Spring 5-4-2021

The Need for Speed: Broadband Access as a Social Determinant of Health

Mwoddah Habib

ABSTRACT

THE NEED FOR SPEED:

BROADBAND ACCESS AS A SOCIAL DETERMINANT OF HEALTH

By

MWODDAH HABIB

MAY 4, 2021

The COVID-19 pandemic amplified existing socioeconomic inequities in the United States while often requiring access to broadband in all aspects of life. Currently, there are significant broadband coverage gaps in the United States, widening a digital divide and leaving many individuals at a disadvantage during a critical public health crisis and beyond. Given its widespread use, broadband access intersects with all the social determinants of health (SDOH), as either a bridge or a barrier. Thereby, barriers to broadband access are a major factor contributing to socioeconomic inequities. The goal of this capstone is to discuss the link between broadband access and SDOH, policies to increase broadband coverage, and the need to add broadband access as an all-encompassing element in the SDOH model.

Keywords: COVID-19, pandemic, broadband access, social determinants of health, inequities, health disparities

THE NEED FOR SPEED:

BROADBAND ACCESS AS A SOCIAL DETERMINANT OF HEALTH

by

MWODDAH HABIB

B.S., AGNES SCOTT COLLEGE

A Capstone Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment
of the
Requirements for the Degree

MASTER OF PUBLIC HEALTH

ATLANTA, GEORGIA 30303

APPROVAL PAGE

THE NEED FOR SPEED:

BROADBAND ACCESS AS A SOCIAL DETERMINANT OF HEALTH

By

MWODDAH HABIB

Approved:

Harry J Heiman. MD, MPH, Committee Chair

_____

Antonio Neri, MD, MPH, FACPM, CAPT USPHS Committee Member

5/4/2021

Date

ACKNOWLEDGMENTS

First, I would like to thank my capstone committee chair, Dr. Harry Heiman, and committee member, Dr. Antonio Neri, for offering their time, guidance, and knowledge throughout the preparation and review of this document. I am forever grateful for your support.

Second, I would like to thank my loving, caring parents for their unconditional love and unwavering support. Words cannot express my gratitude, respect, and love for you. This is your degree just as much as it is mine. The best is yet to come, insha'Allah.

Finally, to all my friends and colleagues, thank you for your patience, understanding, and support. I have enjoyed my journey through this program with all its ups and downs, and I have you to thank for that. I look forward to reconnecting and working with you all.

Cheers.

AUTHOR'S STATEMENT PAGE

In presenting this capstone as a partial fulfillment of the requirements for an advanced degree from Georgia State University, I agree that the Library of the University shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote from, to copy from, or to publish this capstone may be granted by the author or, in his/her absence, by the professor under whose direction it was written, or in his/her absence, by the Associate Dean, School of Public Health. Such quoting, copying, or publishing must be solely for scholarly purposes and will not involve potential financial gain. It is understood that any copying from or publication of this capstone which involves potential financial gain will not be allowed without written permission of the author.

Mwoddah Habib

Signature of Author

TABLE OF CONTENTS

Introduction 8

COVID-19 Pandemic and Broadband Access 11

Broadband Coverage Gaps 16

Broadband As A Social Determinant of Health 25

Addressing Broadband Access 31

Discussion & Recommendations 39

Conclusion 43

LIST OF FIGURES

Figure 1 *Average Subscription Rate for Urban/Rural Counties by Median Household Income*

Figure 2 *Nationwide Residents Without Broadband Access by Household Median Income*

Figure 3 *Digital Divide: Percentage of Households by Broadband Internet Subscription, Computer Type, and Race and Hispanic Origin*

Figure 4 *Social Determinants of Health (SDOH) Model*

Figure 5 *Revised Model of the Social Determinants of Health (SDOH)*

I. INTRODUCTION

On March 11, 2020, the World Health Organization (WHO) declared the novel coronavirus (SARS-CoV-2), causing COVID-19, a global pandemic (Cucinotta, 2020). Governments worked to control the disease's transmission through lockdown policies, promoting social distancing, mask-wearing and hygiene measures, while at the same time working to ramp up COVID-19 testing as well as the public health case identification and contact tracing infrastructure and workforce. The pandemic's dramatic impact was seen not only in the increasing numbers of cases, hospitalization, and deaths, but also in the visible and invisible daily social and economic impacts on communities and individuals, particularly those most vulnerable. Predictably, the pandemic amplified existing social, racial, economic, and health inequities. Though referred to as the "great equalizer" colloquially, the virus disproportionately impacted communities already experiencing social and economic disadvantages. As businesses and schools shutdown, broadband reliance and usage soared, and it became a critical link to jobs, schools, retail, and health care.

In the United States, as lockdowns were enforced and human activity decreased (e.g., driving to work, attending parties or concerts, participating in sports and recreational activities, etc.), so did the demand for products and items that are normally consumed. This caused different sectors such as agriculture, tourism, petroleum and oil, manufacturing, and others to experience a decrease in demand, leading to employee layoffs (Nicola, et al., 2020). Economically, the impact was first visible in the number of people who lost their employment and income, with more than 42 million Americans filing for unemployment in 2020 due to the COVID-19 pandemic (Benda, Ancker, Veinot, & Sieck, 2020). This was an unprecedented job loss and unemployment rate increase that "rose higher in three months of COVID-19 than it did in

two years of the Great Recession" (Kochhar, 2020). The combined public health and economic impacts were so great that the Centers for Disease Control and Prevention (CDC) issued a moratorium prohibiting evictions and utility shut offs to support shelter in place and social distancing mandates (Centers for Disease Control and Prevention, 2021). However, essential services, which are critical services that must be continued during emergencies, such as hospitals, food manufacturing plants, and utilities, remained functioning (Torpey, 2020). Since the beginning of the pandemic, essential workers have been on the frontlines working to ensure essential services are maintained and the needs of the American people are met (Kearney & Muñana, 2020). Essential workers are still bearing the biggest burden of disease exposure due to the in-person nature of their work and despite most workplaces implementing measures to protect their workers (Kearney & Muñana, 2020). According to the Kaiser Family Foundation Health Tracking Poll, one-third (34%) of U.S. adult workers were considered essential workers at the onset of the pandemic (Kearney & Muñana, 2020). Of employed Black, non-Hispanic workers, 15% were more likely to be essential versus 5% non-essential (Kearney & Muñana, 2020). Similarly, 16% of employed Hispanic individuals were more likely to be essential versus 11%. Both Black and Hispanic essential workers (31%) were more likely to have a household income of less than $40,000 (Kearney & Muñana, 2020). Being on the frontlines and maintaining our essential services puts them at a greater risk; thus, contributing to the disproportionately higher high case, hospitalization, and death rates among these communities (CDC, 2021; Price-Haygood, Burton, Fort, & Seoane, 2020).

However, for other Americans, work simply shifted remotely as they were able to use existing home internet and hardware like laptops or desktops. According to a Pew Research

Center study, 71% of workers were doing their jobs from home all or most of the time (Parker, Horowitz, & Minkin, 2020). As reflected in the earlier numbers, this is not the case for everyone, as lower-income workers were less likely to have the option of teleworking—76% of low-income workers compared to 44% of upper-income workers have job responsibilities that cannot be done from home (Parker, Horowitz, & Minkin, 2020). Low-income individuals not working from home were also the most concerned with exposure to COVID-19 (61%) compