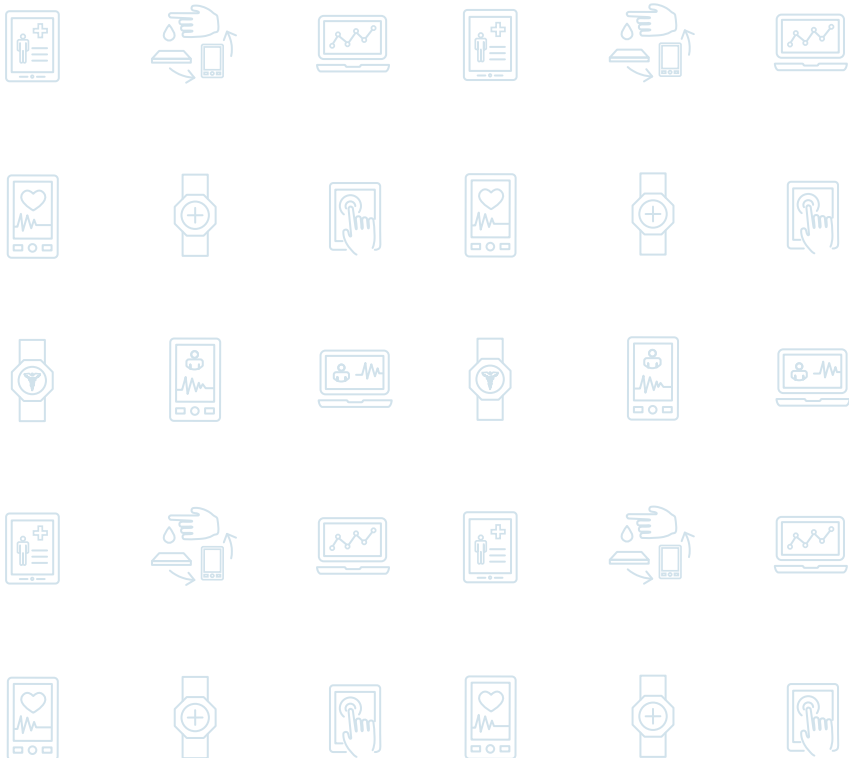
123 telehealth focused startups, only one company's headquarters are in the study region—in Forsyth county.

Thus, while increased access to and adoption of broadband and telehealth by health care providers and patients opens up a natural market for telehealth-focused startups, entrepreneurial-focused support organizations like Digital Health Institute for Transformation (DHIT)^{xiv}, CED and NC IDEA^{xv} should build capacity and support the region's entrepreneurial ecosystem for the region to leverage the natural market opportunity.

Recommendation

Entrepreneurial support organizations should provide intentional support for entrepreneurs who desire to launch digital health startups in the coal-impacted counties.

Implementing these recommendations will require dedicated leadership, sustained partnerships between the state and local leaders, and a willingness to pilot innovative and new programs. The data collected through this feasibility study are clear. If bold and swift actions are not taken to equip providers to deliver health care through telehealth, align policies to foster telehealth growth, increase broadband access and adoption, increase the populations' digital skills and computer ownership, foster an entrepreneurial ecosystem, and rely on the local knowledge and expertise to tailor solutions that meet the community's need then North Carolina's coal-impacted communities will remain sicker, more economically distressed, and without the digital infrastructure necessary to flourish in the 21st century.



An Introduction

Background

In February 2019, the Appalachian Regional Commission awarded the North Carolina Department of Information Technology (DIT) Broadband Infrastructure Office (BIO) and the North Carolina Department of Health & Human Services (DHHS) Office of Rural Health (ORH) a \$98,273.00 Partnerships for Opportunity and Workforce and Economic Recovery (POWER) grant for a Technical Assistance Feasibility study project.

BIO and ORH conducted a 12-month feasibility study to identify the broadband and health care opportunities, challenges, and gaps in the 20 counties with the highest coal-impact in the ARC region and investigate where implementation of telehealth services can bridge health care gaps, reduce costs to the consumer and provider, and improve health outcomes.

The technical assistance project investigated the availability of existing resources necessary for the implementation and expansion of a robust telehealth infrastructure and explored viable programs to address health disparities within North Carolina's coal-impacted counties. The result is a comprehensive picture of existing infrastructure in 20 of the region's coal impacted counties that identifies gaps in service and opportunities for expansion. The study informed the design of recommendations for regional broadband and telehealth expansion and will inform a statewide plan as well.

The project's original intent was to understand the region's assets and opportunities to increase broadband access and telehealth opportunities to bridge

the region's unique health disparities. To implement strategic, feasible, and useful telehealth solutions in the region, a thorough understanding of the region's existing broadband and telehealth assets was needed. Likewise, an understanding of the gaps in telehealth and broadband is essential to leverage the economic and societal opportunities telehealth services promise.

The feasibility study addressed Goals 1, 2 and 3 of ARC's *Strategic Investment Goals of building a Healthy Ready Workforce, Enhancing access to and use of Broadband Services, and Fostering Entrepreneurial Activities*.

Given that health and economic progress are interrelated, improving the state's ability to positively affect health outcomes in the region will positively impact the ARC region's economy and counteract some of the negative impact the absence of the coal economy has had on the region. For the region to thrive, it is essential to ensure the region's workforce is healthy and all health disparities innate to the region are addressed. Unique disparities include chronic health and substance abuse issues such as opioid addiction, diabetes, and heart disease and a shortage of health care providers, including specialists.

According to Rural Health Hub^{xvi}, "Rural Americans are a population group that experiences significant health disparities. Health disparities are differences in health status when compared to the population overall, often characterized by indicators such as higher incidence of disease and/or disability, increased mortality rates, lower life expectancies, and higher rates of pain and suffering. Rural risk factors for health

disparities include geographic isolation, lower socioeconomic status, higher rates of health risk behaviors, limited access to health care specialists and subspecialists, and limited job opportunities.

This inequality is intensified as rural residents are less likely to have employer-provided health insurance coverage, and if they are poor, often are not covered by Medicaid." ORH's mission is to support equitable access to health in rural and underserved communities. To achieve its mission, ORH works collaboratively to provide funding, training and technical assistance for high quality, innovative, accessible, cost effective services that support the maintenance and growth of the state's safety net and rural communities.

Broadband is a sector-crossing technology—it impacts all industries and has the potential to provide economic and health benefits to residents from all walks of life. When communities have affordable access and high broadband adoption rates, opportunities in all sectors are made possible.

The opportunities broadband fosters in the health care industry are particularly exciting. Internet-based telehealth technologies have the potential to positively impact a person's health, their ability to receive care despite their location, and in some cases can even help save a person's life. However, many of these telehealth technologies rely upon consistent and pervasive broadband that is available and used effectively and efficiently by both patients and health care providers.

Increasing the use of telehealth also has the potential to contribute to the growth



Rural Americans are a population group that experiences significant health disparities. Health disparities are differences in health status when compared to the population overall, often characterized by indicators such as higher incidence of disease and/or disability, increased mortality rates, lower life expectancies, and higher rates of pain and suffering. Rural risk factors for health disparities include geographic isolation, lower socioeconomic status, higher rates of health risk behaviors, limited access to healthcare specialists and subspecialists, and limited job opportunities. This inequality is intensified as rural residents are less likely to have employer-provided health insurance coverage, and if they are poor, often are not covered by Medicaid.”

of entrepreneurial activities in the region. North Carolina boasts many business startups in telehealth, digital health, and various health care-focused products and services. For example, RelyMD, a startup founded by a group of NC-based Emergency Room (ER) physicians, created a secure portal through which patients can videoconference with an ER physician in lieu of visiting an ER.

As more patients and providers begin using these types of on demand telehealth services, the size of the market will increase. As such, existing North Carolina-based startups, like RelyMD, could identify additional digital health market opportunities, thus expanding their business and revenues and potentially increasing access to health care. Expanding the market also has the potential for new entrants to the market that fosters local innovation and economic growth. Existing health care providers can also realize cost savings and efficiencies when telehealth services are implemented, and care is coordinated.

Telehealth Definitions

According to the Health Resources and Services Administration (HRSA), telehealth is defined as “the use of electronic information and telecommunication technologies to support long-distance clinical health care, patient and professional health-related education, public health, and health administration.”^{xvii} While telehealth and telemedicine are often used interchangeably, the term telemedicine is specific to the diagnosis and treatment of patients using telecommunications technology.

As telehealth technology continues to evolve, so will the ways in which people use it. Currently, the most common forms of telehealth are synchronous “live” video conferencing, asynchronous “store and forward,” remote patient monitoring (RPM), and mHealth or Mobile Health.

Synchronous video conferencing^{xviii} is a modality that uses “two-way interactive audio-video technology to connect users with a live, face-to-face interaction.” Video conferencing uses computer screens, tablets, or other video-capable devices along with microphones to allow real-time face-to-face interaction between providers and patients. It also allows for use of peripheral equipment such as electronic stethoscopes, otoscopes, and electrocardiogram transmissions (ECGs).

One example of this modality is the Health-e-Schools program that operates in several public schools in counties across the Western Region (see case study below). Health-e-Schools is a telehealth model with a Nurse Practitioner (NP) available during school hours Monday through Friday. Students across 50+ sites can go to the school nurse’s office like Avery, Burke, and Yancey. The program offers students and staff virtual health care using live video and electronic stethoscopes and otoscopes. This method reduces absences, tardiness, their parent’s absences from work, and improves student’s access to timely care.

Asynchronous “Store and Forward”^{xix} is not real-time, but allows for the electronic transmission of medical information, such as digital images, documents, and pre-recorded videos through secure email

or text messaging. Clinicians at distant sites can review and analyze tests, exams, images and additional information after the patient visit has concluded. For example, a Community Paramedic (CP) conducting a visit with a patient in their residential setting who notices a new rash from a recent change in medication could take a picture of the rash, text it to the patient’s primary care provider (PCP) for review and the PCP can recommend adjustments to medication through a HIPAA compliant texting platform.

A third form of telemedicine is remote patient monitoring (RPM).^{xx} This modality collects patient vital signs and relevant chronic disease biometrics (such as glucose levels) for transmission to clinical staff who can contact the patient for follow-up if needed. In many cases, RPM is used for patients who are recently discharged from the hospital or who are considered “high-risk” by clinical staff. This can include patients with uncontrolled diabetes, heart failure, blood pressures monitoring, and peak flow monitoring.

The last form of telemedicine is mHealth (also known as Mobile Health).^{xxi} This modality uses “devices such as smart phones and portable monitoring sensors that transmit information to providers, as well as dedicated application software (apps), which are downloaded onto devices.” mHealth’s popularity is increasing as more people purchase wearables such as fitness trackers, pedometers, and heartbeats sensors to monitor their own biometrics. In some cases, information obtained through mHealth can be sent to a provider for clinical review and assessment.

Telehealth in North Carolina

Over the past 20 years, telehealth services have become more widely available and accessible. The opportunities telehealth provides to communities range from improving health outcomes for patients with chronic conditions, improving access to health care in rural areas, and significantly reducing costs to the health care system.

Increasing access to care through telehealth can also result in a healthier population and workforce. According to the 2019 Office of Management and Budget Report, North Carolina has 70 counties that are designated as “rural”.^{xxii}

Residents of rural areas often encounter transportation difficulties as well as provider shortages, particularly in specialty health care services, that limit access to care. A 2015 report from The Cecil G. Sheps Center for Health Services Research concluded that North Carolina does not have a shortage of physicians overall.^{xxiii}

Rather, North Carolina experiences a maldistribution of physicians, with most specialty physicians choosing to practice in urban areas rather than rural ones. Unsurprisingly, health indicators also reflect this urban-rural divide.

For example, rural residents face higher mortality rates and higher rates of other adverse health outcomes from cardiovascular disease and diabetes.

^{xxiv} The increase of telehealth options would allow patients access to health care providers and could assist to better care for themselves through telehealth modalities such as remote patient monitoring.

In 1999, NC Medicaid enacted a policy to reimburse certain telemedicine services.

^{xxv} However, the amount of covered NC Medicaid telehealth services is limited. At the federal level, the Centers for Medicare and Medicaid services continues to adapt policies to fit the changing health care landscape and cover more telehealth services.

Currently, North Carolina does not have statewide telehealth legislation. This leaves individual health insurance carriers to determine telehealth coverage and reimbursement for their subscribers. Due to the continued economic and health care opportunities that telehealth presents, 42 states and the District of Columbia have enacted a telehealth commercial insurance coverage law.^{xxvi}

The following map shows the breakdown of which states have telehealth commercial payors legislation.^{xxvii}

Broadband in North Carolina

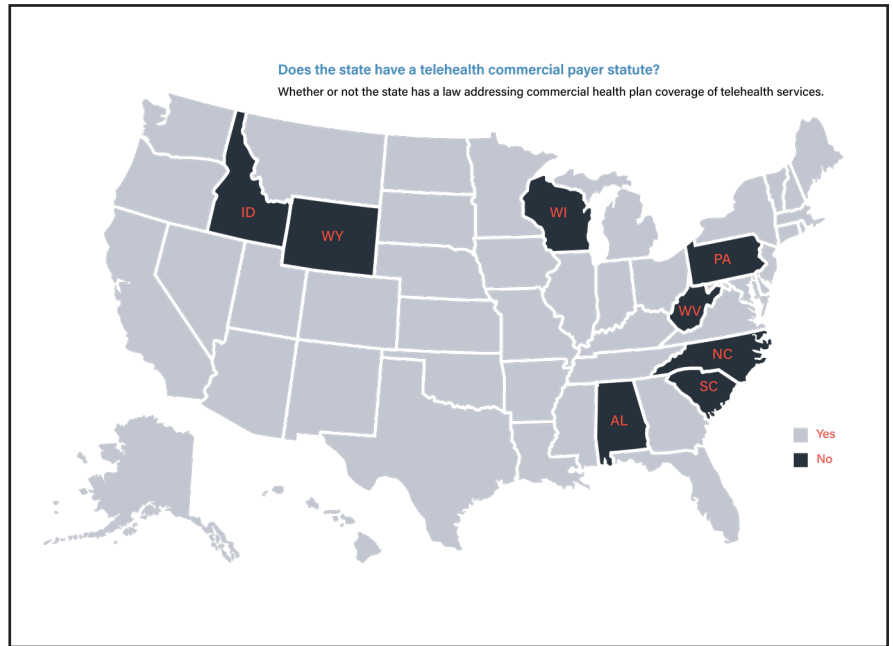
Today, the internet intersects with and impacts nearly every facet of a North Carolinian's life. It provides workforce development and continuing educational opportunities, it fosters and enables innovation and entrepreneurship, and it has the capacity to improve health care delivery and health outcomes for patients. But broadband is still not available to, nor adopted by all North Carolinians.

Broadband infrastructure can be delivered via a range of technologies including fiber, coax cable, copper, or wireless technologies and allows for higher capacity and faster data transmission than when connected via older technologies like dial-up.

According to the most recent data from the Federal Communications Commission (FCC), 94.8 percent of North Carolina's households have access to broadband in their homes at 25 Mbps (download)/3 Mbps (upload), the FCC's current recommended speed threshold.^{xxviii}

Meanwhile only 59.4^{xxix} percent of households adopt (or pay for a subscription in their home) at that speed threshold according to the FCC.

The 2018 American Community Survey shows that 78.3 percent of North Carolina households adopt broadband when considering any speed threshold, while the U.S. average is 85.1.^{xxx} Broadband coverage is a key determinant of adoption, individuals and households can only adopt



broadband in areas where it is available.

However, broadband coverage is not the only factor that limits adoption. Subscription costs, a lack of access to computer devices, a lack of digital literacy knowledge, and relevancy or a lack of understanding how the internet impacts one's life restrict adoption rates even in areas with enough broadband coverage. Subscription cost is the main barrier to adoption among households with access.

In 2015, the Pew Research Center found that subscription costs are the primary barrier to adoption for 33 percent of non-adopting households nationwide.^{xxxi}

This is especially true among low-income households. North Carolina's high-income households are more than twice as likely to adopt broadband than low-income households.

Only 51.2 percent of North Carolina households with an annual income of

Image 2

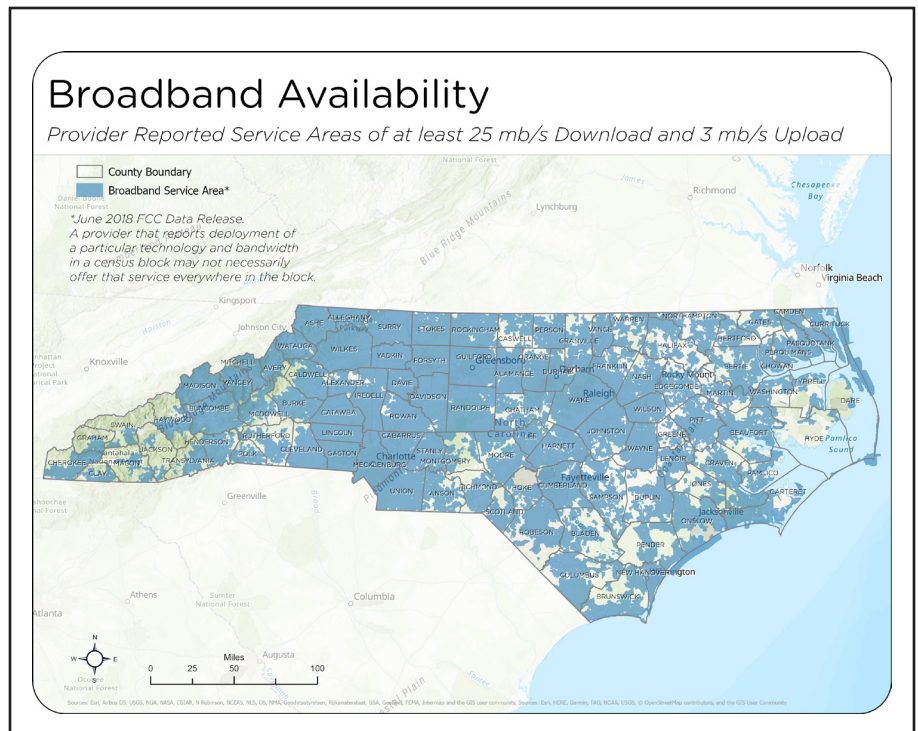
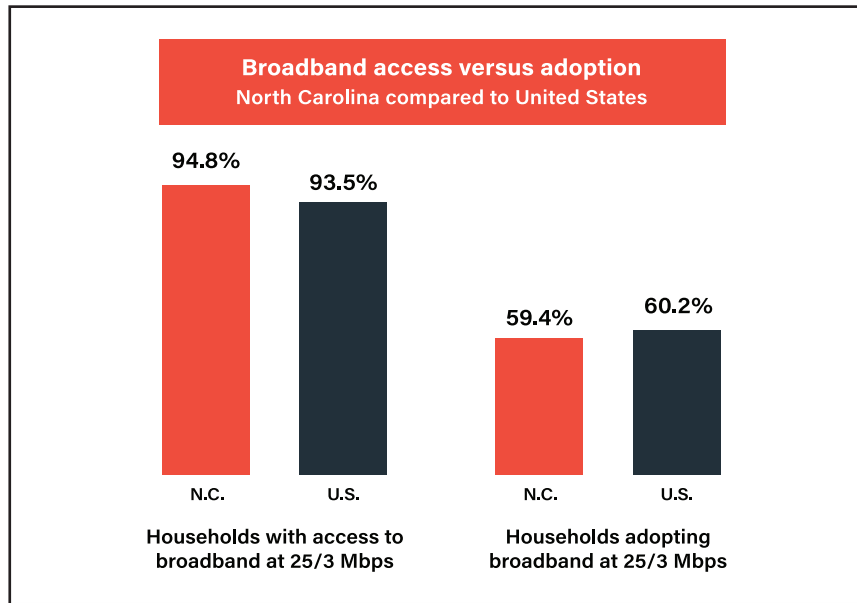


Image 3



\$20,000 or less adopt broadband while 93.8 percent of households with an annual income over \$75,000 adopt broadband.^{xxxvii} A lack of access to a digital device—such as a laptop, tablet or computer also discourages broadband adoption.

Currently, 12.6 percent of households do not have a computer of any type and 5.9 percent only use a smartphone to access the internet.^{xxxviii} This means that 18.5 percent or 726,122 North Carolina households have no access to meaningful device and are unlikely to subscribe to an

internet service.^{xxxiv}

Individuals with lower levels of education, income, and who are elderly or disabled are less likely to adopt broadband too.^{xxxv} Research demonstrates that disparities by education and income are consistently larger than those observed by any other factor, including population density.

Digital literacy is the ability to use broadband technology to find, evaluate, create, and communicate information.^{xxxvi} Individuals who feel that they lack the

knowledge to use broadband and related technologies or who feel unable to learn how to use them have lower adoption rates.

According to the Pew Research Center, nearly a third (32 percent) of those not online in 2019 cited the 'difficulty of using the internet' as the primary reason for not subscribing to the internet.^{xxxvii}

Project Components and Methodology

The broadband and telehealth feasibility project plan consisted of four main activities split among four project phases, 1) Gather broadband, health, and telehealth quantitative data, 2) gather broadband health, and telehealth qualitative data and best practices, 3) compile, analyze and visualize gathered data, and 4) utilize data to design recommendations.

The project was implemented in accordance with the project plan as seen in Table 1.

In Phase One, the project partners identified the data points and their sources to collect for the project then gathered the data from various sources. Three categories for data collected were identified, 1) broadband, 2) health care, and 3) telehealth.

The project partners assigned each variable to a category, identified potential sources, and defined other attributes for the variables. (See Appendix A).

In Phase Two, the project partners created and distributed a survey to 118 of the 156 safety net sites in the region (see Appendix B). In addition, the project partners visited and conducted standardized interviews with four health care sites utilizing telehealth technologies to deliver care (See Appendix C). The site visits and interviews

Image 4

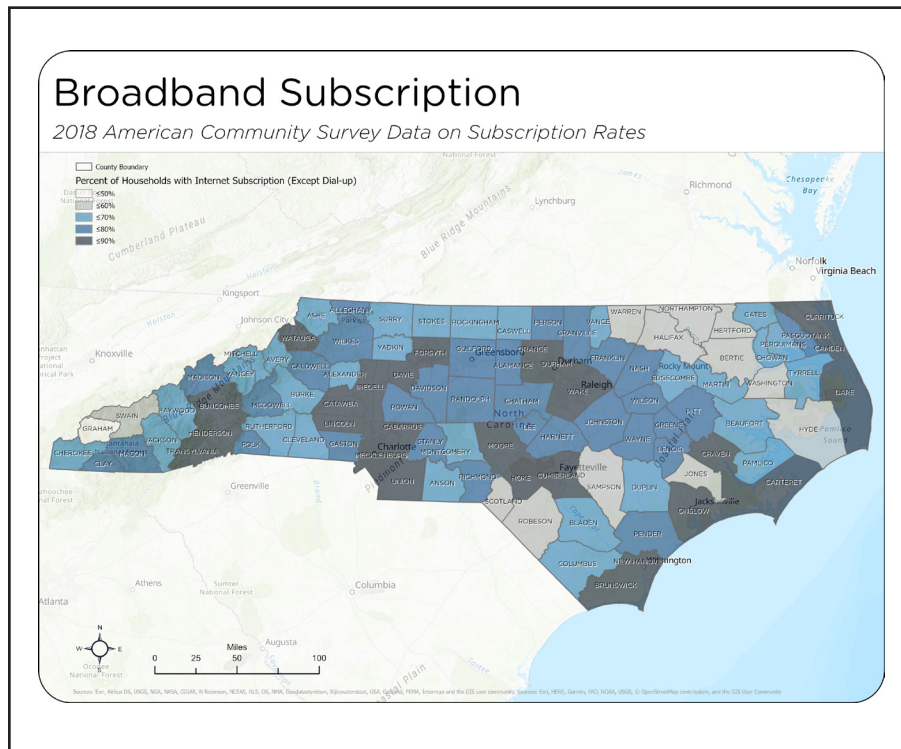


Table 1: Broadband feasibility study for telehealth deployment in Western North Carolina project components		
Phase	Project Activity	Desired Outcome
Phase 1: Months 1-4	Gather qualitative data	1. Comprehensive inventory of broadband assets. 2. Comprehensive inventory of healthcare assets. 3. Comprehensive inventory of telehealth assets.
Phase 2: Months 5-7	Gather qualitative data and best practices	1. Detailed information on the community's broadband, healthcare and telehealth needs. 2. Best practices for using telehealth modalities to treat the ARC regions's most pressing health conditions.
Phase 2: Months 8-9	Analyze and compile data	1. Maps, data, and analysis of broadband gaps and opportunities. 2. Maps, data, and analysis of healthcare gaps and opportunities. 3. Maps, data and analysis of telehealth gaps and opportunities. 4. Cost estimates for different broadband deployment strategies to enable telehealth expansion.
Phase 2: Months 10-12	Compile reports and recommendations	Detailed summary of the study's findings, understanding of gaps and opportunities, information to build recommendations and develop a plan for building broadband capability to support telehealth implementation in the WNC ARC region.

informed the case studies.

In Phase Three, the project partners used the collected data to create three dashboards to visualize and analyze the data. Finally, this report is the summation of the Phase Four activities.

Dashboards and Data Visualization

Given the large number of variables, the different units of measurement and the size of the project area, the project partners determined data visualizations would assist stakeholders and policymakers in using the collected data to inform the development of programs, policies, or tools to increase broadband and telehealth access and adoption in the study area.

As such, the project team created three dashboards designed to assist decision-makers and stakeholders as they view the region's broadband and health disparities.

The first dashboard, called the 'County Profiles Dashboard' has three components: broadband adoption potential by census tract, health data by county, and the count of opioid deaths in the county.^{xxxviii}

The broadband adoption map displays BIO's 'Broadband Adoption Potential' index for the study area.^{xxxix} The 'Broadband Adoption Potential' index is comprised of 11 variables including the percent of households with a wireline subscription.

However, research indicates the need to consider other variables that affect technology adoption including but not

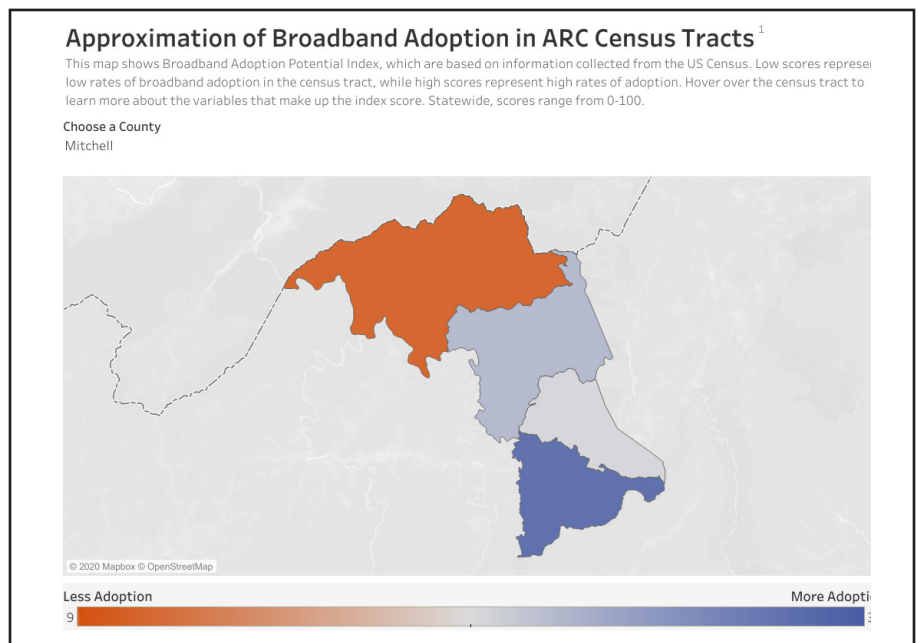
limited to age, income, presence of children and educational attainment among others, as such these and other variables are included to comprise the adoption potential score for each census tract.

Lower scores are shown in orange on the map, and indicate lower rates of broadband adoption potential whereas

higher scores are shown in blue on the map, and indicate higher broadband adoption potential.

Adoption potential scores range from 0 to 100 and include census tracts from the entire state, as such census tracts in the study area are compared to census tracts outside the study area. Users can hover over the census tracts to obtain additional

Image 5



information about the specific variables that comprise the index.

Image 6

While county index scores are available, the census tract scores assist communities in identifying the subtle yet sometimes dramatic difference between communities, assisting in community planning. For example, as seen in image 5, the index score ranges from nine to 31 among Mitchell County's four census tracts.

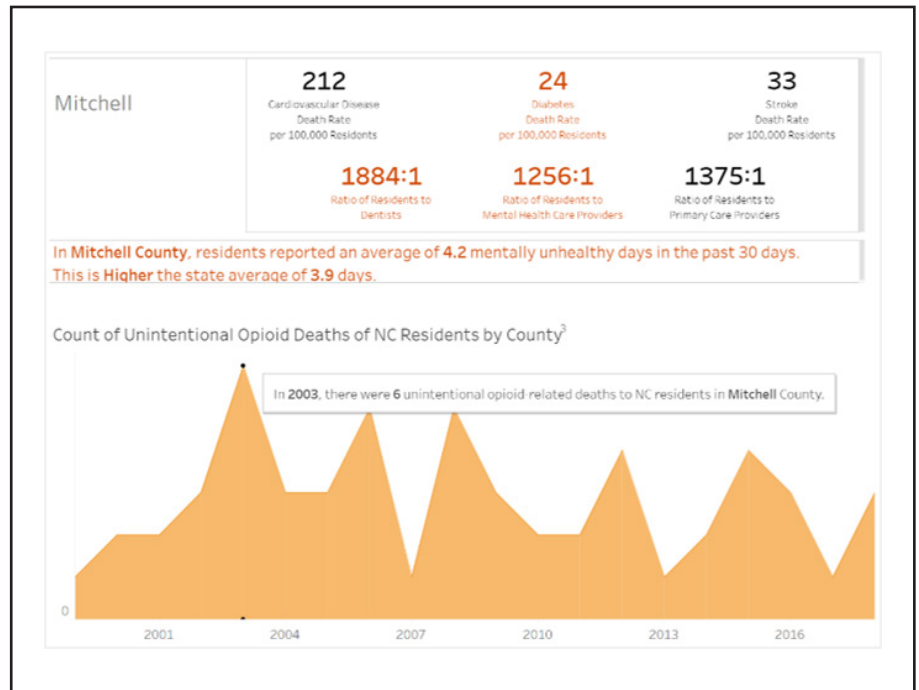
Variables include: death rates due to cardiovascular disease, diabetes, and stroke, the ratio of residents to dentists, mental health and primary care providers, and the average number of mentally unhealthy days in the past 30, as reported by county health rankings data.

Profile

Finally, this dashboard includes the count of unintentional opioid deaths in the county. The example from Mitchell County above (Image 7) shows that four of the seven health indicators are higher than the state averages, and that the count of opioid deaths has varied since 1999.

The opioid death chart includes an example of the pop-out information that appears when users hover over the data visualizations.

The second dashboard is titled, "Internet Access and safety net sites in North Carolina's ARC Counties."^{xl} The dashboard's map displays the distribution of safety net sites, community anchor institutions, and (where available) households who reported not having internet access for each county in the



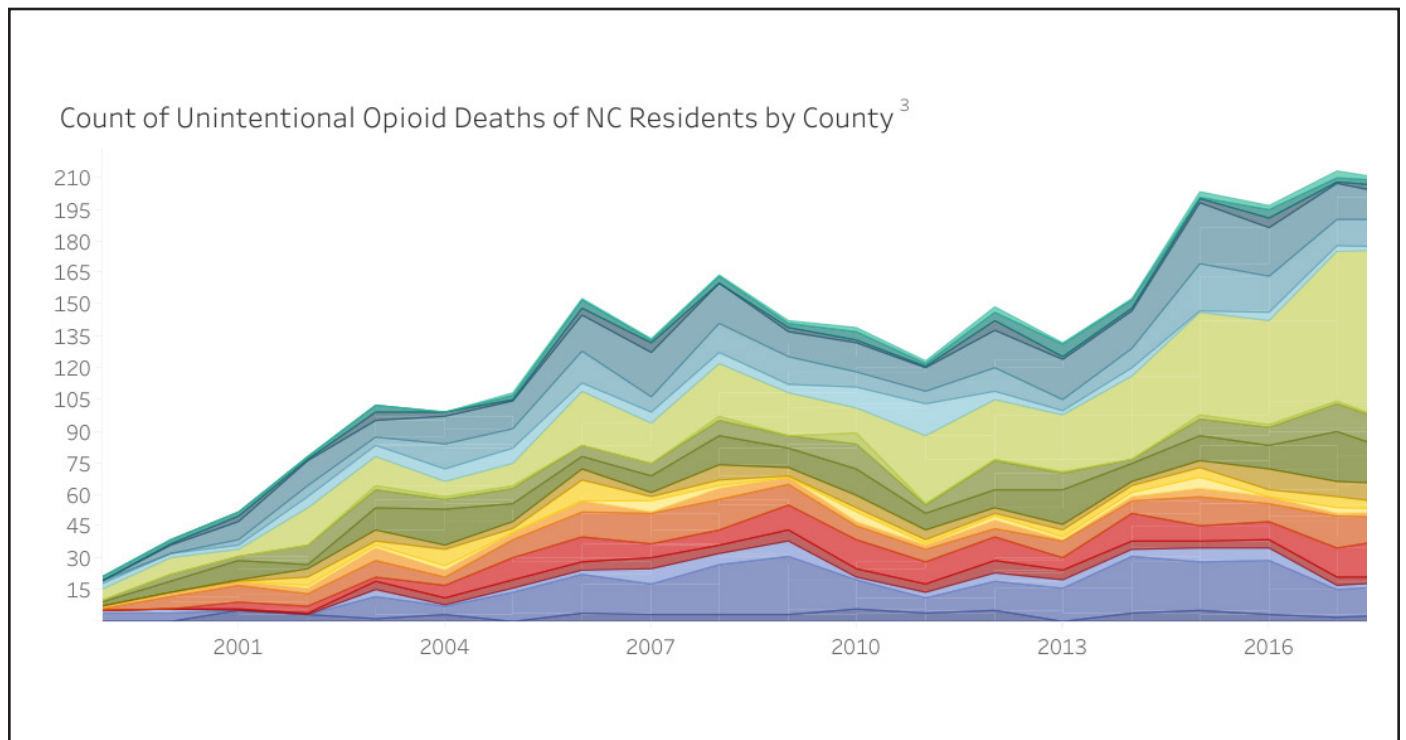
study area. The background base maps show broadband coverage in the county's census blocks at 25 Mbps/3 Mbps.

who reported not having broadband access would be identified.

The third dashboard titled, "ARC Cluster Analysis" is the result of the effort to determine which areas in each county demonstrated the highest need. To do so, a clustering methodology was developed wherein clusters of surveyed households

The result is an interactive display wherein stakeholders can determine how many homes are in a .25, .5 or 1 mile radius in the study counties where household reported data is available (see Appendix D for more information).

Image 7



What the Data Say

In sum, the data provide a more nuanced understanding of the similarities and differences between the 20 counties. While many counties do not have adequate broadband, have low adoption rates, and have high health disparities, no two counties are the same; however, all could benefit from telehealth services, and broadband access should be addressed as should broadband adoption for the region to realize telehealth's full benefits.

Broadband

Available data for broadband access and broadband adoption were collected from existing third-party sources, primarily the U.S. Census Bureau's American Community Survey (ACS) and the FCC. Surveys deployed to citizens in the region were also compiled, aggregated, and mapped in the dashboards.^{xii} Surveys were conducted on an ad hoc basis between 2014 and 2019, were mostly led by county or regional leaders, and were shared with BIO for its work in supporting counties in their broadband expansion efforts.

All but two broadband variables—digital literacy skills, and broadband usage rates at safety net sites—the team aimed to collect were available and collected.^{xiii}

To assess the broadband needs at the county-level, variables are compared to the overall state average when available. The project team gathered data for eight broadband and technology variables to measure broadband access and adoption in the region.

For the purposes of this study, unserved

households are determined by whether they have access to broadband at the FCC's recommended speed threshold for broadband, 25Mbps download/3Mbps upload.

This threshold is used for this study in lieu of the often used 10Mbps download/1Mbps upload threshold because telehealth applications such as synchronous video require higher speeds for adequate performance. In addition, given their increasing complexity and scope, future telehealth applications will require higher speeds to operate without disruption and will likely increase as the applications become more complex.

At 25Mbps download/3Mbps upload, an estimated 71,637 households in the 20 study counties do not have broadband (or are unserved).^{xiii} This is 30 percent of the total estimated number of unserved households statewide.

As displayed in Table 2, the project team collected both the percent of unserved households by county at 25/3 Mbps and the estimated total number of unserved households.

Table 2: Households and census tracts without broadband access at 25/3 Mbps

County	Percent unserved households at 25/3 Mbps	Total unserved households at 25/3 Mbps	Percent unserved census tracts at 25/3 Mbps
Alleghany	8	666	5
Ashe	7	1,129	24
Avery	4	499	1
Burke	3	1,289	4
Caldwell	3	1,150	2
Cherokee	28	4,892	52
Forsyth	0	40	0
Graham	53	3,123	72
Haywood	21	7,235	17
Henderson	9	5,084	13
Jackson	73	18,984	61
Macon	44	11,186	38
Madison	0	-	0
Mitchell	10	912	29
Rutherford	25	8,455	28
Surry	2	533	5
Transylvania	21	4,064	21
Watauga	3	894	2
Wilkes	1	255	1
Yancey	11	1,247	31
North Carolina	5.54	239,945	-



An estimated 71,637 households in the 20 study counties do not have broadband (or are unserved).

The state average for unserved households at the speed threshold 25/3 Mbps is 5.54 percent and eleven of the 20 counties have a higher percent of unserved households than the state average. They are: Alleghany, Ashe, Cherokee, Graham, Haywood, Henderson, Jackson, Macon, Mitchell, Rutherford, Transylvania, and Yancey.

At 73 percent, Jackson's percent of unserved households is the highest in the study area, Graham is the second highest with 53 percent, and at 44 percent Macon is the third highest. Avery, Burke, Caldwell, Forsyth, Madison, Surry, Watauga and Wilkes all have lower averages of unserved households than the state average.

At an estimated 18,984 unserved households, Jackson has the highest number of unserved households in the study area. Macon is the second highest with an estimated 11,186 unserved households, and Rutherford is third with an estimated 8,455 unserved households.

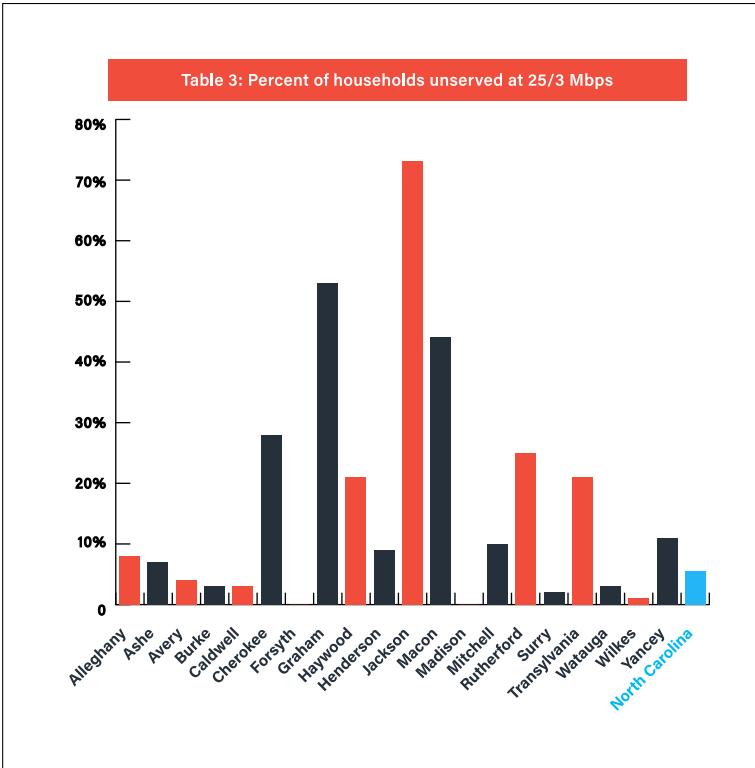
The team also calculated the percent of entire census tracts that are reported to

not have service at the designated speed threshold. Graham had the highest percent of unserved census tracts with 72 percent of its census tracts reporting as unserved, Jackson had the second highest with 61 percent of its census tracts reporting unserved, and Cherokee was the third highest with 52 percent.

Prior to the feasibility study, 13 of the 20 counties conducted a residential survey to identify unserved households. Both the survey instruments and the responses vary between counties. As such, the only data point from the surveys used in this study is whether households reported having broadband access or not.^{xiv} In sum, 4,918 households reported not having broadband access—many in areas where the FCC data indicates service is available.

Broadband Subscriptions and Computer Ownership

In addition to examining broadband access, broadband subscription and computer ownership are also examined because even if broadband is available, households may not



percent. The remaining counties percent of unserved households ranges between 25.4 and 37.4 percent. In total, 15.3 percent of all households in North Carolina without subscriptions are in the 20 counties included in this study.

It is important to note that while Forsyth, Henderson, and Watauga do rate better than the other counties and fall under the state threshold, each is just a few percentage points less than the state average, and thus many households in their counties lack a subscription.

For instance, 32,049 households in Forsyth county alone lack subscriptions alone. When evaluating computer ownership, again, just three counties—Forsyth, Transylvania, and Watauga—had higher computer ownership rates than the state average of 14.5 percent.

At 28.8 percent Yancey county has the highest percent of households without computers. Mitchell, at 24.9 is the second highest, and Surry, at 24.7 is the third.

In sum, 91,420 households in the study area do not have computers in their homes, this accounts for 16.3 percent of the total number households statewide without computers.

subscribe to it. Computer ownership rates are also analyzed because households without computers are less likely to subscribe to broadband.

These variables are included in the “Broadband Adoption Potential Index” at the census tract level and examined at the county level here. The cost of broadband subscriptions and the level of digital literacy skills are the other primary barriers to broadband adoption, however, robust data for these two factors does not exist.

As such, proxies—the percent of the population with a bachelor’s degree and the percent of the population in poverty—are included in the index and in the county summaries.

Statewide, 937,408 or 24.2 percent of households do not subscribe to broadband when considering any speed threshold according to ACS data. In the study area, just three counties—Forsyth, Henderson, and Watauga—subscription rate is equal to or higher than the state average. Meanwhile, seventeen of the twenty counties have lower subscription rates than the state average, meaning more than 23.6 percent of their households do not have broadband subscriptions.

At 51 percent, Graham has the highest percent of households without a subscription, Yancey ranks second at 40.9 percent, and Surry ranks third at 37.7 percent.

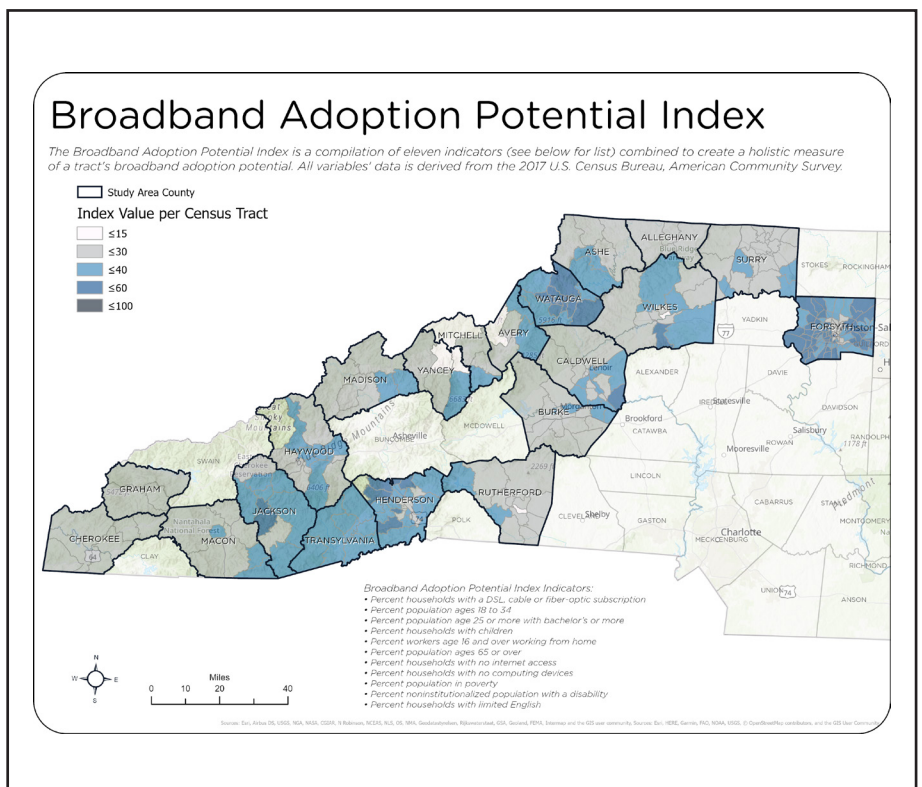
The remaining counties’ percent of unserved households ranges between 25.4 and 37.4 percent. In total, 15.3 percent of all households in North Carolina without

subscriptions are in the 20 counties included in this study.

At 51 percent, Graham has the highest percent of households without a subscription, Yancey ranks second at 40.9 percent, and Surry ranks third at 37.7 percent.

To roughly measure digital literacy and how costs of broadband service may impact a household’s ability to subscribe to a service, proxy variables were identified and examined. On average, across the state, 29.9 percent of the population that is age 25 or older holds a bachelor’s

Image 8



degree or more.^{xlv} Fifteen of the 20 counties rated lower than the state average in this measure, with Graham (14.2), Caldwell (14.8), and Wilkes (15.4) having the lowest population rate with a bachelor's degree. This indicates that a lack of digital literacy skills could impact the highest proportion of residents in Graham, Caldwell and Wilkes counties in inhibiting broadband adoption.

On average, across the state, 29.9 percent of the population that is age 25 or older holds a bachelor's degree or more. Fifteen of the 20 counties rated lower than the state average in this measure, with Graham (14.2), Caldwell (14.8), and Wilkes (15.4) having the lowest population rate with a bachelor's degree. This indicates that a lack of digital literacy skills could impact the highest proportion of residents in Graham, Caldwell and Wilkes counties in inhibiting broadband adoption.

Statewide, roughly 16.1 percent of the population lives in poverty.^{xlvi} Just four counties poverty rate is lower than the state average—Avery, Henderson, Mitchell, and Transylvania. Watauga's poverty rate is the highest among the 20 counties at 28.3 percent. At 21.6 percent, Jackson ranks second, and at 21 percent, Alleghany ranks third.

This suggests that broadband subscription costs could be the primary barrier to broadband adoption in Watauga, Jackson, and Alleghany counties. Finally, as previously noted, the project team utilized the "Broadband Adoption Potential Index" to measure broadband adoption potential and identify causal factors for low broadband adoption rates in the twenty counties and their respective census tracts.

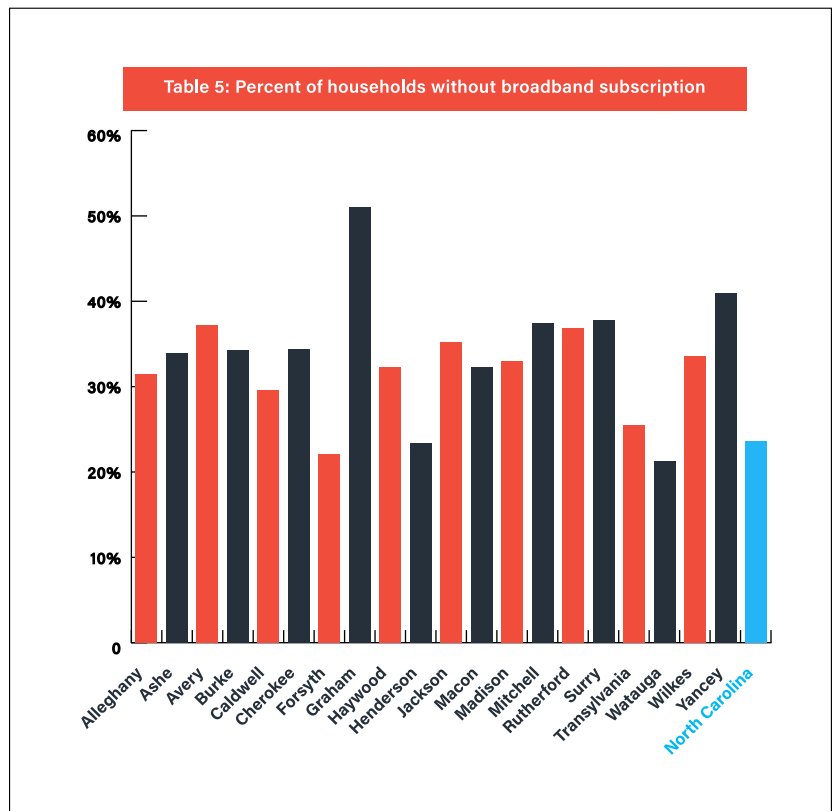
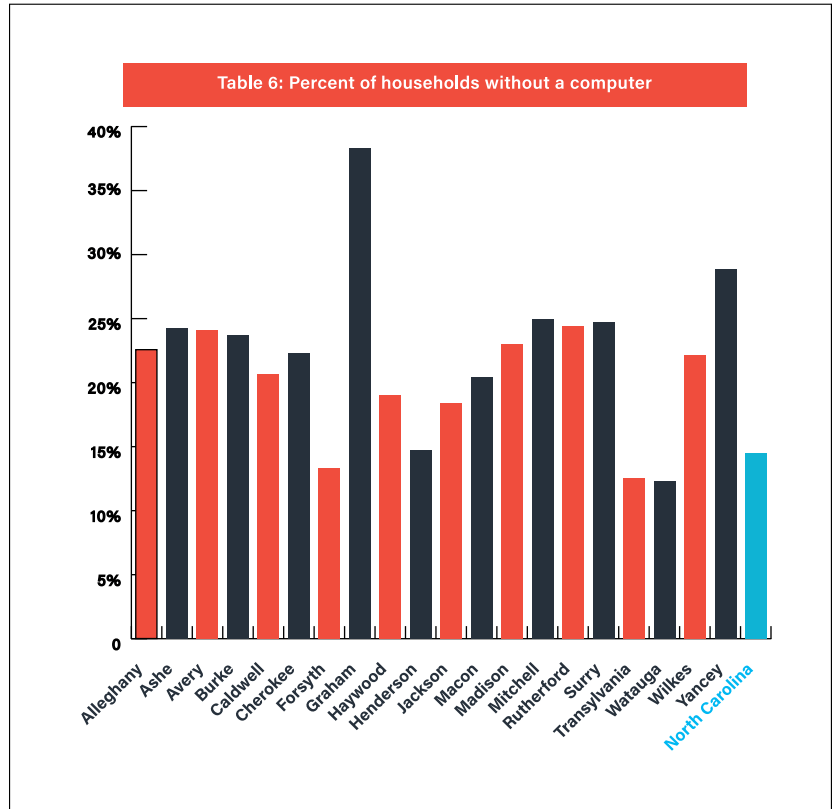
At both levels of granularity, the index is scored on a scale of 0-100, with counties or census tracts receiving scores in that range. Only two of the 20 counties had scores above 50—Forsyth (62.49) and Watauga (76.05). Henderson and Jackson ranked slightly under 50 with scores of 46.32, and Transylvania has a ranking of 44.77. Graham scored the lowest of the 20 counties with a score of 7.08. In total, the scores indicate broadband adoption is low among the study counties and the opportunity to increase broadband adoption rates is high and could lead to positive impacts.

Healthcare Data

The Institute of Medicine defines "safety net providers" as providers who by mandate or mission offer access to care regardless of a patient's ability to pay—and whose patient population includes a substantial share of uninsured, Medicaid, and other vulnerable patients. ORH supports over 700 Safety Net sites throughout the state, 156 of which are in the 20 county study area.

A review of the health care data in the study counties is consistent with the findings in many rural areas throughout the country. Based on the comprehensive study of the region's Community Health Needs Assessments^{xlvii}, the top health disparities are cardiovascular disease, diabetes and mental health.

Health care specialists who treat these specific disease states are in short supply in the 20 counties, according to the North Carolina SHEP Center's Health Professional Supply Data. Cardiologists Average 0.45:10,000, Endocrinologists Average 0.18:10,000, and Mental Health 0.14:10,000.^{xlviii}



This means that for every 10,000 residents in the service area, there is less than one full time Cardiologist (.45FTE), Endocrinologist (.18FTE) or Mental Health Professional (.14FTE) available to serve the chronic health needs of these patients (See Appendix E).

To customize telehealth solutions to address each community's most pressing needs, the project team gathered data for eight health related variables: death rates for cardiovascular disease, diabetes, and stroke, the number of mentally unhealthy days reported in the past 30 days, the ratio of residents to health care providers for dentistry, mental health, and primary care, and the sum of unintentional opioid deaths from 2009-2018.

To better understand the primary health concerns and unique health disparities in each of the 20 counties, variables are compared to the overall state average when available.

On average, 217.9 North Carolinians die each year from cardiovascular disease. Eight of the 20 counties in the study area exceed this rate, they are: Burke, Caldwell, Cherokee, Graham, Haywood, Madison, Rutherford, and Surry counties. At 282.4 deaths per year, Rutherford county ranks the highest, Cherokee is second with 252.2, and Caldwell is third with 246.6.

Diabetes and complications related to the disease cause an annual average of 23.3 deaths for North Carolina. Eight of the 20 counties in the study area exceed this rate, however. They are Burke, Caldwell, Graham, Jackson, Macon, Mitchell, Rutherford, and Surry counties. At 32.1 deaths per year, Jackson county ranks the highest, Rutherford is second with 28.6, and Caldwell is third with 26.1.

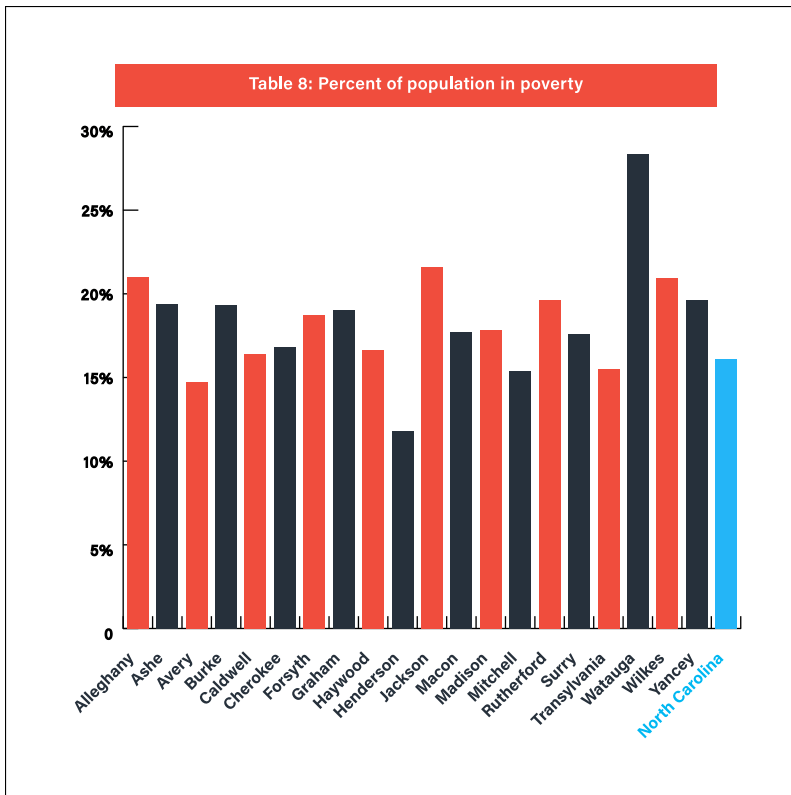
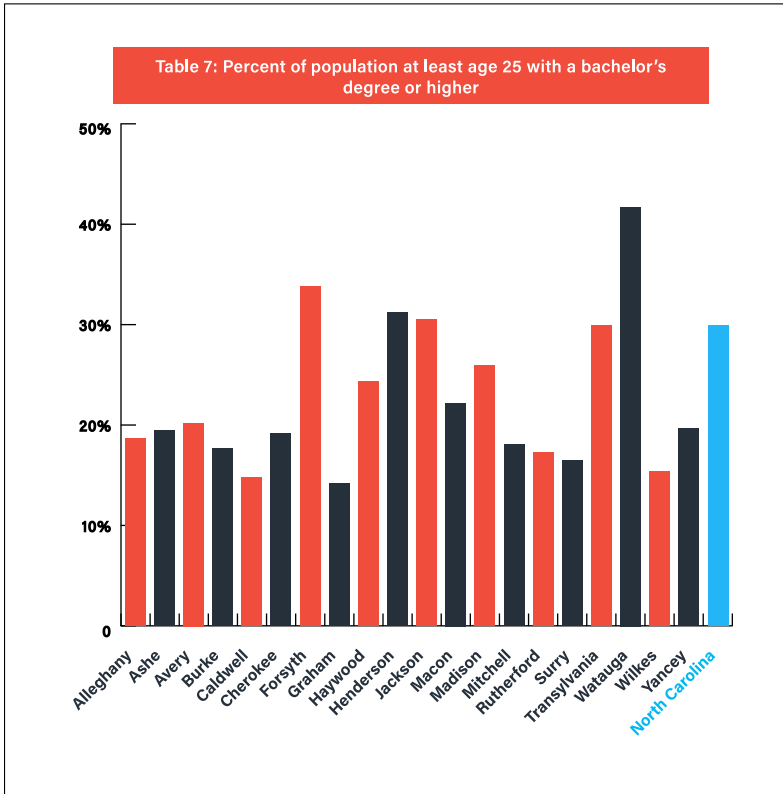
Stroke and stroke related complications cause an average of 43.2 deaths per year in North Carolina. Six of the 20 counties in the study area exceed this rate, they are: Burke, Caldwell, Forsyth, Madison, Rutherford, and Surry counties. At 59.4 deaths per year, Rutherford ranks the highest, Madison is second with 52.7, and Caldwell is third with 47.1.

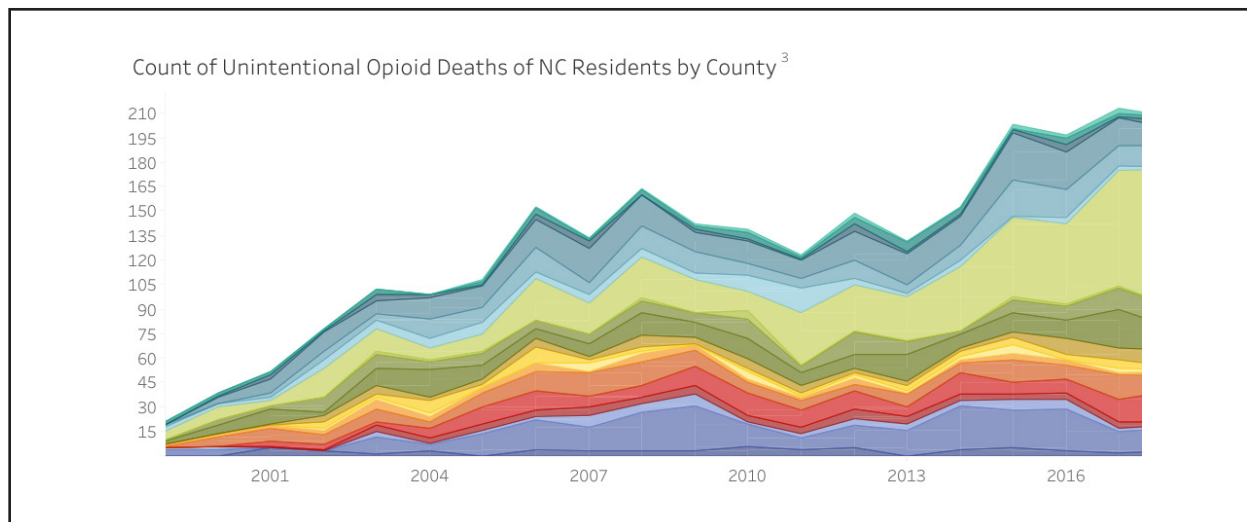
On average, over a 30-day period, North Carolinians have 3.9 mentally unhealthy days. Nineteen of the 20 counties in the study area exceed this rate, the only county that does not is Henderson. At 4.5 days, Watauga and Cherokee counties rank the highest, the second ranking is 4.4 days which includes Graham, Jackson, Surry, Wilkes and Yancey.

Within North Carolina, the average ratio of residents to primary care providers is 1,421:1. Twelve of the 20 counties in the study area exceed this rate, they are: Alleghany, Ashe, Avery, Burke, Caldwell, Cherokee, Forsyth, Graham, Madison, Rutherford, Surry, and Wilkes counties. At a ratio of 4,279:1, Graham county ranks the highest, Avery is second with a ratio of 2,919:1, and Wilkes is third with 2,291:1.

Throughout North Carolina, the average ratio of residents to dentists is 1,797:1. Several of the counties in the study area do not meet this average. Indeed, 17 of the 20 counties have a much higher average, indicating their residents do not have adequate access to dental care. The three counties that do not exceed this average are Forsyth, Macon, and Watauga. With a ratio of 5,516:1, Alleghany has the highest ratio, Avery is second with 4,384:1, and Madison is third with 4,349:1.

The average ratio of residents to a mental health care provider in North Carolina is 439:1. Thirteen of the 20 counties in the study area exceed this rate, they are:





Alleghany, Ashe, Caldwell, Cherokee, Graham, Henderson, Macon, Madison, Mitchell, Rutherford, Surry, Wilkes and Yancey counties. At almost four times the North Carolina average, Caldwell ranks the highest with 1,640:1, Mitchell is second at a ratio of 1,256:1, and Graham is third with 1,220:1.

Between 2009 and 2018, opioid use or overuse was the cause of death for 1,823 people in the 20-county study area. Like many areas in Appalachia, the number of deaths sharply rose between 2009 and 2018, during the time opioid use disorder became a national epidemic.

When looking back further, to 1999, opioid related deaths were nearly non-existent or at least negligible compared to the number of deaths caused by the disease in 2017 and 2018 when the crisis exploded.

Forsyth had the most lives claimed by opioid use over the course of the nine years with 435 deaths being attributed to it. With 206 deaths, Wilkes had the second highest opioid related deaths, and Burke was the third highest with 191 deaths.

Telehealth Data

To understand current telehealth usage throughout the study area, the project team conducted a survey of 118 health care safety net sites in the 20-county study area. With an 80 percent response rate, 94 sites responded with information regarding their telehealth activities.

The survey included single-answer multiple choice questions and open-ended questions regarding four related topics: a site's use of the four modalities of telehealth technologies, a site's internet availability and reliability, a site's interest in training methods and the benefits and barriers a site sees for implementing, continuing or expanding their use of telehealth of any modality. The responses were analyzed using descriptive and statistical analysis.

Telehealth Utilization

Of the ninety-four respondents, 69 percent indicated one of the four telehealth modalities was available at their site. Of the four modalities available, 55 percent of the sites have mHealth available and 56 percent of the sites have live synchronous video available.

Within the sites that have live synchronous video available, 58 percent of the providers use it frequently. Usage of the modalities varies at each site. For example, while mHealth is available to over 56 percent of the sites it is rarely used by those with access.

Many respondents indicated they are generally optimistic about telehealth and its potential to increase positive outcomes for their patients and communities, however, they desired more information and training on telehealth's different modes of delivery, the costs associated with implementing telehealth, and how the services can be reimbursed through health insurance.

Broadband at Safety net Sites

When asked about their broadband connections, 94 percent respondents indicated they believe they have reliable internet defined in the survey as "high-speed, high quality access delivered by a wire or fiber optic cable not to include cellular hotspots, satellite, dial-up or site to site microwave." However, 47 percent of the sites were unsure what their connections are.

Two sites indicated their internet was not reliable and the key reasons they cited were that the internet was "slow or not reliable," "the site's Wi-Fi and LAN lacked capacity" to use the available internet, and the available internet was "too expensive."

The project team also gathered data from the North Carolina Telehealth Network

(NCTN) on the number of sites in the 20 counties who participate in the consortia as members of the NCTN. To date, seven sites are members of the NCTN. Qualified members of the NCTN receive discounted broadband service provided by the FCC's Health care Connect Fund (HCF).

Perceived Benefits of Telehealth

Survey respondents believe telehealth's primary benefits are the opportunity it provides to increase timely access to care, increased speed of interventions, and its ability to reach patients without access to care. Sites rated the lower costs for providers to provide patient care, ability to treat more patients than currently treating, and better patient outcomes as telehealth's moderate benefits.

Respondents also indicated they believe telehealth can alleviate patients' transportation challenges and expand clinical times. One provider believes telehealth could help their clinic establish a mobile clinic by which the care they deliver could be extended beyond their clinic building. The survey responses indicate that many of the sites view telehealth and the opportunities it provides positively and have a solid grasp on what telehealth can do and how a robust telehealth network can benefit their clinics and communities.

Perceived Barriers to Telehealth Use

In addition to benefits of telehealth, the survey sought to learn what challenges the safety net sites encountered, or anticipated encountering when establishing telehealth programs.

The data show that over 50 percent of the respondents believe to implement or expand their site's telehealth use would require additional staff and funds.

Ninety-four percent of respondents indicated they have reliable internet (described as high speed, high quality access delivered by a wire or fiber optic

Table 9: Telehealth benefits

Benefit	Moderate benefit	Moderate benefit %	No benefit	No benefit %	Significant benefit	Significant benefit %	S b
Quicker intervention when patient issues arise	20	21.28	1	1.06	63	67.02	
Better patient outcomes	51	54.26	4	4.26	26	27.66	
Lower cost to patients	8	8.51	2	2.13	29	30.85	
Reduced time for patients to receive care	13	13.83	2	2.13	63	67.02	
Provide patients access to experts outside their geographic area	15	15.96	3	3.19	28	29.79	
Lower costs for care providers to deliver quality care	50	53.19	1	1.06	27	28.72	
Allow care providers to see more patients per week	48	51.06	4	4.26	26	27.66	
Allow care providers to reach new patients not currently accessible	12	12.77	1	1.06	62	65.96	

cable excluding hotspots, satellite, dial up and site to site microwaves) that serves their current needs. Another 41 percent of respondents indicated that the computer literacy of the staff would have a significant impact in implementing a telehealth program.

The sites listed numerous additional barriers, but they followed a few themes. The sites are concerned with lack of adequate internet services to support telehealth, patients having poor digital and computer literacy comprehension levels, computer skills, and provider buy in.

Other things the sites are concerned with and identify as barriers to adopting a robust telehealth network include: how technology barriers impact patients seen at free clinics where economic barriers are a concern (access to devices), accessing services from the patients' homes, patient acceptance, patients and providers preferring onsite visits, language barriers, and telehealth being the "new flavor of direct patient care".

Additionally, sites indicated they are overwhelmed with the methodology of telehealth, understanding the benefits telehealth could have on community based primary prevention and population health work, how telehealth insurance reimbursement works and identifying funding for the initial startup costs of telehealth.

Table 10: Telehealth barriers

Barrier	A great deal	A great deal %	A little	A little %	Moderate amount	Moderate amount %	Signific amount
Level of staffing	51	54.26	13	13.83	11	11.70	12
Current budget	54	57.45	2	2.13	18	19.15	13
Internet access at your site	40	42.55	8	8.51	13	13.83	4
Internet access at patient's homes	30	31.91	36	38.30	9	9.57	15
Computer literacy skills of staff	3	3.19	30	31.91	7	7.45	39
Compur literacy skills of patients	21	22.34	39	41.49	13	13.83	17
Clinic space	10	10.64	14	14.89	15	15.96	45

Light benefit	Slight benefit %	No answer	No answer %	Negative effect	Negative effect %
5	5.32	5	5.32	0	0
7	7.45	5	5.32	1	1.06
43	45.74	12	12.77	0	0
9	9.57	7	7.45	0	0
3	3.19	45	47.87	0	0
9	9.57	7	7.45	0	0
9	9.57	7	7.45	0	0
9	9.57	10	10.64	0	0



Significant amount	Significant amount %	None	None %
	12.77	7	7.45
	13.83	7	7.45
	4.26	29	30.85
	15.96	4	4.26
	41.49	15	15.96
	18.09	4	4.26
	47.87	10	10.64



Case Studies

To showcase current sites and programs across the state that have successfully executed telehealth programs with improved clinical outcomes, four case studies are presented below that span the state, types of sites, and modalities used. Information obtained during the case study research and site visits revealed four major trends.

First, it showed that health care providers across the state are seeking new and innovative ways to expand access to care. Next, it revealed that even with existing broadband infrastructure, various modalities of telehealth can be used successfully, and with large-scale impacts to the community. Third, the case studies proved that telehealth can be implemented in both large and small health care settings with both internal funding options as well as grant funded support. And last, information from visiting the case study examples allowed us to see how telehealth is impacting both individuals and communities.

In every case, patients were receiving services that they would not have been able to receive otherwise. This has moved these sites towards achieving the Institute for Health care Improvement's Triple Aim of 1) improving the patient experience of care (I.e. closer distances to travel), 2) improving the health of populations (I.e. having behavioral health services in county), and 3) reducing the per capita cost of health care (I.e. patients receiving the right care at the right time in the right place).



Case Study 1:

Mount Olive Family Medicine Center, Inc., Mount Olive, NC

Diabetic Retinopathy Eye Exam, Store and Forward Telehealth Technology

Background

The office manager for the Mount Olive Family Medicine Center realized many patients were not completing their annual diabetic retinopathy eye exams. Diabetic retinopathy, if undetected, can lead to vision complications or blindness. The eye exam required a separate appointment with an ophthalmologist, which proved to be a barrier for many patients.

The office manager investigated efficient ways to reduce this gap in care and used grant funding to purchase two diabetic retinopathy eye exam machines. The tool is small, compact, and easy-to-use, allowing clinic staff the ability to complete the exam on site and coordinate care with an ophthalmologist who would read and interpret the exam results. Since July 2019, the center has used these tools to screen more than 100 diabetic patients for diabetic retinopathy.

Rationale for Adopting Telehealth Service

Administering diabetic retinopathy eye exams at the Mount Olive Family Medical Center and virtually sending the images to an ophthalmologist for review provides an example of the effectiveness of "store-and-forward" telehealth technology. Implementation of telehealth "store-and-forward" services can increase access to eye exams for diabetic patients while also

helping health care providers comply with annual wellness visit requirements and implement care gap measurements. This service captures early clinical markers for concern and can greatly improve health outcomes.

Benefits of Telehealth

In this setting, telehealth allows patients to receive a necessary eye exam during a primary care visit. This prevents patients from having to schedule additional appointments and greatly increases the odds they receive this annual screening. In the Mount Olive Family Medical Center, this telehealth service is available for all diabetic patients, regardless of insurance or payor type. Current staff incorporated the exam into the existing workflow, so no additional staff was needed to operate the machine used for the exam. Additionally, the turn-around time for ophthalmologist review is quick, usually within 24 hours. This quick evaluation allows providers to serve high-risk patients expeditiously and coordinate their follow-up with an appropriate specialist.

Funding and Sustainability

The clinic used \$10,000 in grant funding to purchase two Welch-Allen diabetic eye cameras. The machines cost \$160 per month to operate, but reimbursement from insurance providers ranges from \$35

to \$75 per eye exam. Since the machines were purchased up front with grant funding, and because no additional full-time employees were needed to operate them, this technology is realistically sustainable if reimbursement covers the \$160 per month operating cost.

Challenges and Barriers

The challenges for implementing telehealth in this clinic were minimal. Initially, the main challenge was determining how to incorporate this new service into the current workflow without expanding staff. There was a learning curve for providers, staff, and patients to use the eye exam equipment correctly and effectively, but once all were comfortable with this, they understood the exam's value.

Long-term Goals

Mount Olive Family Medicine Center aims to complete annual Diabetic Retinopathy Eye Exams on every diabetic patient to provide and expand quality telehealth services to improve the health of all patients, regardless of their ability to pay. Eventually, Mount Olive would like to expand their telehealth services to cover other wellness and preventive exams not easily obtained in the traditional primary care model.

Key findings

- » Easy implementation in outpatient setting.
- » Positive return on investment.
- » Accurate data and image capturing for patient care coordination.
- » Primary Care Providers able to ensure completion of CMS Annual Wellness Visits and other quality measures.

Case Study 2:

Health-e-Schools, Marion, NC

School Based Provider Assessments using Synchronous Video

Background

Founded in 2011, Health-e-Schools is a 501c3 non-profit that provides virtual primary care to K-12 students and faculty in four counties in the ARC region. Dr. Steve North, who, at the time, was a teacher in North Carolina's western region recognized the need to improve health care access for students, particularly in Tier 1 counties, whose attendance, coursework, and behavior in school were negatively affected by health concerns.

As a result, he devised a way to bring health care to the students during normal school hours with the goal of increasing their access without missing school.

This service connects ill or injured students to a medical provider for immediate assessment, consultation, and treatment. While the patient is at school, the initial assessment is completed by the school nurse, which includes documenting a complete set of vital signs.

After determining whether the patient is a good fit for the telehealth program, the nurse initiates a synchronous video consultation with the provider. The provider reviews the patient's information and complaints, then conducts a physical assessment of the patient through TyToCare equipment.

This equipment allows for real-time audio of the patient's lung sounds, heart tones, direct visualization of the patient's ears and mouth, and a real-time conversation with the nurse and patient.

Once the assessment and treatment plan have been established, the patient returns to class for the remainder of the day, and

a complete set of clinical notes are sent to the patient's primary care provider.

Rationale for Adopting Telehealth Service

Due to the challenge of accessing care, particularly in rural parts of the state, telehealth expansion was determined as an efficient means to bridge the care gap for school children. Using synchronous video to allow a medical provider to treat students not only reduced the school's health care services costs, but also drastically increased the number of sites and students that could be reached.

More than 80 sites now have access to a provider that students can see during school hours.

Benefits of Telehealth

The Health-e-Schools program has vastly expanded the availability of primary care services for children living in the Appalachian region with limited access to care.

Because of the barriers that prevent parents from taking their children to the doctor such as taking time off work, transportation challenges, and copayments, some easily treatable children's early signs and symptoms are missed and evolve into more acute issues due to lack of early intervention and treatment.

With the school-based health program, children can be evaluated and treated at the school, which not only improves their health outcomes but also improves attendance rates. Since implementing Health-e-Schools, all schools in Mitchell and Yancey counties, which have more

than 4,000 students in their districts, are covered.

Funding and Sustainability

Grants from Appalachian Regional Commission, Health Resources & Service Administration, Blue Cross Blue Shield of North Carolina, and Golden LEAF Foundation provided the program's initial funding. Currently, Health-e-Schools is funded through private donors and Medicaid reimbursement for eligible students. As telehealth reimbursement legislation expands, sustainability depends more on revenue than grant funding.

Challenges and Barriers

Local providers, unfamiliar with telehealth were reticent to adopt and participate in this model of care when the program first began in 2011. The providers were concerned telehealth wouldn't would not be comparable to what was considered high-quality, face-to-face patient care in the traditional clinic setting. To obtain buy-in for the program, Dr. North and his team conducted education, training, and overall awareness regarding telehealth and its benefits, specifically for underserved populations, for both providers and the general public.

Long-term Goals

The program aims to advocate for more telehealth reimbursement avenues, along with expanding the service availability to all schools across the state. If every child in every school could receive medical and mental health services, Health-e-Schools will achieve its goal of providing holistic care to children across the state.

Key findings

- » Extends services available in schools, nurse working at the top of licensure.
- » Valuable time saved for parents and students who can obtain visit during school day.

Case Study 3:

HCA Healthcare (Mission Health), Asheville, NC

Telestroke, Diabetes Education, Mental Health using Synchronous Video

Background

Telehealth programs within the Mission Health (now HCA Healthcare) system, started in 2011 and were aimed at targeting stroke patients in McDowell County. As of 2019, all five Mission hospital locations have access to this stroke service and patients can receive stroke treatment interventions faster.

Additionally, when the North Carolina Statewide Telepsychiatry Program (NC-STeP), began in 2014, Mission Health signed on as a partner. NC-STeP assisted Mission with grant funds for implementation support, site visits, and staff education/training in the program. Due to the success of these telehealth initiatives, Mission Health has launched additional telehealth services such as diabetes education.

Rationale for Adopting Telehealth Service

In 2011, McDowell's hospital did not have any on-site neurologists to respond to strokes or other neurological needs. The time window to successfully treat and counteract the effects of strokes is small, just four hours, which limits intervention options. By participating in HCA Healthcare's telestroke program, patients in McDowell county were able to obtain timely virtual evaluations by neurologists in Asheville. The hospital created additional telehealth programs once the model was successfully implemented.

Benefits of Telehealth

Within a large health system, telehealth is often viewed to avoid costs rather

than generate revenue. Thus, telehealth services are often more inclusive of all patients, regardless of insurance type, given the primary goal is to improve access to health care for vulnerable populations while reducing overall system costs.

Examples of this include using telehealth to provide specialty care for critical access hospitals (CAHs) owned by larger health systems, such as HCA Healthcare. HCA Healthcare uses telehealth to provide telestroke, behavioral health, medicated assisted treatment (MAT), and diabetes education services to remote CAHs in rural areas.

There are many advantages to providing specialty care to CAHs via telehealth including reduced evaluation time, improved clinical outcomes, reduced interfacility transports for moving patients to a higher level of care, and reduced emergency department costs between facilities.

By improving access to specialists for earlier recognition of signs and symptoms, patients who require admission can have reduced length of stay (LOS), which is directly correlated to patient satisfaction and reduction in risk for readmission. The average LOS has decreased from eight days to two days with early intervention of telehealth services. Telepsychiatry services allow patients to receive early psychiatric consults with earlier decision-making for appropriate treatment and/or hospitalization needs for the patient.

Funding and Sustainability

Funding and sustainability for programs

such as telestroke and the diabetes education services are derived from a cost-avoidance model and improved scores for CMS reimbursement. NC-STeP granted Mission \$80,000 for implementation support, site visits, and staff education/training in the program in 2014. Mission also leveraged an U.S. Department of Agriculture grant to purchase additional equipment.

This provided 50 percent of the cost of placing equipment in hospitals, which were not charged. Both HCA Healthcare and the originating site can bill for each encounter. Telepsychiatry consults are now billed directly to patient's insurance carriers. If the patient is uninsured, the bill is sent directly to patient.

Challenges and Barriers

By having a large-scale health system use their internal resources such as providers to participate in the telehealth service, there are few barriers. However, one challenge is the consistency of electronic health records (EHR). Although the CAHs may be owned by a larger health system, they often do not share the same EHR, resulting in a breakdown in communication between patients, providers, and specialists.

Long-term Goals

The program aims to advocate for more telehealth reimbursement avenues along with telehealth services available to critical access hospitals owned by HCA Healthcare so that all patients, regardless of geography, have equal access to care.

Key findings

- » Expanded access to services in rural counties.
- » Improved clinical education with patients across the Western counties.
- » Quicker assessment and intervention for critical conditions

Case Study 4:

NC-STeP, Greenville, NC

Telehealth Psychiatric Consultations using Synchronous Video

Background

The NC Statewide Telepsychiatry Program was developed in November of 2013 to "oversee and monitor establishment and administration of a statewide telepsychiatry program" at the East Carolina University Center for Telepsychiatry and e-Behavioral Health (ECU-CTeBH).

NC-STeP allows referring hospital sites to use real-time interactive audio and video technology, telepsychiatry, for psychiatrists to provide timely psychiatric assessment and rapid initiation of treatment for patients experiencing an acute mental health or substance abuse crisis.

Rationale for Adopting Telehealth Service

Implementing the telepsychiatry program addresses the issue of patient lengths of stay in hospital emergency departments by reducing psychiatric holds to less than 48 hours. The number of Involuntary Commitments (IVC) in emergency departments for patients with psychiatric needs has been historically high. NC-STeP reduces these IVCs by eliminating unnecessary admissions.

Improved patient transition to aftercare and reduced emergency department recidivism increases efficiency of care and reduces costs for both facilities and patients.

Benefits of Telehealth

Through NC-STeP, any patient in a participating hospital emergency room that presents in a behavioral health crisis will

receive care faster through synchronous video to behavioral health specialists. This service is most useful to those that present with a need for psychiatric intervention and is mainly used to address patients that enter on an IVC.

The program was created to increase access to psychiatric services for all North Carolinians. Through its success in the 53 hospitals in which it was implemented, the program demonstrates how invaluable telehealth is to the health care system.

The expansion into community-based sites will allow more patients to receive psychiatric services before a crisis arises.

Funding and Sustainability

Session Law 2013-360¹ provided funding for the developing of NC-STeP. NC-STeP was allocated \$2 million per year in recurring budget funding from the state of North Carolina.

The program also received funding from a one-time Duke Endowment grant. State funding pays for development of infrastructure, including a web portal to manage the data provided by multiple EHRs and the development of an EHR system.

Also, if a patient is not covered by a third party, it would cover that cost. If a patient has insurance, the insurance is billed. Hospitals that participate in the program pay a subscription fee, which is linked to the volume of use. NC-STeP can continue to run a program on \$2 million a year but hopes to obtain additional funding to expand into community-based settings.

Challenges and Barriers

Credentialing providers is one difficulty associated with NC-STeP. It can take three to six months to obtain credentialing approval for each provider at each location. This slow process takes valuable time and resources away from potential patient contact time. The lack of insurance coverage for patients is another barrier.

The average uninsured patient rate is currently approximately 32 percent, making it difficult to sustain a program without reimbursement from high of a percentage of the patient pool. Connectivity for participating provider locations is also difficult in some rural regions of North Carolina. If hospitals or community-based sites do not have good broadband connectivity, it will be difficult to connect to the portal to place a referral for psychiatric services.

Long-term Goals

When the NCGA passed legislation in 2018² to expand NC-STeP services to community-based sites, it provided patients who previously had limited psychiatric options with an opportunity to be seen at a primary care location within their own community. Currently, the program is in seven health departments and plans to expand should funding be made available.

Although the long-term results of this have yet to be seen, the goal would be reduction in psychiatric ED visits and increased access to behavioral health services in North Carolina.

Key findings

- » The program to date has overturned 5,195 involuntary commitments.
- » 38,383 telepsychiatry assessments conducted since 2013.
- » NC-STeP estimates \$28,053,000 in cumulative cost savings to the State.

¹North Carolina General Assembly, 2013 Session. Retrieved 2/18/2020 from <https://www.ncleg.net/enactedlegislation/sessionlaws/html/2013-2014/sl2013-360.html>

²North Carolina General Assembly 2018 Session. Retrieved on 2/18/2010 from https://www.ncleg.gov/EnactedLegislation/Statutes/PDF/BySection/Chapter_143B/GS_143B-139.4B.pdf

Case Study 5:

Roanoke-Chowan Community Health Center, Ahoskie, NC Chronic Disease Management using Remote Patient Monitoring

Background

In 2006, Roanoke-Chowan Community Health Center began a Remote Patient Monitoring (RPM) program that was intended to help close the gap of health care disparities for patients living in the surrounding community. Kim Schwartz, CEO of the health center, applied for and received multiple grant awards to pilot the program and sustained the program for more than three years.

With many patients facing barriers to receiving health care including challenges with transportation, copayments, and personal engagement, Roanoke-Chowan provided the patients tools to monitor and report their disease-specific biometric readings at home.

Providers determined which patients needed extra engagement and oversight for their disease management then these patients were provided with equipment that allowed them to record and track their blood glucose, blood pressure, or other biometric indicators needed to monitor their specific condition. This equipment transmitted the data to the patient's provider. If readings were outside of certain parameters, the clinical team was alerted so they could contact the patient for follow-up.

Rationale for Adopting Telehealth Service

RPM allows for providers to increase oversight of their patients' clinical needs outside of the clinic. The patient's clinical measures can be reported to the provider for early recognition and intervention of concerning changes in the patients' presentation of symptoms. This allows patients to be more confident in the self-management of their chronic diseases and allows providers to feel more engaged in the care of the patient between scheduled

appointments.

Benefits of Telehealth

Telehealth breaks down rural-specific barriers to health access such as extended travel time to providers, limited options for urgent and emergent care, and sparse wrap-around services such as home health, physical therapy, and other in-home care options. It also provides the opportunity to train patients towards self-management of their disease based on recognition of clinical indicators from equipment.

Funding and Sustainability

This program was funded entirely by grants. The clinic has now determined that the service is needed for their patients and has included it in their overall operating budget. To cover ongoing costs, the clinic is considering billing insurance or charging a fee but worries this may deter patients from using the program.

Challenges and Barriers

Patients are often wary of new ideas or programs that do not meet the traditional model of care delivery. RPM was no exception to this. Many patients felt the use of RPM was invasive and did not want to participate in something they believed invades their privacy.

They said they did not like the idea of having something monitor their every move, nor the need for someone to come to their home to set the equipment up and train them on how to use it. However, the program provided benefits for both the patients and providers including lifestyle and behavior change among patients and the availability of detailed health information for providers to make more informed clinical decisions. For example,

if a patient with diabetes is seen by their provider once every six months, then the provider is basing the patient's care for 365 days on two short visits. Most patients do not make and bring daily logs of food intake, fluid intake, weight, and activity, so providers are left to fill in the gaps with the limited information they have. Even if the patient brings daily logs, which is extremely rare, the provider can still miss integral pieces of information needed to give them a comprehensive understanding of how the patient is managing their disease. RPM provides detailed health data to the providers that enables them to better assist the patients in managing their disease.

Long-term Goals

Implementing RPM to measure and treat chronic disease can significantly improve the quality of life for many patients, especially those who handle complex processes such as hemodialysis at home. For example, in the control of diabetes, the real-time transmission of blood glucose reading, and blood pressure allows immediate alerts so that patients and health professionals intervene when necessary. RPM can bridge the gap in these situations by providing real-time information directly to the patient's clinical staff. This allows the clinical staff to, in turn, reach out to the patient to identify unique contributions to the change in patients. By having a real-time, two-way information exchange between the patient and the clinical team, patients can connect the dots between their lifestyle and behavior as it correlates to positive or negative clinical outcomes. Providers are also able to view real-time information that helps them make better informed, comprehensive decisions about the patient's care and medication needs.

Key findings

- » Patients who have objective data are more engaged in managing their healthcare and more likely to reach out for early intervention and care. When they receive immediate feedback about their biometric reading, they in turn have negative or positive reinforcement for the decisions they made throughout the day such as diet, exercise, etc. Early recognition of concerning signs and symptoms combined with provider awareness and outreach results in decreased emergency department utilization, decreased hospital admissions, and improved clinical outcomes.



Major Findings & Recommendations

The study revealed seven major findings that informed seven key recommendations for state and local leaders to undertake to increase broadband access and adoption to households and prepare safety net sites to implement telehealth programs to ensure residents in the coal impacted counties have the access to health care they need to fully participate in the local economy.

Major Findings

1. No two counties are the same, thus programs and health interventions should be tailored to each community's specific needs.

The study confirmed a finding long understood by North Carolinians—no two counties in the Tar Heel state are the same. While not a novel finding, it's important to recognize and understand that the state's geographic, cultural, ethnic, and economic diversity impacts both broadband and health care availability, as well as how their gaps should be addressed.

Understanding the unique aspects of each county impacts the specific way each of the following recommendations should be implemented. While each county is unique, when combining broadband access with health disparities, the data reveal that

most of the counties fall into one of four categories, as they do when looking at broadband adoption combined with health disparities.

While each county is unique, when combining broadband access with health disparities, the data reveal that most of the counties fall into one of four categories, as they do when looking at broadband adoption combined with health disparities.

As seen in Matrix 1 and Matrix 2, each county falls into one of four quadrants. The quadrants for broadband availability are: 1) high broadband access and high health disparities, 2) low broadband access and high health disparities, 3) low broadband access and low health disparities, and 4) high broadband access and low health disparities. Similarly, the quadrants are the same for broadband adoption and health disparities, with broadband adoption

replacing broadband availability.

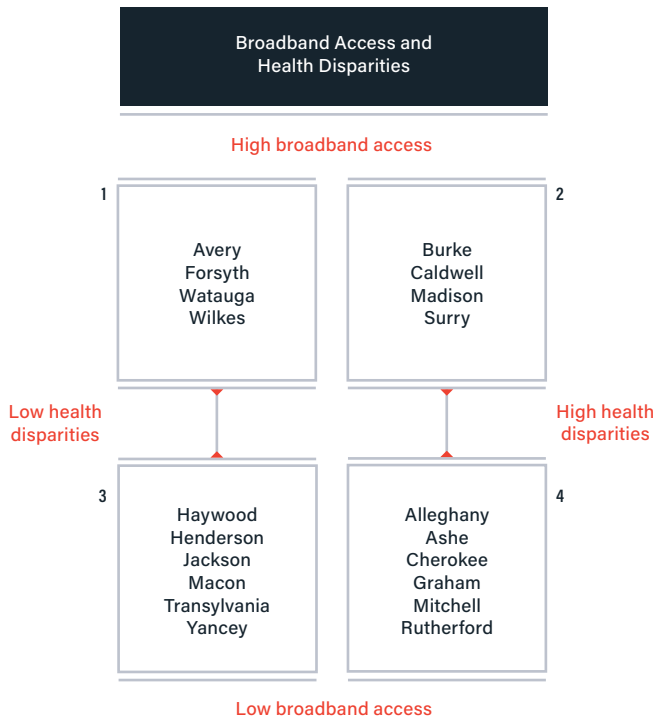
As seen in Matrix 1 below, quadrant one contains four counties—Burke, Caldwell, Madison and Surry.

These counties have high broadband availability when compared to the state average and high health disparities and thus could be ideal sites for telehealth pilots designed to meet their largest health needs.

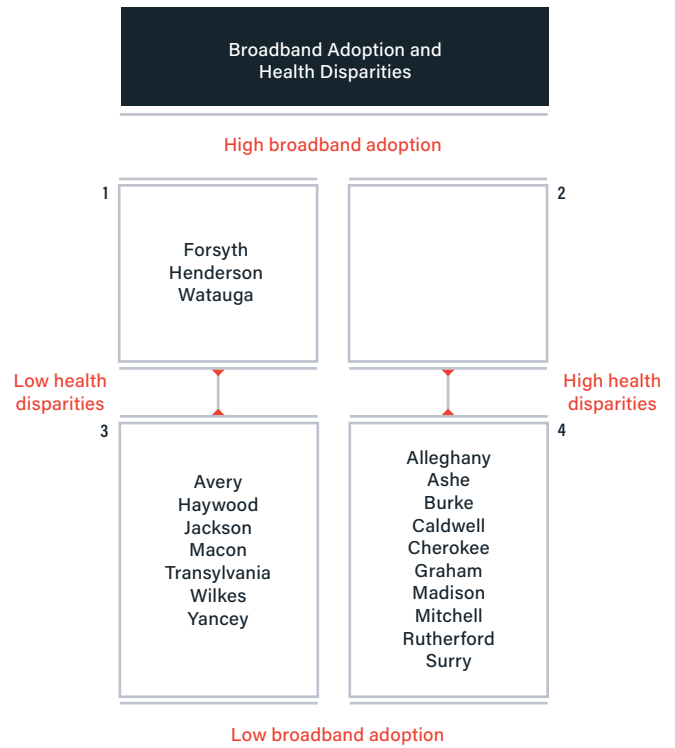
Strikingly, as seen in Matrix 2, no county has a combination of high broadband adoption and high health disparities. Instead, all the counties fall into quadrants two, three and four.

Matrix 2 indicates that for any telehealth pilot launched in the region, broadband adoption will need to be addressed for the population to fully participate and benefit

MATRIX 1



MATRIX 2



from it.

2. A healthy workforce is a productive and competitive workforce, yet health disparities are high in the coal-impacted counties, and doctor shortages abound.

According to 'Healthy People 2020', an initiative of the federal government, improved health directly improves the workforce which then provides additional health care options for individuals.

Paid sick leave, health insurance, and protection from unexpected health care costs are just some of the advantages employed individuals have over those without employment.^{xix}

Many counties within the study area outranked the state average when considering the death rates due to cardiovascular disease, diabetes and stroke. In addition, at least 1,823 people in the coal-impacted counties have died since 2009 from opioid use or overdose.

The study confirmed that a disproportionate number of individuals in the 20 counties live without access to basic healthcare services and access to specialists like cardiologists, because of distance and limited provider availability.

Twelve of the 20 counties outranked the

state average for the ratio of patient to primary care provider, 17 of the 20 counties had a higher patient to dentist ratio, and 13 of the 20 counties had a higher patient to mental health provider ratio than the state average.

The number of specialists located in the coal-impacted communities is particularly low. For example, only two counties—Henderson and Surry—have endocrinologists located in their counties. Endocrinologists are doctors specialized in treating diabetes and other similar diseases.

Without ready access to these specialists, the high number of patients suffering from diabetes in the region rely solely upon their primary care provider, go without the care they need or travel to seek care.

3. Safety net sites feel ill-equipped to establish telehealth programs.

This study confirmed that where broadband and telehealth services exist health care access is improved, patients are more aware of their conditions and equipped with self-management techniques to alert their health care professional when concerns arise.

Indeed, the case studies revealed that when thoughtfully designed and

implemented, telehealth programs can augment traditional care methods and improve health outcomes for patients, increase care to traditionally underserved areas and populations, and provide cost savings for providers.

However, the safety net site survey results revealed many sites have a variety of concerns and requests regarding the use of telehealth.

The majority of respondents were most concerned about a lack of training, misperceptions about the use of telehealth, how to integrate telehealth with traditional care models, and liability concerns. Thus, an opportunity exists to provide this training and demonstrate the health and economic value telehealth programs can have in their sites and communities.

4. Broadband access rates are low on average in coal-impacted counties, especially when considering increased bandwidth needs to utilize telehealth applications.

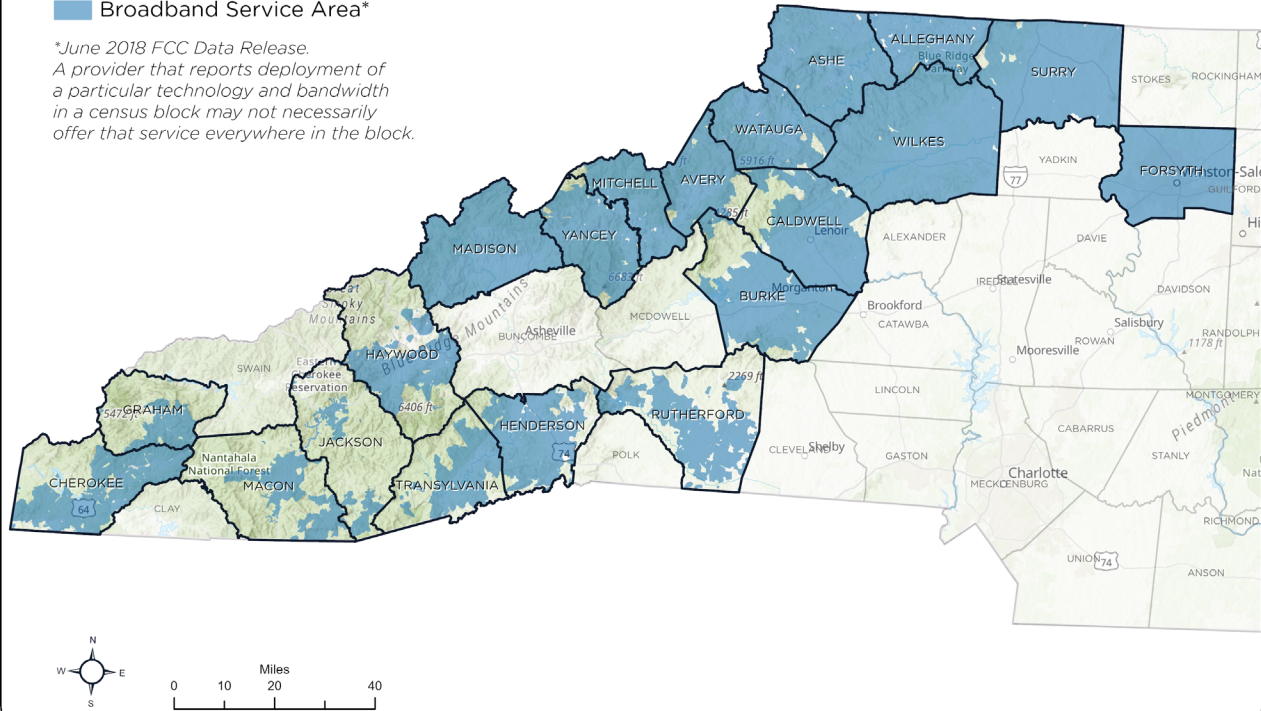
In every broadband related metric, at least half of the counties rank lower than the state average. In terms of broadband access, 11 of the 20 coal-impacted counties have higher rates of unserved households at 25Mbps/3Mbps than the state average

Broadband Availability

Provider Reported Service Areas of at least 25 mb/s Download and 3 mb/s Upload

- Study Area County
- Broadband Service Area*

*June 2018 FCC Data Release.
A provider that reports deployment of a particular technology and bandwidth in a census block may not necessarily offer that service everywhere in the block.



Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatasynthesen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

of 5.94 percent.

To fully achieve the ARC's strategic investment goal of "enhancing access to and use of broadband services," the 71,637 households in the coal-impacted counties without access to broadband need to be served.

If telehealth services were widely available across the study area today, 71,637 households would not be able to access them simply because they do not have internet access in their homes.

5. Broadband adoption rates are low in the coal-impacted counties.

Broadband subscription rates and computer ownership rates are lower than the state average in 17 of the 20 counties. Meanwhile, 15 of the counties also have fewer worker aged residents with a bachelor's degree and 16 of the counties have higher rates of their population living in poverty than the rest of the state. In sum, the data convey a dire need to expand broadband access, broadband adoption, computer ownership, and digital

skills throughout North Carolina's coal-impacted communities so the residents and communities can participate in and flourish in today's digital economy.

6. Most safety net sites have broadband, but the type of broadband, the speeds they're subscribed to, the reliability of their connection, and its affordability are unknown.

Ninety-four percent of the surveyed safety net sites indicated they had reliable internet, 47 percent of the sites were unsure of what type of internet they had and 32 percent indicated they have a fiber connection but 71 percent indicated they are extremely satisfied with their internet service.

Although this information indicated that most sites have the broadband access they require, and some knowledge of existing services, it does not necessarily indicate a knowledge of the full bandwidth and broadband needed to support and sustain growing telehealth capabilities. In addition, many sites were unaware of the speeds and technologies they are subscribed to.

Finally, it is unclear how many sites are aware of the FCC's funding program that provides discounts for broadband connectivity for rural health providers called the Healthcare Connect Fund (HCF) administered by the Universal Service Administration Co. (USAC).ⁱⁱ In North Carolina, the North Carolina Telehealth Network (NCTN) is the consortia through which eligible health care sites can receive discounted internet service through the FCC's HCF program.ⁱⁱⁱ

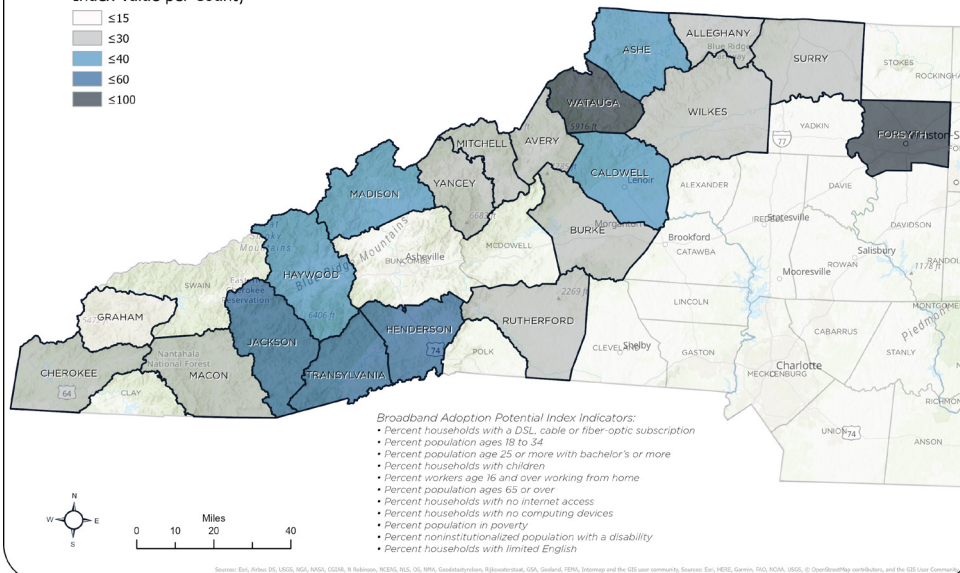
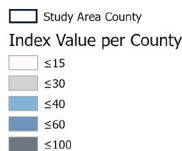
7. Increased demand for telehealth services could lead to the creation of a telehealth technology cluster.

Increasing the use of telehealth could contribute to the creation of a telehealth industry cluster and could also foster the growth of entrepreneurial activities in the region. According to the Council for Entrepreneurial Development (CED), North Carolina boasts at least 123 startups building telehealth, digital health, and healthcare-focused products and servicesⁱⁱⁱ.

For example, RelyMD, a startup founded

Broadband Adoption Potential Index

The Broadband Adoption Potential Index is a compilation of eleven indicators (see below for list) combined to create a holistic measure of a county's broadband adoption potential. All variables' data is derived from the 2017 U.S. Census Bureau, American Community Survey.



by a group of North Carolina-based Emergency Room (ER) physicians, created a secure portal through which patients can video-conference with an ER physician in lieu of visiting an ER.^{liv}

One Wilmington-based startup, OpiAID, is developing a wearable device using machine learning and artificial intelligence designed for those suffering from Opioid Use Disorder.^{lv} When complete, the wearable device will be able to detect cravings, contact the wearer's support network, collect and share data with partners, and even deliver naloxone in the event of an overdose.

The company's goal is to have the first commercial-grade version of OpiAID available in by summer 2020.^{lvi}

New telehealth technologies such as this could prove to be effective methods for addressing the opioid epidemic in the study area. However, as the technology will rely on mobile broadband services, spotty mobile coverage in the region could prove to inhibit its efficacy.

In light of these findings, and to fully realize the health and economic benefits both broadband availability and telehealth services can have in the in the coal-impacted communities, governments at all levels, health care providers, and

stakeholders should collaborate to ensure all safety net site providers and residents can access and use the technologies telehealth requires.

Recommendations

1. Programs and health interventions should be tailored to each community's specific needs.

Given the unique nature of each North Carolina county and community, programs, policies, and tools should be designed to meet each community's needs.

For example, Madison county does not have enough mental health providers to meet their population's needs and their residents reported more mentally unhealthy days in the past 30 days than the state average. Madison also has a greater number of households with access to 25/3 than the state average, thus a telehealth solution that addresses mental health for unserved patients could be implemented. Forsyth county had the highest number of deaths due to the opioid crisis.

A telehealth Medication Assisted Treatment (MAT) program that could allow health care providers to check in with patients at frequent intervals, could save patients travel time to the clinic, as well as

ensure they do not have to take off work to visit follow their treatment plan.

2. Develop a Cohesive State Policy to Enable Telehealth Expansion

To increase the expansion and adoption of telehealth, North Carolina should develop robust and data-driven policies to enable its expansion. At this time, DHHS has an interdivisional Telehealth Workgroup to provide guidance and subject matter expertise for policy makers as increasing telehealth use the use of telemedicine is an agency priority.^{lvii} The department is working to develop standards; including scope of services, online prescribing, data transfer protocols and reimbursement standards.

The commitment to increasing telehealth access is also reflected in North Carolina's redesign of the Medicaid program officially known as Medicaid Transformation. Finally, DHHS supports innovative approaches to utilize telehealth as evidenced in the current NC DHHS Strategic plan.^{lviii}

3. Through the Office of Rural Health, the state should provide Technical Assistance to Safety Net Sites to Support Telehealth Implementation.

Because many of the surveyed safety net sites indicated they were uncomfortable or

needed assistance in implementing a new telehealth program, DHHS recommends the creation and implementation of comprehensive and expansive training and education to prepare the coal-impacted counties for telehealth program implementation.

It is recommended that each county will complete an asset mapping assessment to determine their current capabilities and needs. Once this is complete, each county will have access to statewide resources that help them define next steps.

These resources will include a Telehealth 101 Workshop that works in conjunction with an interactive Telehealth Playbook. The Telehealth 101 Workshop will be a partial day training course available through an online webinar, as well as through individual site requests for in-person training. The workshop is intended to provide introductory level information regarding telehealth basics, practices, and models for use.

The Telehealth Playbook will be a more comprehensive tool that will complement the workshop. The content is intended to have users complete the asset mapping, needs assessment, and goal setting.

It will also provide a checklist and key steps for users to follow while rolling out a telehealth program. Both tools will be available online and through site visitation.

These recommendations allow for a universal approach to addressing the telehealth needs of the region while also being able to customize the tools and content depending on familiarity with each site.

4. The state, federal government, partners and stakeholders should dedicate resources to increase broadband availability to unserved households in the coal-impacted counties.

To fully achieve the ARC's strategic investment goal of "enhancing access to and use of broadband services," the 71,637 households in the coal-impacted counties without access to broadband need to be served. Ensuring these households have broadband will require funding and partnerships.

In addition to continuing to implement the recommendations made in Connecting North Carolina: The State Broadband Plan^{ix} state and local policymakers, governments, and stakeholders should consider implementing the following recommendations.

Increase and Modify Growing Rural Economies with Access to Technology (GREAT) Grant Program

In 2018, through S.L. 2018-5 the North

Carolina General Assembly established the Growing Rural Economies with Access to Technology (GREAT) grant program to provide funding to private broadband service providers to extend service to unserved areas of the state.^{ix} To date, nearly \$10 million has been distributed to connect 9,800 households and more than 590 businesses, agricultural operations, and community anchor institutions.

Local, state, and federal policymakers should target investments to increase broadband access in the eleven counties in the study area with higher rates of unserved households, at the FCC threshold of 25Mbps/3Mbps, than the state average.

However, despite the need for increased access to broadband, nine of the eleven counties are currently ineligible for the GREAT grant due to their economic tier status.^{ixi} For instance, 73 percent of households are unserved in Jackson county, but because Jackson is designated as a 'Tier 2' county, its communities are ineligible for GREAT grant funds until July 2020.

Haywood, a county designated as a 'Tier 3' county exceeds the state average by nearly 15 percentage points, with 21 percent of its households currently designated as unserved. Due to its tier status, Haywood will not be eligible for GREAT grant funds.

Meanwhile, based on estimates derived from data collected through this study, it could cost up to \$34 million to serve unserved households in Jackson and another \$13 million to serve unserved households in Haywood. ^{ixii} At this time, the GREAT grant funding is restricted \$15 million annually.

The state should consider appropriating additional funding to the GREAT grant to continue extending last-mile service to North Carolina's unserved households. Many of the estimated 71,637 unserved households in the 20 study counties will remain unserved unless additional resources are dedicated to increasing service in the region. In addition, given the need for higher speeds for patients to.

The state should also consider increasing the speed threshold by which unserved areas are defined for the purposes of the GREAT grant.

Currently, locations with less than 10Mbps/1Mbps are considered unserved and any location with greater levels of service is an ineligible area and will not be an allowable site for a project funded by GREAT.

Given that telehealth services require higher speeds to perform adequately, increasing the speed threshold for the GREAT grant would ensure more

residents are equipped with the necessary technology to fully engage in telehealth opportunities as they're made available.

Leverage Federal and Outside Funding

State, regional, and local governments should continue to coordinate and leverage federal funding to increase the region's broadband access and adoption. As additional federal funds such as the U.S. Department of Agriculture's ReConnect grant program are made available to increase residential broadband access, the State should continue to coordinate with local and regional governments, private internet service providers, and the federal government to ensure North Carolina receives the funding necessary to increase access throughout the region and state.^{ixiii}

Continue Data Collection and Mapping Initiatives

This study reinforces the oft-cited need for reliable, granular broadband access data. BIO has undertaken several initiatives to collect and refine datasets on where broadband is available, this study being one of them.

However, the state should continue to collect address-level data on broadband availability to inform funding decisions for programs such as the GREAT grant, the USDA's ReConnect grant program, and the forthcoming Rural Digital Opportunity Fund (RDOF) program from the FCC. Accurate maps will ensure funding is directed where it's needed most.

In addition, this study proved there is value in combining broadband data with other community data to reveal how broadband and other factors are intertwined. For instance, identifying the counties with poor health, and either high or low broadband availability can determine where telehealth is a viable option for supporting the community's health now.

Finally, BIO is developing a statewide survey to identify unserved and underserved households. A standardized, statewide survey will provide a robust data set for planning and mapping use. The state should continue to undertake initiatives such as this and local governments and stakeholders should partner with the state to assist in collecting this type of data.

5. The state, partners and stakeholders should implement innovative and comprehensive broadband adoption and digital inclusion programs.

Research shows that the sheer availability of or access to broadband isn't enough to positively impact a local economy. Rather it's the adoption of it, when people actually have it in their homes, and use it in ways

that positively impact their economic outlooks—that we begin to see a positive relationship between broadband and a community’s economic health. Low adoption results in a loss of opportunity: educational, economic, income, civic and cultural.

The consequences undermine society by further dividing the haves from the have-nots. And while broadband adoption is a challenge felt in urban areas of North Carolina and across the country, the relative lack of investment in deployment of broadband infrastructure in rural areas concentrates these effects in ways that further depress economic opportunities.

The state and local governments should partner to implement innovative and comprehensive broadband adoption and digital inclusion programs. Programs should be comprehensive and holistic in scope or leverage partners so that all facets of the digital divide—affordable internet access, access to computers, and access to digital skills education resources—are simultaneously addressed.

They should also leverage each community’s and unique assets and address their specific needs.

Digital Inclusion and Broadband Adoption Funding

Few funding opportunities exist that support digital inclusion and broadband adoption initiatives. Rather, most opportunities for expanding broadband adoption or implementing a digital inclusion program are only found as part of

an addition to another funding opportunity. As such, dedicated funding for increasing digital equity through digital inclusion programs is needed. All levels of government should allot funding to pilot, support, and sustain digital inclusion programs, and other stakeholders such as foundations and private donors should consider investments in digital inclusion and broadband adoption initiatives.

6. Encourage safety net sites to evaluate their broadband subscription before launching telehealth programs.

Of the 156 safety net sites surveyed, 94 percent indicated they have adequate broadband access. However, 47 percent of the sites were unsure what their connections are as such it is unclear whether the site’s definition of “reliable” will support larger bandwidth synchronous videos or higher capacity files. In addition, just two sites indicated their internet was not reliable but did not indicate they lacked broadband access.

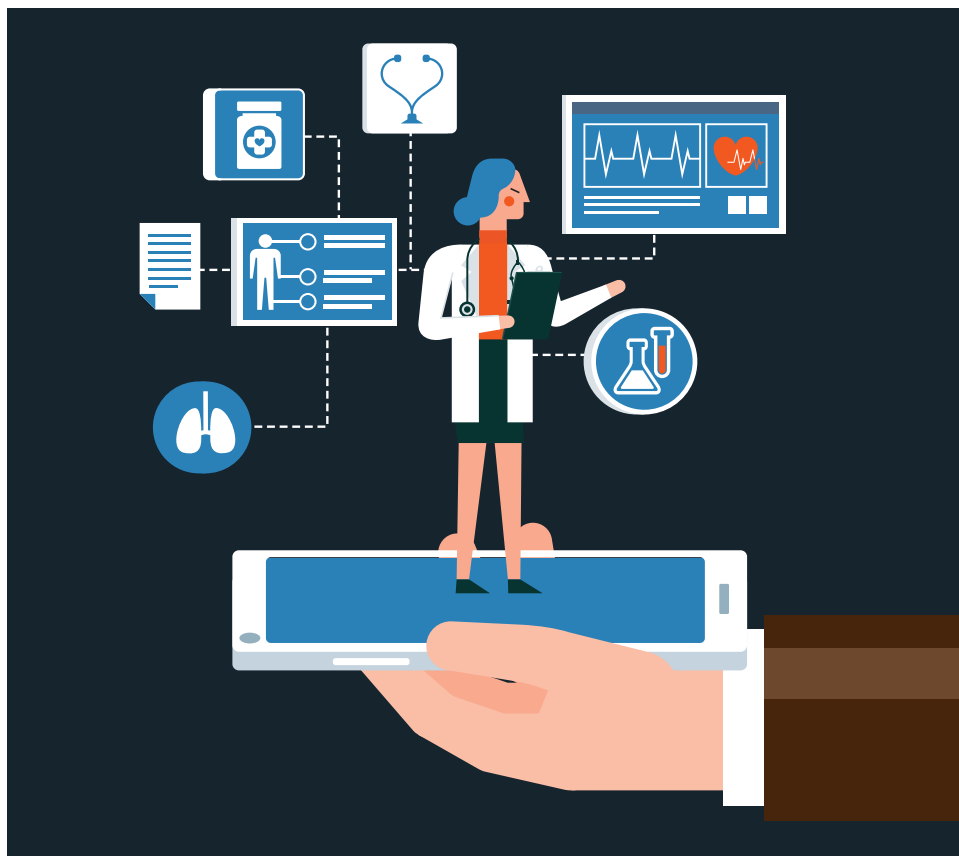
Although this information indicated that most sites have the broadband access they require, and some knowledge of existing services, it does not necessarily indicate a knowledge of the full bandwidth and broadband needed to support and sustain growing telehealth capabilities. In addition, many sites were unaware of the speeds and technologies they are subscribed to. Finally, it’s unclear how many sites are aware of the FCC’s funding program that provides discounts for broadband connectivity for rural health providers called the Healthcare Connect Fund (HCF) administered by the Universal

Service Administration Co. (USAC).^{lxiv} In North Carolina, the North Carolina Telehealth Network (NCTN) is the consortia through which eligible health care sites can receive discounted internet service through the FCC’s HCF program.^{lxv}

As such the safety net sites should evaluate their broadband capacity and internet enabled devices used in their sites prior to implementing telehealth programs and investigate whether they are eligible for the HCF program and serviceable by the NCTN. Should any safety net site in the region or the state not have adequate, reliable broadband service, or understand how to investigate their current options, the site should contact BIO who can provide technical assistance.

7. Entrepreneurial support organizations should provide intentional support for entrepreneurs who desire to launch digital health startups in the coal-impacted counties.

Of the estimated 123 telehealth focused startups in North Carolina, only one company’s headquarters are in the study region—in Forsyth county. Thus, while increased access to and adoption of broadband and telehealth by healthcare providers and patients opens up a natural market for telehealth-focused startups, entrepreneurial-focused support organizations like Digital Health Institute for Transformation (DHIT)^{lxvi}, CED and NC IDEA^{lxvii} should build capacity and support the region’s entrepreneurial ecosystem for the region to leverage the natural market opportunity.



Conclusion

As a whole, residents in North Carolina's Appalachian coal-impacted communities are sicker, have access to fewer health care providers, have less broadband available to them, adopt broadband at lower rates, and do not have the computers or skills needed to use telehealth services. Yet, opportunity abounds. Local leaders in counties like Wilkes, Mitchell, Madison, and Macon have indicated an eagerness to test new ideas and innovative solutions to address these challenges.

New funding opportunities from the federal and state government are or will soon be available to address the lack of broadband access in the region. And proven models to increase digital inclusion, telehealth and broadband adoption are taking root state and nation-wide and could be mirrored in the region.

Implementing this study's recommendations will require dedicated leadership, sustained partnerships between the state and local leaders, and a willingness to pilot innovative and new programs. Understanding each coal-impacted community's unique opportunities and challenges will be crucial to successful implementation of the recommendations. Finally, equipping the safety net sites with the knowledge, skills, and technical capacity will enable them to leverage telehealth technologies to expand and enhance health care.

The data collected through this feasibility study are clear, bold and swift actions from state and local leaders are necessary to ensure North Carolina's Appalachian coal-impacted communities do not remain sicker, more economically distressed, and without the digital infrastructure necessary to flourish in the 21st century.

Appendices

Appendix A: Data Variables Collected

Category	Data
Broadband	Residential BB Availability for each Tech Type (in range of safety net sites)
Broadband	Residential Mobile BB Availability
Broadband	Residential BB Adoption
Broadband	Digital Literacy Skills
Broadband	Device Adoption
Broadband	Inventory of Available Digital Literacy Trainings
Broadband	BB Availability to safety net Sites
Broadband	BB Subscription and Tech Type at safety net sites
Broadband	BB Usage Rates at safety net sites
Healthcare	Number of safety net sites
Healthcare	Number of Mental Health Providers
Healthcare	Number of Substance Abuse Rehabilitation Providers
Healthcare	Number of MAT Providers
Healthcare	Inventory of healthcare initiatives/providers addressing opioid epidemic
Healthcare	Opioid epidemic rates
Healthcare	Health disparity rates
Telehealth	Case Studies of telehealth initiatives addressing primary care health issues
Telehealth	Case Studies of telehealth initiatives addressing substance abuse
Telehealth	Case Studies of telehealth initiatives addressing mental health issues
Telehealth	Inventory of safety net sites use of telehealth applications (include modality)
Telehealth	Safety net sites comfortability using telehealth applications to deliver healthcare
Telehealth	Capacity of safety net sites to instruct patients how to use telehealth applications
Telehealth	Funding for telehealth use by safety net sites
Telehealth	Businesses with interest in telehealth

Appendix B: Safety Site Net Survey

ARC Survey

Start of Block: Contact info

Q1

The Office of Rural Health (ORH) is partnering with the Broadband Infrastructure Office (BIO) of the NC Department of Information Technology to conduct a broadband and telehealth feasibility study in 20 of North Carolina's coal impacted counties funded by a grant from the Appalachian Regional Commission. The 20 counties include Alleghany, Ashe, Avery, Burke, Caldwell, Cherokee, Forsyth, Graham, Haywood, Henderson, Jackson, Macon, Madison, Mitchell, Rutherford, Surry, Transylvania, Watauga, Wilkes, and Yancey.

As part of this study, ORH and BIO are surveying Safety Net Sites in NC's western region to identify their existing telehealth and broadband assets. Your survey responses will inform the overall feasibility study and recommendations for telehealth and broadband moving forward. Please complete this survey as accurately as possible by June 28th, 2019. It will take an estimated 15-20 minutes to complete. The survey will ask about both current internet access at your site, as well as any telehealth services your health care providers use for patient care. By identifying the Safety Net Sites' existing telehealth and broadband capabilities and needs, we will be better informed for developing solutions. If you have any questions about the details or purpose of this survey, please feel free to contact me at robyn.mcardle@dhs.nc.gov or 919-527-6469. We appreciate your assistance as we work to find better ways for individuals and communities with improved access to health care.

Page Break

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Q2

Contact Information

What is your First and Last name?

Q3 What is your e-mail address?

Q4 What is your phone number? (Provide in format of 828-123-4567)

Q5 Which safety net site do you represent?

Select one... (4)

▼

Q28 If you selected "Other" from the list, please provide the name of your site.

End of Block: Contact info

Start of Block: Telehealth usage

Q6

Telehealth Usage

For the purpose of this survey, telehealth is defined as the use of electronic information and

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Q7 Indicate how often your care providers use each of the following telehealth technologies:

	All care providers use frequently (1)	Most care providers use frequently (2)	Available but not used by most care providers (3)	Available but rarely used by care providers (4)	Not currently available at my site (5)
Two-way live video with patients (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Remote patient monitoring (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recorded video and secure messaging (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mobile health applications that utilize phones, tablets or laptops (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q8

Telehealth Training

If telehealth training and support were provided by the North Carolina Office of Rural Health, which of the following would be of interest for your site:

	Yes (1)	Maybe (2)	No (3)
Resources of current telehealth best practices (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Webinars (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In-person workshops (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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telecommunications technologies to support and promote long-distance clinical health care, patient and professional health-related education, public health and health administration.

The four types of telehealth include:

- 1) **Two-way live video** - A two-way audiovisual link between a patient and a care provider. Both parties talk in real time and the care provider's services are delivered via this route.
- 2) **Remote patient monitoring** - The use of connected electronic tools to record personal health and medical data in one location for review by a care provider in another location, usually at a different time.
- 3) **Recorded video, secure messaging** - The sending of health information to a care provider via electronic means, such as HIPAA compliant texting or email, often used to reach specialists.
- 4) **Mobile health applications** - The delivery of health care and health information through mobile apps on phones, tablets or laptop computers.

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Q9 What telehealth topics would you like covered in a training provided by the North Carolina Office of Rural Health?

Q10 How comfortable are the majority of care providers at your sites with the task of teaching patients how to use telehealth services?

- Extremely comfortable (1)
- Somewhat comfortable (2)
- Neither comfortable nor uncomfortable (3)
- Somewhat uncomfortable (4)
- Extremely uncomfortable (5)
- Not applicable (6)

Skip To: Q12 If How comfortable are the majority of care providers at your sites with the task of teaching patien... = Extremely comfortable

Skip To: Q12 If How comfortable are the majority of care providers at your sites with the task of teaching patien... = Somewhat comfortable

Skip To: Q12 If How comfortable are the majority of care providers at your sites with the task of teaching patien... = Neither comfortable nor uncomfortable

Q11 What makes the care providers uncomfortable with telehealth?

Q12 How much do you think each of the following issues would impact your site's ability to implement, expand, or continue the use of telehealth services:

	A great deal (1)	A significant amount (2)	A moderate amount (3)	A little (4)	None at all (5)
Level of staffing (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Current budget (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Internet access at your site (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Internet access at patients' homes (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Computer literacy skills of staff (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Computer literacy skills of patients (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clinic space (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q13 What are the benefits of implementing telehealth services at your site?

	Significant benefit (1)	Moderate benefit (2)	Slight benefit (3)	No benefit (4)	Negative effect (5)	Not applicable (6)
Quicker intervention when patient issues arise (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Better patient outcomes (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lower cost to patients (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduced time for patients to receive care (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide patients access to experts outside their geographic area (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lower costs for care providers to deliver quality care (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Allow care providers to see more patients per week (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Allow care providers to reach new patients not currently accessible (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Skip To: Q15 If What are the benefits of implementing telehealth services at your site? = Lower costs for care providers to deliver quality care

Q14 Are there any other potential benefits of implementing telehealth services at your site that are not listed in the previous question?

Q15 Are there any other concerns or potential disadvantages of implementing telehealth services at your site?

End of Block: Telehealth training

Start of Block: Have Internet access?

Q16

Internet Usage

Does your site have reliable, high-speed, high-quality Internet access delivered by a wire or

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fiber optic cable? (Cellular hotspots, satellite, dial-up and site-to-site microwave are not considered reliable and high-speed.)

- Yes (1)
- No (2)
- Not sure (3)

End of Block: Have Internet access?

Start of Block: No Internet access

Display This Question:

If Internet Usage Does your site have reliable, high-speed, high-quality Internet access delivered b...
= No

Q17 What are the key reasons your site does not currently have reliable, high-speed, high-quality Internet access: (You may select up to three choices.)

- Site doesn't see the need for Internet access to deliver healthcare (1)
- Not available at the site from any Internet service provider (2)
- Internet is present, but the speed is too slow or not reliable (3)
- Site doesn't have computers and devices that can utilize high-speed Internet (4)
- Site has Internet, but the WiFi and LAN lack capacity to use it effectively (5)
- Staff lacks skills to use high-speed Internet effectively (6)
- Too expensive (7)
- Concerns about information privacy (8)
- Other (9) _____

End of Block: No Internet access

Start of Block: Finish

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Q18 Does your site offer online billing to patients?

- Yes (1)
- No (2)

Skip To: Q20 If Does your site offer online billing to patients? = No

Q19

About what percent of your patients have signed up for online billing at your site?

Do not include a percent sign in your response.

Q20 If you have any other thoughts or suggestions on telehealth as it relates to your site, please take a moment to comment here:

End of Block: Finish

Start of Block: Yes Internet access

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Q21 Which type of Internet service do you currently utilize at your site:

- Dial-up (1)
- Satellite (e.g. Hughes Net) (2)
- Fixed Wireless (e.g. Light Leap) (3)
- Cellular hotspot (e.g. Verizon Mi-fi, Sprint, US Cellular, AT&T, etc.) (4)
- DSL (e.g. Century Link) (5)
- Cable Modem (e.g. Spectrum, SuddenLink, etc.) (6)
- Fiber (7)
- Not sure (8)

Q22 What is the current Internet service provider at your site?

Q23 How satisfied are you with your current Internet service?

- Extremely satisfied (1)
- Somewhat satisfied (2)
- Neither satisfied nor dissatisfied (3)
- Somewhat dissatisfied (4)
- Extremely dissatisfied (5)

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Q24 What is the average cost per month for Internet access at your site?
Omit dollar sign and any non-numeric characters.

Q25 What is the data rate for your Internet service measured in bits per second? Omit non-numeric characters and select the bit rate unit of measure from the list below. This information may be on your telecommunications bill. If unsure, leave blank.
Data rates can range from 56 kilobits per second (Kbps) for dial-up modems to several gigabits per second (Gbps) for the fastest fiber-optic network connections. Satellite is slow compared to some of these other connections with download speeds from 750 Kbps to 2 Mbps.

Q26 units:

- Kbps (1)
- Mbps (2)
- Gbps (3)

Q27 Would you be willing to share a copy of your recent Internet bill with the North Carolina Office of Rural Healthcare and the North Carolina Broadband Infrastructure Office? (If yes, the team will follow up with you after you complete the survey to obtain a copy.)

- Yes (1)
- Maybe (2)
- No (3)

End of Block: Yes Internet access

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Appendix C: Case Study Questionnaire

1. **Goals for meetings with case study sites:**
 - a. To learn what their telehealth program entails
 - b. To learn how their telehealth program is implemented
 - c. To learn who their telehealth program serves
 - d. To learn outcomes of program
 - e. To learn costs of program and how it's funded
 - f. To learn what technology capacities they require to implement & run program
 - g. To learn what their goals for the future of the program are
 - h. To learn of any tips or best practices they would share with others
 - i. To learn of any lessons learned or biggest challenges
 - j. To learn how the benefits of the program relate to the mission of the organization and needs of the community
 - k. To learn of patient's satisfaction and experience of the telehealth program

2. **Questions for Case Study Organizations:**
 - a. Programmatic Questions:
 - i. Please describe your telehealth program
 1. What is it?
 2. Why did you start it?
 3. When was it started? (what year)
 4. Who does it serve?
 5. What telehealth modality is used?
 6. Does it address a specific diagnosis?
 - ii. How did you first implement your telehealth program?
 1. I.e. phased or pilot?
 2. Hire new staff?
 3. Target which patients to include in the telehealth program?
 4. Where does the telehealth program operate? (ex. in patient home, at clinic, etc.)
 5. Etc.
 - iii. How do you advertise your telehealth program?
 - iv. What is your organizational model for the program?
 1. I.e. # of FTE, did you have to hire additional staff to implement the program? Etc.
 - v. How is your telehealth program integrated into your other clinic operations?

b. Digital Literacy Questions:

- i. When you first discussed using telehealth within your practice, what was the response from both providers, staff and patients?
- ii. Had anyone in your practice previously used telehealth at another location?
- iii. How did you train your employees on this technology and how to deliver care via telehealth?
- iv. What was the biggest challenge in rolling out telehealth from an end-user perspective?
- v. How do you address digital skill gaps for patients and providers without the skills necessary to use the telehealth program?

c. Program Outcomes Questions:

- i. What are your program impacts to date?
- ii. How has your program impacted the health of the patients it serves?
- iii. How do you measure your impacts and outcomes?
- iv. How do the benefits of the program relate to the mission of the organization and needs of the community?
- v. What were the barriers or challenges you encountered during the program implementation?

d. Funding Questions:

- i. How is your program funded?
 1. What were the startup costs?
 2. What are the ongoing operating costs?
- ii. Do insurance providers provide reimbursement for your program?
- iii. What (if any) cost reductions has your organization experienced as a result of the program?

e. Technology Questions:

- i. What equipment do you use to implement your program?
- ii. What network do you use to operate the program?
- iii. What hardware is needed to operate the program?
- iv. What broadband speeds are needed to offer the telehealth program for the program administrator?
- v. What broadband speeds are needed to utilize the telehealth program for the user?
- vi. Interoperability and scalability of telehealth technology
- vii. What existing organizational resources did you have to leverage to address the technology needs for the program?

3. **Things we need to see while at the case study sites:**

- Telecommunications rooms
- o Wired broadband connections
- Any telehealth equipment they use to deliver care via telehealth
- Room(s) where telehealth program is operated out of

Appendix D: Dashboard Methodology

Background

The Friday Institute, in partnership with the NC Department of Information Technology (DIT) Broadband Infrastructure Office (BIO) and NC Department of Health and Human Services (DHHS) Office of Rural Health (ORH), created dashboards to identify the areas of greatest need with regard to Internet access and health challenges in twenty counties in Western North Carolina.

Counties selected for analysis are part of the Appalachian Regional Commission (ARC). The static images below provide snapshots of the dashboards for Mitchell County as an example.

County Profiles Dashboard

The first dashboard, called the 'County Profiles Dashboard' has three components: broadband adoption potential by census tract, health data by county, and the count of opioid deaths in the county.

The broadband adoption map displays BIO's 'Broadband Adoption Potential' index for the study area.

The 'Broadband Adoption Potential' index is comprised of 11 variables including the percent of households with a wireline subscription. However, research indicates the need to consider other variables that affect technology adoption including but not limited to age, income, presence of children and educational attainment among others, as such these and other variables are included to comprise the adoption potential score for each census tract.

Lower scores are shown in orange on the map, and indicate lower rates of broadband adoption potential whereas higher scores are shown in blue on the map, and indicate higher broadband adoption potential.

Adoption potential scores range from 0 to 100 and include census tracts from the entire state, as such census tracts in the study area are compared to census tracts outside the study area.

Users can hover over the census tracts to obtain additional information about the

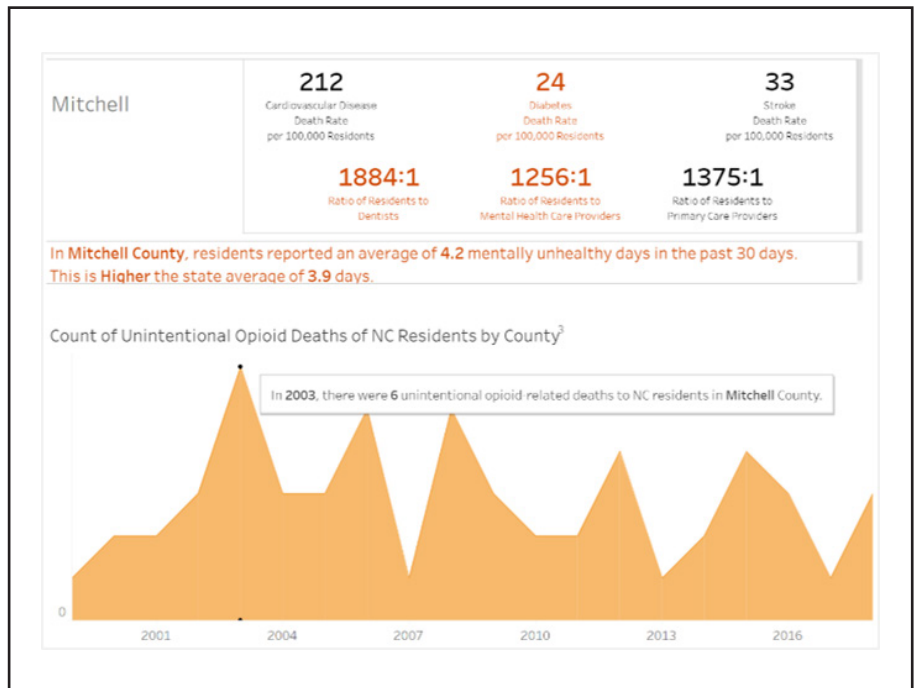


Image 6

specific variables that comprise the index.

While county index scores are available, the census tract scores assist communities in identifying the subtle yet sometimes dramatic difference between communities, assisting in community planning.

Higher scores are shown in orange on the map, and indicate more need. Lower scores are shown in blue on the map, and indicate less need. Users can hover over the Census tracts to get more information about the specific variables. I

n Mitchell County, one of the Census tracts, shown in orange, has a higher need for Broadband connectivity than the other tracts.

Health data by county (right) appear in the lower half of the dashboard. Variables include: Death rates due to cardiovascular disease, diabetes, and stroke, the ratio of residents to dentists, mental health care providers, and primary care providers, and

the average number of mentally unhealthy days in the past 30, as reported by county health rankings data.

If the text in the dashboard is orange, it means that the rate/ratio/number of days is higher than the state average.

Finally, this dashboard includes the count of unintentional opioid deaths in the county. The example from Mitchell County (Image 6) shows that four of the seven health indicators are higher than the state averages, and that the count of opioid deaths has varied since 1999.

The opioid death chart includes an example of the pop-out information that appears when users hover over the data visualizations.

[Internet Access and Safety net Sites in North Carolina's ARC Counties Dashboard](#)

The map in this dashboard shows the

distribution of Safety net Sites, community anchor institutions, and (where available) households without Internet access for each NC county in the ARC.

Here, Safety net Sites are displayed as stars, community anchor institutions like schools and libraries are mapped as crosses, and points for households without internet access, collected from surveys conducted within each county or grouping of counties between 2014-2019, appear as blue dots.

Users can hover over the Safety net Sites and community anchor institutions to get more information about their names and classifications.

Similarly, users can hover over the blue household data points to learn more about the survey from which the information was collected.

The background base maps show Census blocks in dark grey and light grey. The dark grey areas are those in which the download/upload Internet speeds are less than 25 Mbps/3 Mbps, which are the lowest acceptable speeds for conveying telehealth services, according to the NC Broadband Infrastructure Office (BIO).

Alternatively, the light grey areas are those in which the download/upload Internet speeds are at or above the 25 Mbps/3 Mbps threshold, which is deemed

sufficient by the NC BIO.

The example above shows Mitchell County, which has 14 Safety net Sites and 10 community anchor institutions. The blue dots showing households without Broadband are scattered throughout the county. The household data was collected in 2019 through the IMLS HWG Survey.

ARC Cluster Analysis

To better determine which areas within each county demonstrate the highest need, a methodology of clustering was developed, wherein: clusters of homes deemed to be without access (based on the FCC 25/3 threshold) would be identified.

Indeed, there are numerous perspectives from which the ARC data set could be grouped.

However after careful inspection, the most appropriate method was determined to be the DBSCAN clustering heuristic, based on efficiency, extensibility and apparent axiomatic cogency.

To determine where a cluster is defined, DBSCAN operates on two parameters: a minimum cluster size, and a maximal distance between points (in this case, homes). Our analysis was run with nine different combinations of minimum cluster

size and maximal distance:

Minimum homes in a cluster:

1. 5 homes
2. 10 homes
3. 20 homes

Maximal distance between homes in a cluster:

1. 0.25 miles
2. 0.5 miles
3. 1 mile

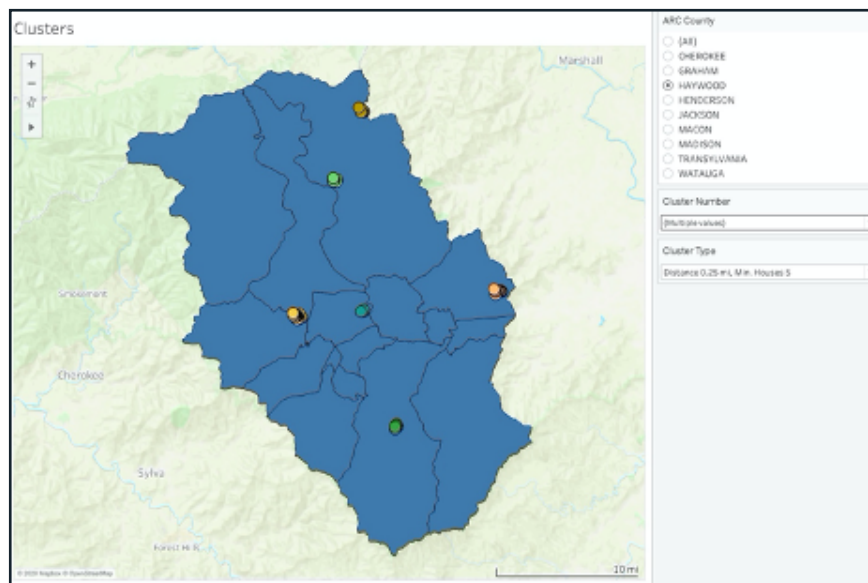
This yields perspective clusters defined by, for example: 5 homes with 0.25 miles, 20 homes with 1 mile, and any other combinations of the two parameters.

After the clusters were generated using the above parameter sets, a given cluster's area (in miles) and center point (centroid), were calculated.

Abstractly, one can think of taking all points in the cluster and wrapping them in gift wrap: the total size of the wrapping paper is the area of the cluster.

An important item to note is the sensitivity of the two parameters. If, for example, the maximal distance is set to 0.25 miles, and a home lies at a distance of 0.249999 miles, that home will not be added to the cluster.

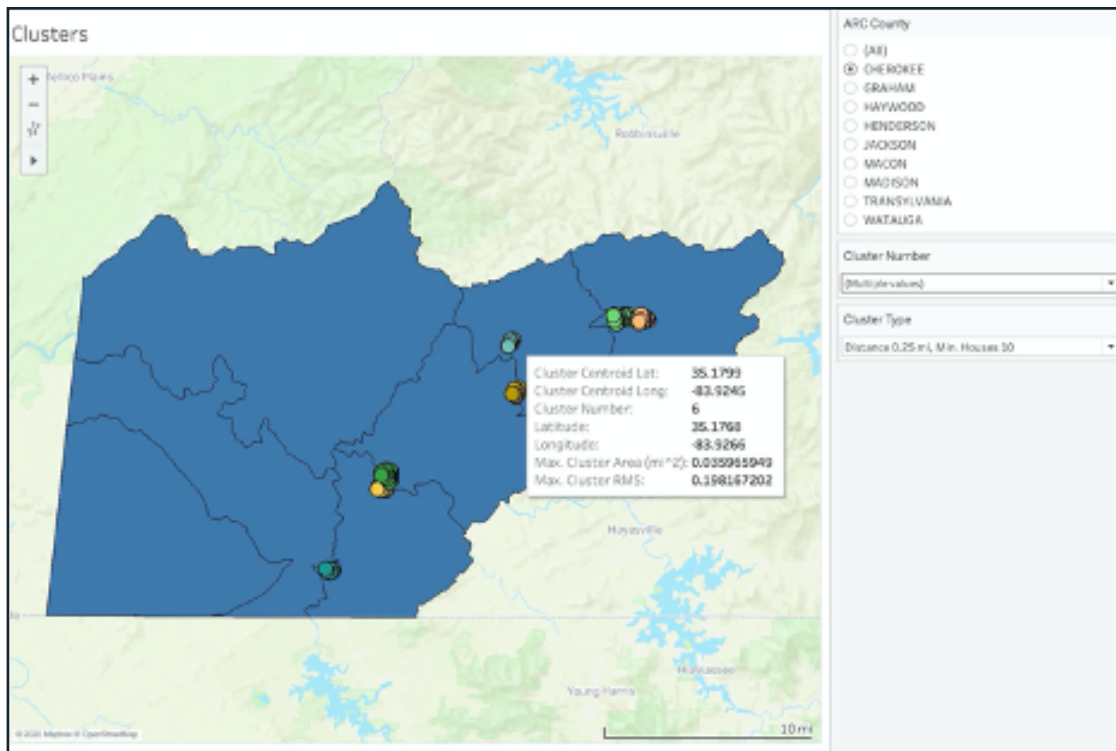
The following view shows an example of the current data:



The input selectors, ARC County and Cluster Type, select the unique view of the data. A cluster number is assigned to an individual home, representing to which cluster it belongs; the color is subsequently generated from that number.

If, within a particular view, a home does not belong to a cluster, it is labeled an outlier with a cluster number of -1 and corresponding color of black.

Note: that as there are a limited number of distinct colors within a Tableau color palette, counties with a large number of clusters (16+) have duplicate cluster coloring; the cluster number, however, shall never collide with another.



A final important note: by hovering over a point within a cluster, the following attributes of both an individual home and overarching cluster are displayed.

For the individual point:

1. Latitude
2. Longitude
3. Cluster number

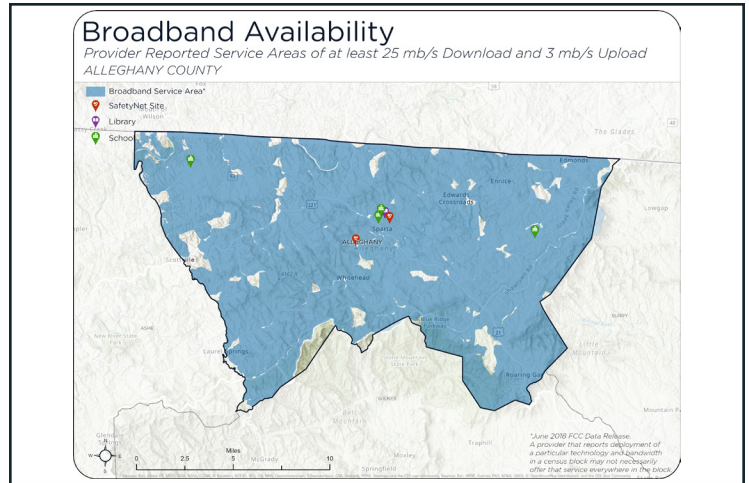
For the overarching cluster:

1. Cluster Centroid Latitude
2. Cluster Centroid Longitude
3. Max. Cluster Area (in square miles)
4. Max. Cluster RMS: This is an experimental Root Mean Square value representing the 'spread' of a given cluster; the lower the value, the more tightly packed the cluster.

Appendix E: Health Specialists Data

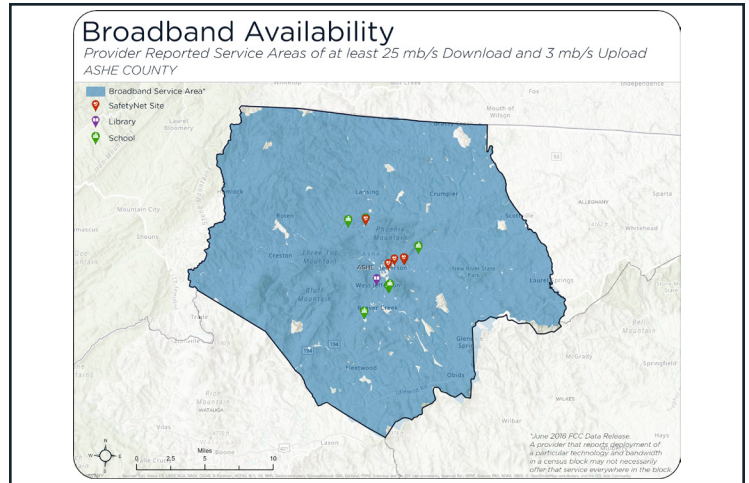
State: North Carolina (Rate per 10K)		Cardiologists	Endocrinologists	Mental Health
Alleghany	0.00		0.00	0.89
Ashe	0.37		0.00	0.73
Avery	0.55		0.00	1.10
Burke	0.66		0.00	2.75
Caldwell	0.24		0.00	0.16
Cherokee	0.00		0.00	0.78
Forsyth	1.86		0.00	1.72
Graham	0.00		0.00	0.00
Haywood	0.64		0.00	0.95
Henderson	1.19		0.17	0.65
Jackson	0.69		0.00	1.60
Macon 0.28	0.00		0.46	
Madison	0.00		0.00	0.75
Mitchell	0.00		0.00	0.87
Rutherford	0.15		0.00	0.49
Surry	0.82		0.14	0.18
Transylvania	0.29		0.00	0.76
Watauga	1.05		0.00	2.61
Wilkes 0.28	0.00		0.33	
Yancey 0.00	0.00		0.18	
State Average	0.83		0.22	1.41

Appendix F: Allegheny County



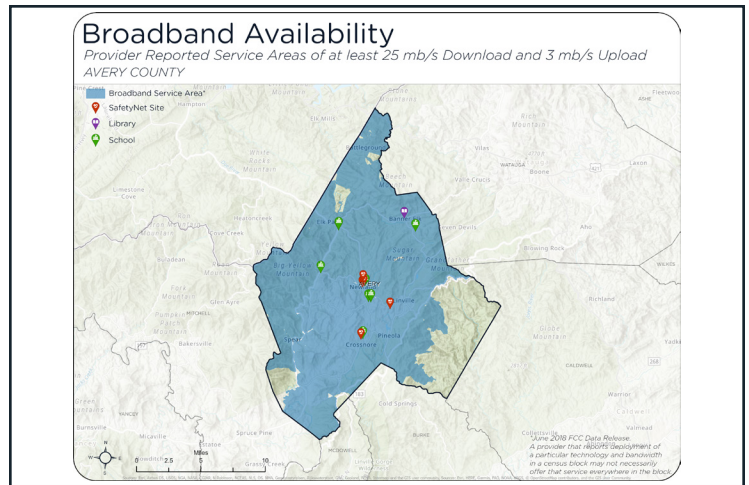
2020 Economic Tier	2
Council of Governments Region	High Country
Total Population	10935
Total Households (Census)	8,094
Percent of Population age 25 or more with Bachelor's Degree or Higher	18.7
Percent Population in Poverty	21.0
Percent of Unserved Households at 25/3Mbps	8%
Estimated Number of Unserved Households at 25/3Mbps	666
Percent of Unserved Census Tracts at 25/3Mbps	5%
Citizen Reported Unserved Households	insufficient information
Estimate - Total Households (ACS)	4742
Total Households with Broadband	3251
Total Households without Broadband Subscription	1491
Percent of Households without Broadband Subscription	31.4%
Total Households without Computer	1070
Percent of Households without Computer	22.6%
Broadband Adoption Potential Index Score	18.64
Number of Libraries	1
Number of Schools	4
Number of Safety net Sites	2
Cardiovascular disease death rate per 100,000 residents	192.8
Diabetes death rate per 100,000 residents	22.3
Stroke death rate per 100,000 residents	28.4
Mentally unhealthy days in the past 30	4.3
Ratio of residents to dentists	5516:1
Ratio of residents to mental health care providers	501:1
Ratio of residents to primary care providers	904:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	17

Ashe County



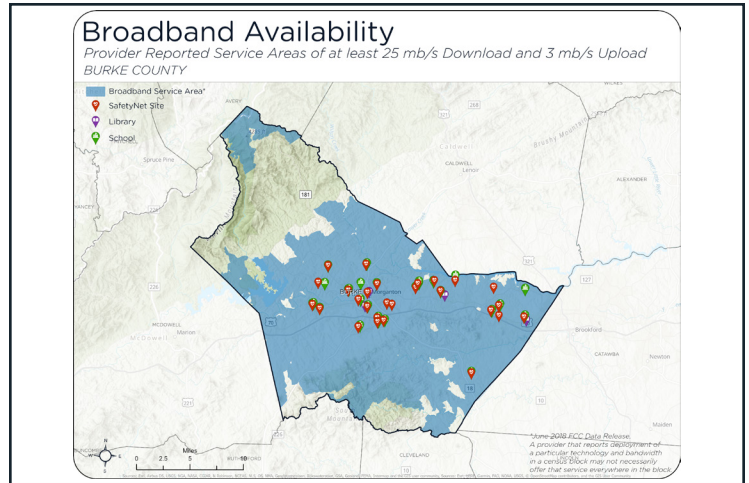
2020 Economic Tier	2
Council of Governments Region	High Country
Total Population	26833
Total Households (Census)	17,342
Percent of Population age 25 or more with Bachelor's Degree or Higher	19.5
Percent Population in Poverty	19.4
Percent of Unserved Households at 25/3Mbps	7%
Estimated Number of Unserved Households at 25/3Mbps	1,129
Percent of Unserved Census Tracts at 25/3Mbps	24%
Citizen Reported Unserved Households	insufficient information
Estimate - Total Households (ACS)	11995
Total Households with Broadband	7931
Total Households without Broadband Subscription	4064
Percent of Households without Broadband Subscription	33.9%
Total Households without Computer	2900
Percent of Households without Computer	24.2%
Broadband Adoption Potential Index Score	30.86
Number of Libraries	1
Number of Schools	6
Number of Safety net Sites	5
Cardiovascular disease death rate per 100,000 residents	205.3
Diabetes death rate per 100,000 residents	16.6
Stroke death rate per 100,000 residents	33.9
Mentally unhealthy days in the past 30	4.1
Ratio of residents to dentists	2995:1
Ratio of residents to mental health care providers	613:1
Ratio of residents to primary care providers	1923:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	34

Avery County



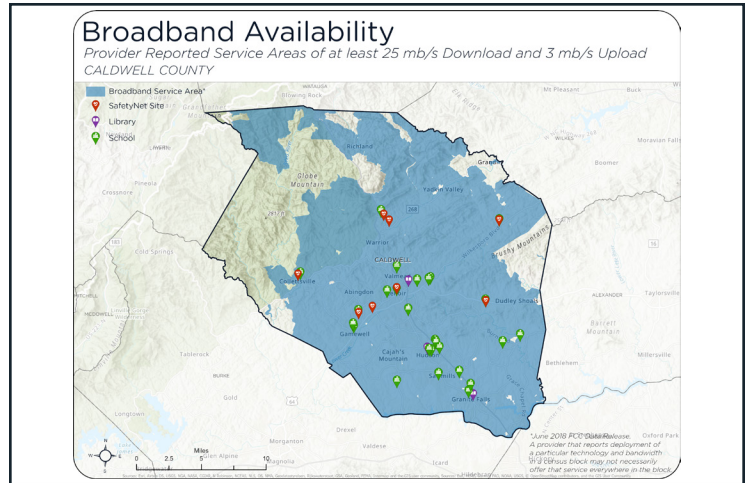
2020 Economic Tier	2
Council of Governments Region	High Country
Total Population	17535
Total Households (Census)	13,890
Percent of Population age 25 or more with Bachelor's Degree or Higher	20.2
Percent Population in Poverty	14.7
Percent of Unserved Households at 25/3Mbps	4%
Estimated Number of Unserved Households at 25/3Mbps	499
Percent of Unserved Census Tracts at 25/3Mbps	1%
Citizen Reported Unserved Households	771
Estimate - Total Households (ACS)	6725
Total Households with Broadband	4225
Total Households without Broadband Subscription	2500
Percent of Households without Broadband Subscription	37.2%
Total Households without Computer	1618
Percent of Households without Computer	24.1%
Broadband Adoption Potential Index Score	27.60
Number of Libraries	2
Number of Schools	9
Number of Safety net sites	5
Cardiovascular disease death rate per 100,000 residents	203.6
Diabetes death rate per 100,000 residents	15
Stroke death rate per 100,000 residents	24.9
Mentally unhealthy days in the past 30	4.2
Ratio of residents to dentists	4384:1
Ratio of residents to mental health care providers	262:1
Ratio of residents to primary care providers	2919:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	22

Burke County



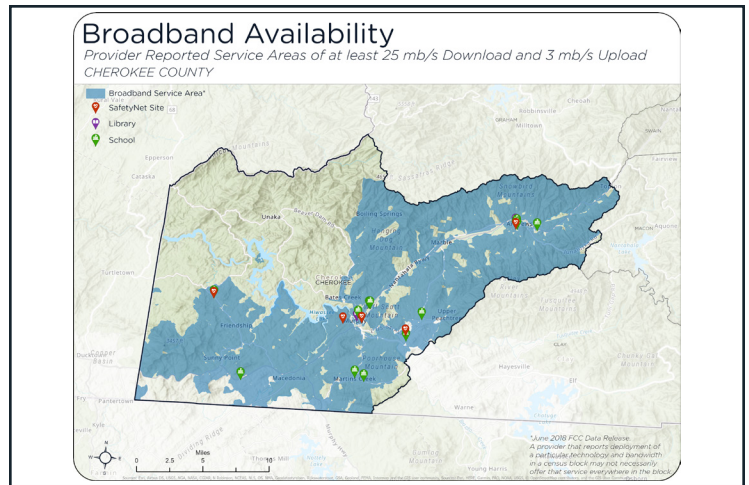
2020 Economic Tier	2
Council of Governments Region	Western Piedmont
Total Population	88898
Total Households (Census)	40,879
Percent of Population age 25 or more with Bachelor's Degree or Higher	16.7
Percent Population in Poverty	19.3
Percent of Unserved Households at 25/3Mbps	3%
Estimated Number of Unserved Households at 25/3Mbps	1,289
Percent of Unserved Census Tracts at 25/3Mbps	4%
Citizen Reported Unserved Households	303
Estimate - Total Households (ACS)	34568
Total Households with Broadband	22730
Total Households without Broadband Subscription	11838
Percent of Households without Broadband Subscription	34.2%
Total Households without Computer	8185
Percent of Households without Computer	23.7%
Broadband Adoption Potential Index Score	25.34
Number of Libraries	4
Number of Schools	26
Number of Safety net sites	28
Cardiovascular disease death rate per 100,000 residents	239.9
Diabetes death rate per 100,000 residents	24.4
Stroke death rate per 100,000 residents	45.8
Mentally unhealthy days in the past 30	4.1
Ratio of residents to dentists	2350:1
Ratio of residents to mental health care providers	371:1
Ratio of residents to primary care providers	1851:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	191

Caldwell County



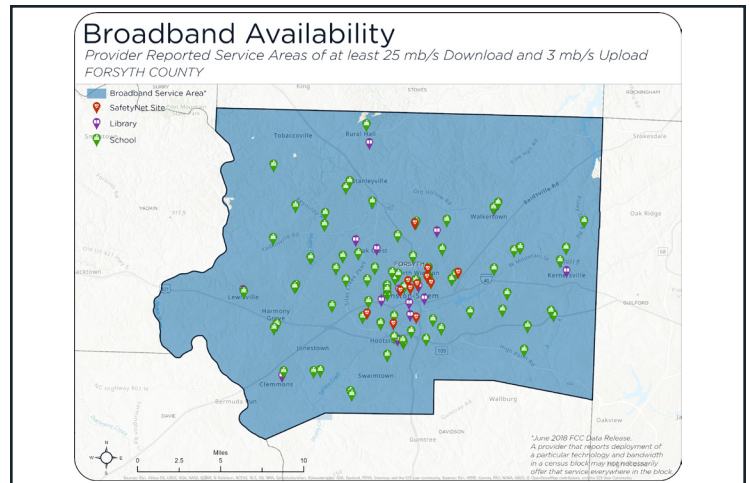
2020 Economic Tier	1
Council of Governments Region	Western Piedmont
Total Population	81805
Total Households (Census)	37,659
Percent of Population age 25 or more with Bachelor's Degree or Higher	14.8
Percent Population in Poverty	16.4
Percent of Unserved Households at 25/3Mbps	3%
Estimated Number of Unserved Households at 25/3Mbps	1,150
Percent of Unserved Census Tracts at 25/3Mbps	2%
Citizen Reported Unserved Households	insufficient information
Estimate - Total Households (ACS)	32150
Total Households with Broadband	22625
Total Households without Broadband Subscription	9525
Percent of Households without Broadband Subscription	29.6%
Total Households without Computer	6616
Percent of Households without Computer	20.6%
Broadband Adoption Potential Index Score	35.50
Number of Libraries	4
Number of Schools	26
Number of Safety net sites	8
Cardiovascular disease death rate per 100,000 residents	246.6
Diabetes death rate per 100,000 residents	26.1
Stroke death rate per 100,000 residents	47.1
Mentally unhealthy days in the past 30	4.2
Ratio of residents to dentists	3279:1
Ratio of residents to mental health care providers	1640:1
Ratio of residents to primary care providers	2201:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	129

Cherokee County



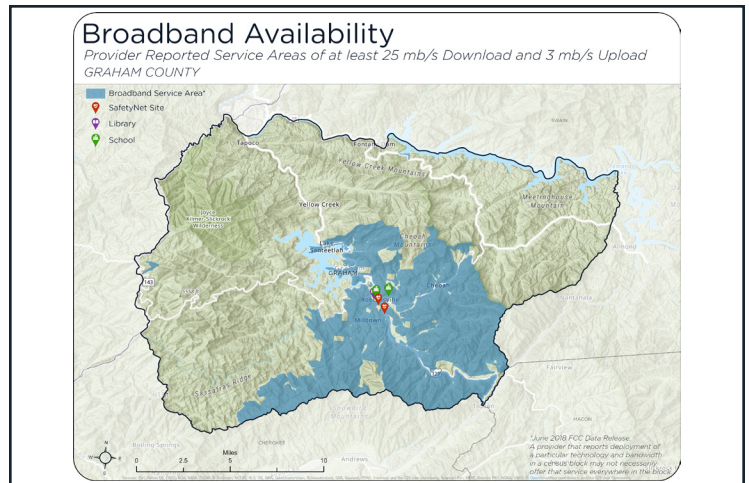
2020 Economic Tier	2
Council of Governments Region	Southwest Commission
Total Population	27463
Total Households (Census)	17,515
Percent of Population age 25 or more with Bachelor's Degree or Higher	19.2
Percent Population in Poverty	16.8
Percent of Unserved Households at 25/3Mbps	28%
Estimated Number of Unserved Households at 25/3Mbps	4,892
Percent of Unserved Census Tracts at 25/3Mbps	52%
Citizen Reported Unserved Households	156
Estimate - Total Households (ACS)	11206
Total Households with Broadband	7348
Total Households without Broadband Subscription	3858
Percent of Households without Broadband Subscription	34.4%
Total Households without Computer	2502
Percent of Households without Computer	22.3%
Broadband Adoption Potential Index Score	22.90
Number of Libraries	5
Number of Schools	13
Number of Safety net sites	6
Cardiovascular disease death rate per 100,000 residents	252.2
Diabetes death rate per 100,000 residents	21.7
Stroke death rate per 100,000 residents	36.7
Mentally unhealthy days in the past 30	4.5
Ratio of residents to dentists	3121:1
Ratio of residents to mental health care providers	739:1
Ratio of residents to primary care providers	2537:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	53

Forsyth County



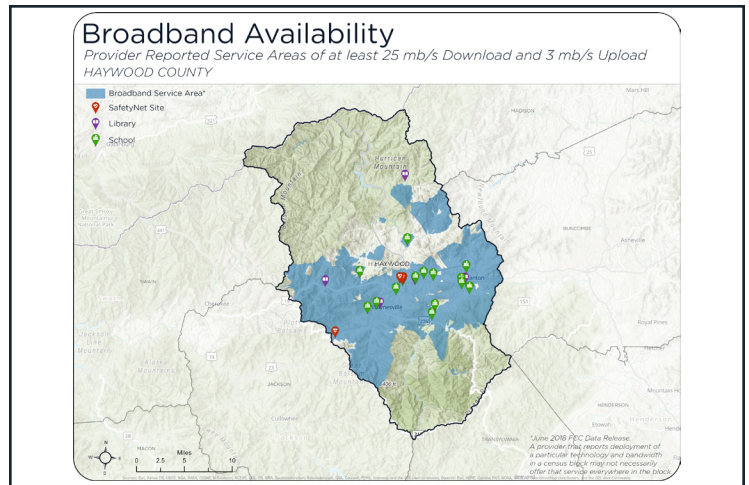
2020 Economic Tier	2
Council of Governments Region	Piedmont Triad
Total Population	368362
Total Households (Census)	156,872
Percent of Population age 25 or more with Bachelor's Degree or Higher	33.8
Percent Population in Poverty	18.7
Percent of Unserved Households at 25/3Mbps	0%
Estimated Number of Unserved Households at 25/3Mbps	40
Percent of Unserved Census Tracts at 25/3Mbps	0%
Citizen Reported Unserved Households	insufficient information
Estimate - Total Households (ACS)	145102
Total Households with Broadband	113053
Total Households without Broadband Subscription	32049
Percent of Households without Broadband Subscription	22.1%
Total Households without Computer	19315
Percent of Households without Computer	13.3%
Broadband Adoption Potential Index Score	62.49
Number of Libraries	16
Number of Schools	79
Number of Safety net sites	14
Cardiovascular disease death rate per 100,000 residents	205.6
Diabetes death rate per 100,000 residents	22.8
Stroke death rate per 100,000 residents	43.6
Mentally unhealthy days in the past 30	4.2
Ratio of residents to dentists	1695:1
Ratio of residents to mental health care providers	378
Ratio of residents to primary care providers	906:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	435

Graham County



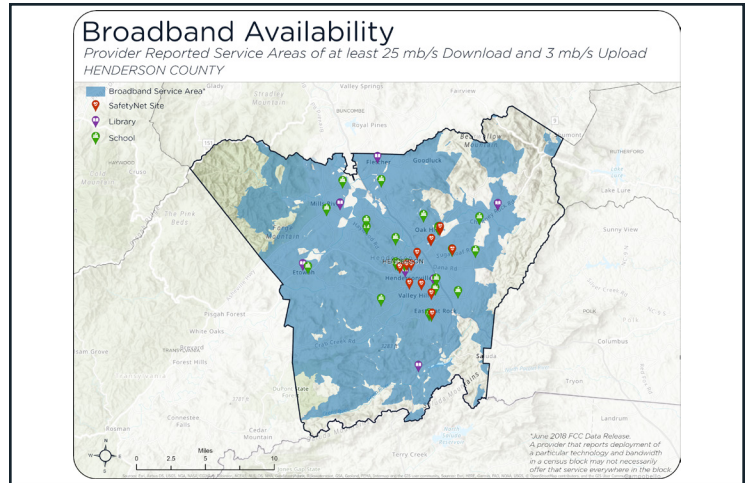
2020 Economic Tier	1
Council of Governments Region	Southwest Commission
Total Population	8607
Total Households (Census)	5,930
Percent of Population age 25 or more with Bachelor's Degree or Higher	14.2
Percent Population in Poverty	19.0
Percent of Unserved Households at 25/3Mbps	53%
Estimated Number of Unserved Households at 25/3Mbps	3,123
Percent of Unserved Census Tracts at 25/3Mbps	72%
Citizen Reported Unserved Households	50
Estimate - Total Households (ACS)	3303
Total Households with Broadband	1619
Total Households without Broadband Subscription	1684
Percent of Households without Broadband Subscription	51.0%
Total Households without Computer	1266
Percent of Households without Computer	38.3%
Broadband Adoption Potential Index Score	7.08
Number of Libraries	1
Number of Schools	3
Number of Safety net sites	2
Cardiovascular disease death rate per 100,000 residents	224.8
Diabetes death rate per 100,000 residents	25.3
Stroke death rate per 100,000 residents	37.1
Mentally unhealthy days in the past 30	4.4
Ratio of residents to dentists	2847:1
Ratio of residents to mental health care providers	1220
Ratio of residents to primary care providers	4279:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	14

Haywood County



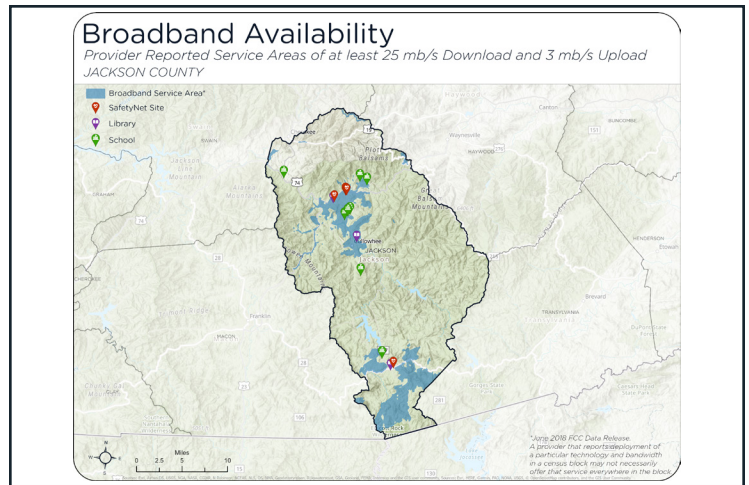
2020 Economic Tier	3
Council of Governments Region	Southwest Commission
Total Population	59854
Total Households (Census)	34,954
Percent of Population age 25 or more with Bachelor's Degree or Higher	24.3
Percent Population in Poverty	16.6
Percent of Unserved Households at 25/3Mbps	21%
Estimated Number of Unserved Households at 25/3Mbps	7,235
Percent of Unserved Census Tracts at 25/3Mbps	17%
Citizen Reported Unserved Households	432
Estimate - Total Households (ACS)	26288
Total Households with Broadband	17790
Total Households without Broadband Subscription	8498
Percent of Households without Broadband Subscription	32.3%
Total Households without Computer	5006
Percent of Households without Computer	19.0%
Broadband Adoption Potential Index Score	34.35
Number of Libraries	6
Number of Schools	15
Number of Safety net sites	4
Cardiovascular disease death rate per 100,000 residents	237.2
Diabetes death rate per 100,000 residents	13.8
Stroke death rate per 100,000 residents	36.2
Mentally unhealthy days in the past 30	4.2
Ratio of residents to dentists	2182:1
Ratio of residents to mental health care providers	262:1
Ratio of residents to primary care providers	1379:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	96

Henderson County



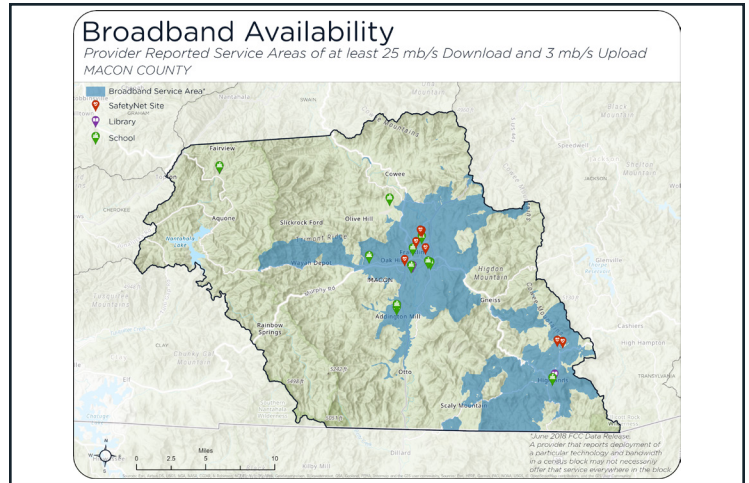
2020 Economic Tier	3
Council of Governments Region	Land of Sky
Total Population	112156
Total Households (Census)	54,710
Percent of Population age 25 or more with Bachelor's Degree or Higher	31.2
Percent Population in Poverty	11.8
Percent of Unserved Households at 25/3Mbps	9%
Estimated Number of Unserved Households at 25/3Mbps	5,084
Percent of Unserved Census Tracts at 25/3Mbps	13%
Citizen Reported Unserved Households	70
Estimate - Total Households (ACS)	47804
Total Households with Broadband	36675
Total Households without Broadband Subscription	11129
Percent of Households without Broadband Subscription	23.3%
Total Households without Computer	7041
Percent of Households without Computer	14.7%
Broadband Adoption Potential Index Score	46.32
Number of Libraries	14
Number of Schools	23
Number of Safety net sites	14
Cardiovascular disease death rate per 100,000 residents	179.5
Diabetes death rate per 100,000 residents	12.5
Stroke death rate per 100,000 residents	34.2
Mentally unhealthy days in the past 30	3.8
Ratio of residents to dentists	1866:1
Ratio of residents to mental health care providers	584:1
Ratio of residents to primary care providers	1120:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	137

Jackson County



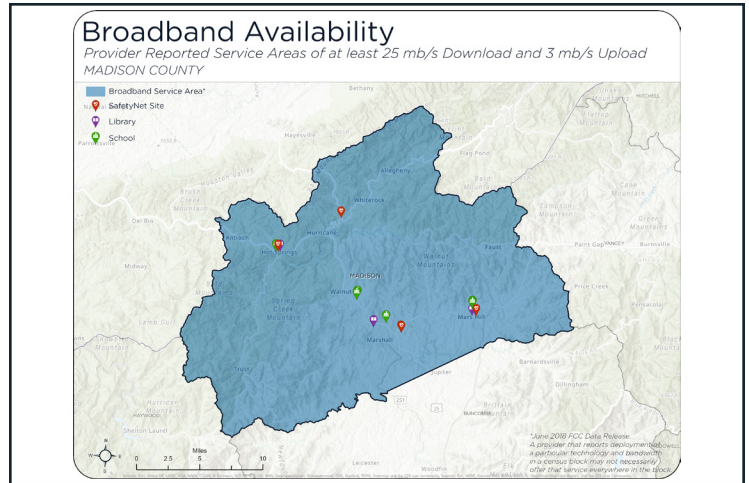
2020 Economic Tier	2
Council of Governments Region	Southwest Commission
Total Population	41725
Total Households (Census)	25,948
Percent of Population age 25 or more with Bachelor's Degree or Higher	30.5
Percent Population in Poverty	21.6
Percent of Unserved Households at 25/3Mbps	73%
Estimated Number of Unserved Households at 25/3Mbps	18,984
Percent of Unserved Census Tracts at 25/3Mbps	61%
Citizen Reported Unserved Households	82
Estimate - Total Households (ACS)	16218
Total Households with Broadband	10515
Total Households without Broadband Subscription	5703
Percent of Households without Broadband Subscription	35.2%
Total Households without Computer	2982
Percent of Households without Computer	18.4%
Broadband Adoption Potential Index Score	46.32
Number of Libraries	4
Number of Schools	8
Number of Safety net sites	5
Cardiovascular disease death rate per 100,000 residents	191.8
Diabetes death rate per 100,000 residents	32.1
Stroke death rate per 100,000 residents	29.2
Mentally unhealthy days in the past 30	4.4
Ratio of residents to dentists	1868:1
Ratio of residents to mental health care providers	222:1
Ratio of residents to primary care providers	1056:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	59

Macon County



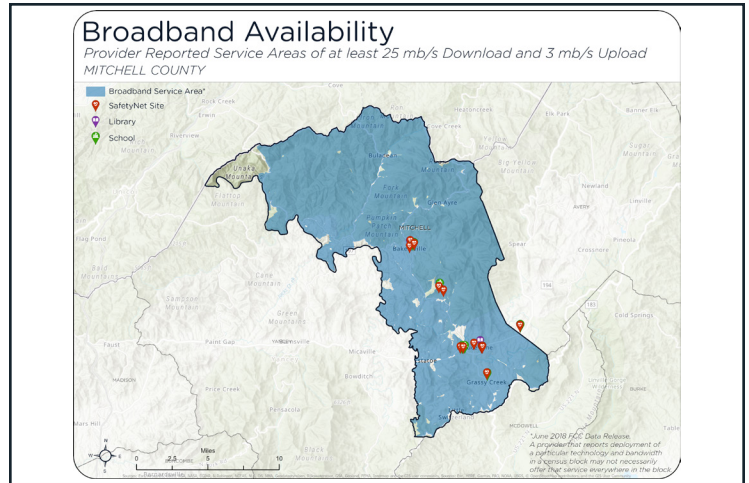
2020 Economic Tier	2
Council of Governments Region	Southwest Commission
Total Population	34160
Total Households (Census)	25,245
Percent of Population age 25 or more with Bachelor's Degree or Higher	22.2
Percent Population in Poverty	17.7
Percent of Unserved Households at 25/3Mbps	44%
Estimated Number of Unserved Households at 25/3Mbps	11,186
Percent of Unserved Census Tracts at 25/3Mbps	38%
Citizen Reported Unserved Households	133
Estimate - Total Households (ACS)	15513
Total Households with Broadband	10507
Total Households without Broadband Subscription	5006
Percent of Households without Broadband Subscription	32.3%
Total Households without Computer	3157
Percent of Households without Computer	20.4%
Broadband Adoption Potential Index Score	24.65
Number of Libraries	3
Number of Schools	11
Number of Safety net sites	7
Cardiovascular disease death rate per 100,000 residents	202.2
Diabetes death rate per 100,000 residents	23.7
Stroke death rate per 100,000 residents	35.3
Mentally unhealthy days in the past 30	4.2
Ratio of residents to dentists	1737:1
Ratio of residents to mental health care providers	482:1
Ratio of residents to primary care providers	1322:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	30

Madison County



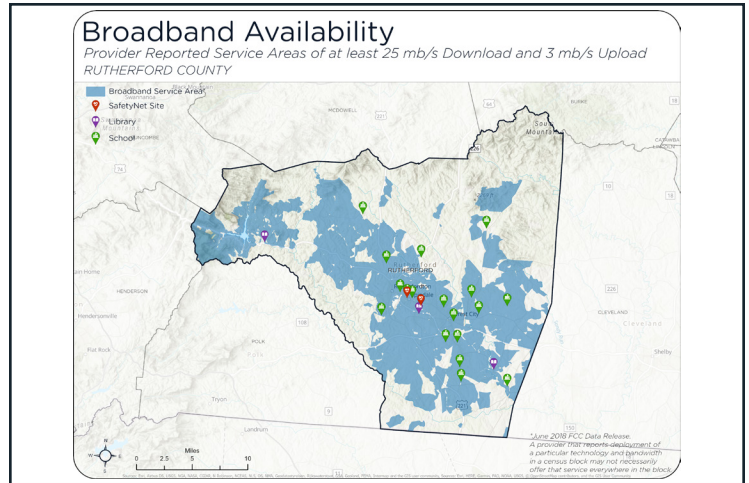
2020 Economic Tier	2
Council of Governments Region	Land of Sky
Total Population	21347
Total Households (Census)	10,608
Percent of Population age 25 or more with Bachelor's Degree or Higher	25.9
Percent Population in Poverty	17.8
Percent of Unserved Households at 25/3Mbps	0%
Estimated Number of Unserved Households at 25/3Mbps	-
Percent of Unserved Census Tracts at 25/3Mbps	0%
Citizen Reported Unserved Households	669
Estimate - Total Households (ACS)	8346
Total Households with Broadband	5590
Total Households without Broadband Subscription	2756
Percent of Households without Broadband Subscription	33.0%
Total Households without Computer	1917
Percent of Households without Computer	23.0%
Broadband Adoption Potential Index Score	39.96
Number of Libraries	8
Number of Schools	6
Number of Safety net sites	5
Cardiovascular disease death rate per 100,000 residents	235.2
Diabetes death rate per 100,000 residents	20.5
Stroke death rate per 100,000 residents	52.7
Mentally unhealthy days in the past 30	4.1
Ratio of residents to dentists	4349:1
Ratio of residents to mental health care providers	640:1
Ratio of residents to primary care providers	2134:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	21

Mitchell County



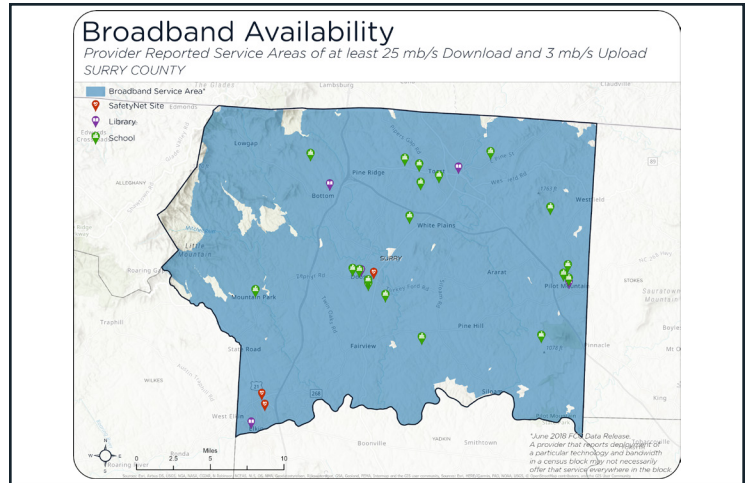
2020 Economic Tier	1
Council of Governments Region	High Country
Total Population	15155
Total Households (Census)	8,713
Percent of Population age 25 or more with Bachelor's Degree or Higher	18.1
Percent Population in Poverty	15.4
Percent of Unserved Households at 25/3Mbps	10%
Estimated Number of Unserved Households at 25/3Mbps	912
Percent of Unserved Census Tracts at 25/3Mbps	29%
Citizen Reported Unserved Households	30
Estimate - Total Households (ACS)	6390
Total Households with Broadband	4000
Total Households without Broadband Subscription	2390
Percent of Households without Broadband Subscription	37.4%
Total Households without Computer	1589
Percent of Households without Computer	24.9%
Broadband Adoption Potential Index Score	19.58
Number of Libraries	3
Number of Schools	7
Number of Safety net sites	14
Cardiovascular disease death rate per 100,000 residents	212.4
Diabetes death rate per 100,000 residents	23.9
Stroke death rate per 100,000 residents	32.6
Mentally unhealthy days in the past 30	4.2
Ratio of residents to dentists	1884:1
Ratio of residents to mental health care providers	1256:1
Ratio of residents to primary care providers	1375:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	30

Rutherford County



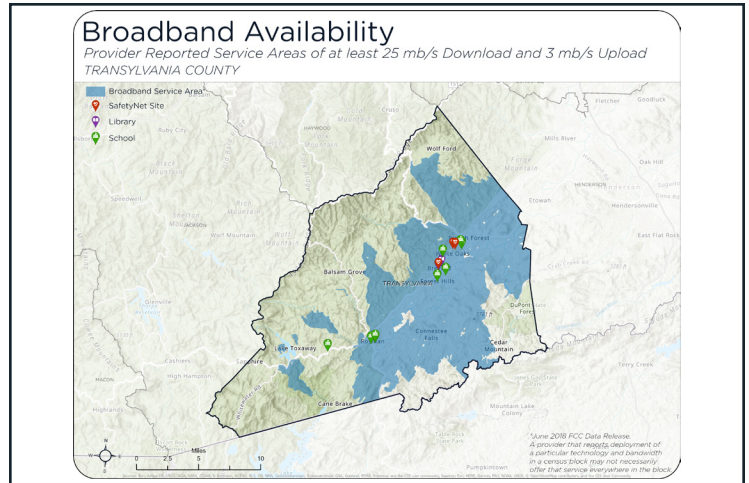
2020 Economic Tier	1
Council of Governments Region	Isothermal
Total Population	66523
Total Households (Census)	33,878
Percent of Population age 25 or more with Bachelor's Degree or Higher	17.3
Percent Population in Poverty	19.6
Percent of Unserved Households at 25/3Mbps	25%
Estimated Number of Unserved Households at 25/3Mbps	8,455
Percent of Unserved Census Tracts at 25/3Mbps	28%
Citizen Reported Unserved Households	1965
Estimate - Total Households (ACS)	26497
Total Households with Broadband	16736
Total Households without Broadband Subscription	9761
Percent of Households without Broadband Subscription	36.8%
Total Households without Computer	6475
Percent of Households without Computer	24.4%
Broadband Adoption Potential Index Score	23.44
Number of Libraries	4
Number of Schools	18
Number of Safety net sites	2
Cardiovascular disease death rate per 100,000 residents	282.4
Diabetes death rate per 100,000 residents	28.6
Stroke death rate per 100,000 residents	59.4
Mentally unhealthy days in the past 30	4.3
Ratio of residents to dentists	4159:1
Ratio of residents to mental health care providers	739:1
Ratio of residents to primary care providers	2013:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	102

Surry County



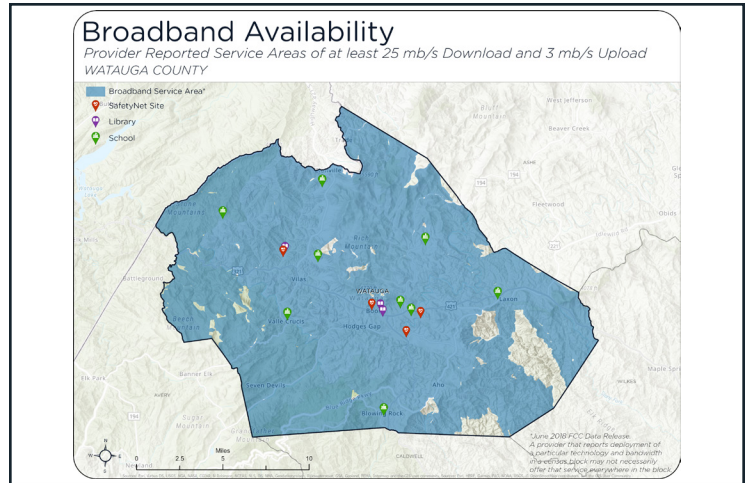
2020 Economic Tier	2
Council of Governments Region	Piedmont Triad
Total Population	72315
Total Households (Census)	33,667
Percent of Population age 25 or more with Bachelor's Degree or Higher	16.5
Percent Population in Poverty	17.6
Percent of Unserved Households at 25/3Mbps	2%
Estimated Number of Unserved Households at 25/3Mbps	533
Percent of Unserved Census Tracts at 25/3Mbps	5%
Citizen Reported Unserved Households	insufficient information
Estimate - Total Households (ACS)	29256
Total Households with Broadband	18212
Total Households without Broadband Subscription	11044
Percent of Households without Broadband Subscription	37.7%
Total Households without Computer	7236
Percent of Households without Computer	24.7%
Broadband Adoption Potential Index Score	26.27
Number of Libraries	6
Number of Schools	19
Number of Safety net sites	3
Cardiovascular disease death rate per 100,000 residents	232.8
Diabetes death rate per 100,000 residents	24.9
Stroke death rate per 100,000 residents	44.2
Mentally unhealthy days in the past 30	4.4
Ratio of residents to dentists	2490:1
Ratio of residents to mental health care providers	976:1
Ratio of residents to primary care providers	1803:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	121

Transylvania County



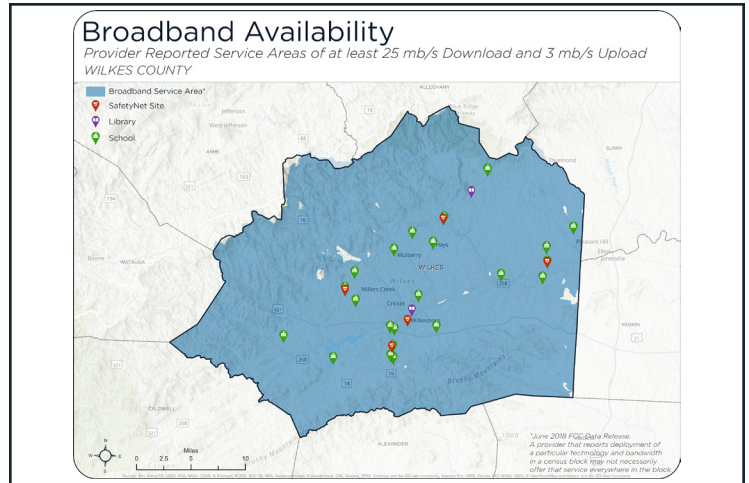
2020 Economic Tier	2
Council of Governments Region	Land of Sky
Total Population	33291
Total Households (Census)	19,163
Percent of Population age 25 or more with Bachelor's Degree or Higher	29.9
Percent Population in Poverty	15.5
Percent of Unserved Households at 25/3Mbps	21%
Estimated Number of Unserved Households at 25/3Mbps	4,064
Percent of Unserved Census Tracts at 25/3Mbps	21%
Citizen Reported Unserved Households	95
Estimate - Total Households (ACS)	14125
Total Households with Broadband	10541
Total Households without Broadband Subscription	3584
Percent of Households without Broadband Subscription	25.4%
Total Households without Computer	1765
Percent of Households without Computer	12.5%
Broadband Adoption Potential Index Score	44.77
Number of Libraries	4
Number of Schools	9
Number of Safety net sites	3
Cardiovascular disease death rate per 100,000 residents	162.1
Diabetes death rate per 100,000 residents	13.6
Stroke death rate per 100,000 residents	32.8
Mentally unhealthy days in the past 30	4.1
Ratio of residents to dentists	2830:1
Ratio of residents to mental health care providers	430
Ratio of residents to primary care providers	1288:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	44

Watauga County



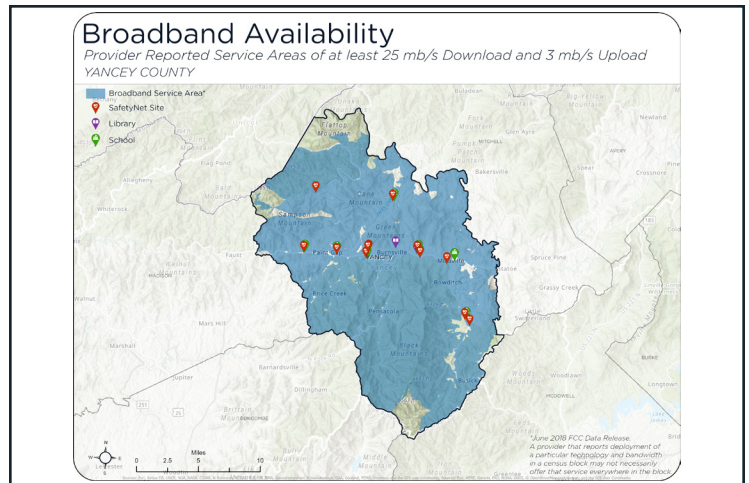
2020 Economic Tier	3
Council of Governments Region	High Country
Total Population	53,421
Total Households (Census)	32,137
Percent of Population age 25 or more with Bachelor's Degree or Higher	41.7
Percent Population in Poverty	28.3
Percent of Unserved Households at 25/3Mbps	3%
Estimated Number of Unserved Households at 25/3Mbps	894
Percent of Unserved Census Tracts at 25/3Mbps	2%
Citizen Reported Unserved Households	162
Estimate - Total Households (ACS)	20,331
Total Households with Broadband	15,996
Total Households without Broadband Subscription	4,335
Percent of Households without Broadband Subscription	21.3%
Total Households without Computer	2497
Percent of Households without Computer	12.3%
Broadband Adoption Potential Index Score	76.05
Number of Libraries	3
Number of Schools	9
Number of Safety net sites	4
Cardiovascular disease death rate per 100,000 residents	162
Diabetes death rate per 100,000 residents	14.9
Stroke death rate per 100,000 residents	30.6
Mentally unhealthy days in the past 30	4.5
Ratio of residents to dentists	1621:1
Ratio of residents to mental health care providers	252:1
Ratio of residents to primary care providers	1315:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	44

Wilkes County



2020 Economic Tier	1
Council of Governments Region	High Country
Total Population	68,525
Total Households (Census)	33,065
Percent of Population age 25 or more with Bachelor's Degree or Higher	15.4
Percent Population in Poverty	20.9
Percent of Unserved Households at 25/3Mbps	1%
Estimated Number of Unserved Households at 25/3Mbps	255
Percent of Unserved Census Tracts at 25/3Mbps	1%
Citizen Reported Unserved Households	insufficient information
Estimate - Total Households (ACS)	27,765
Total Households with Broadband	18,459
Total Households without Broadband Subscription	9,306
Percent of Households without Broadband Subscription	33.5%
Total Households without Computer	6126
Percent of Households without Computer	22.1%
Broadband Adoption Potential Index Score	28.05
Number of Libraries	3
Number of Schools	22
Number of Safety net sites	5
Cardiovascular disease death rate per 100,000 residents	205.8
Diabetes death rate per 100,000 residents	23
Stroke death rate per 100,000 residents	32.1
Mentally unhealthy days in the past 30	4.4
Ratio of residents to dentists	2982:1
Ratio of residents to mental health care providers	562:1
Ratio of residents to primary care providers	2291:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	206

Yancey County



2020 Economic Tier	2
Council of Governments Region	High Country
Total Population	17,605
Total Households (Census)	11,032
Percent of Population age 25 or more with Bachelor's Degree or Higher	19.7
Percent Population in Poverty	19.6
Percent of Unserved Households at 25/3Mbps	11%
Estimated Number of Unserved Households at 25/3Mbps	1,247
Percent of Unserved Census Tracts at 25/3Mbps	31%
Citizen Reported Unserved Households	insufficient information
Estimate - Total Households (ACS)	7,493
Total Households with Broadband	4,425
Total Households without Broadband Subscription	3,068
Percent of Households without Broadband Subscription	40.9%
Total Households without Computer	2,157
Percent of Households without Computer	28.8%
Broadband Adoption Potential Index Score	17.11
Number of Libraries	2
Number of Schools	8
Number of Safety net sites	12
Cardiovascular disease death rate per 100,000 residents	205.6
Diabetes death rate per 100,000 residents	21.9
Stroke death rate per 100,000 residents	32.2
Mentally unhealthy days in the past 30	4.4
Ratio of residents to dentists	3549:1
Ratio of residents to mental health care providers	522:1
Ratio of residents to primary care providers	1360:1
Sum of Unintentional Opioid Deaths over 10 years (2009-18)	38

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The Southwest Commission

The Land of Sky Regional Council of Governments

The High Country Council of Governments

About the Authors

The Broadband Infrastructure Office is a division of the North Carolina Department of Information Technology. The office administers the GREAT Grant and provides policy and technical guidance to local and state leaders seeking to expand and enhance affordable, high-speed internet access in their communities. The office understands that broadband can enhance a community's viability and livelihood by creating income opportunities, facilitating greater civic and cultural participation, expanding educational opportunities, and providing access to health care providers and other essential services.

The Office of Rural Health (ORH) is a division of the North Carolina Department of Health and Human Services. The office assists underserved communities by improving access, quality and cost-effectiveness of health care. In state fiscal year 2018, the office spent \$31.6 million from state, federal, and philanthropic sources. ORH administers over 300 contracts designed to expand access to high quality health care for rural and underserved populations allowing the office to return over 88% of its budget directly to NC communities.

In addition, ORH provides in-depth technical assistance to North Carolina's Safety Net system. In 1973, the North Carolina ORH became the first state office in the nation created to focus on the needs of rural and underserved communities. While we do not provide direct care, our programs support numerous health care safety net organizations throughout North Carolina.

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- xxxix. For more information on the Indices and their methodology visit: <https://www.ncbroadband.gov/indices/>
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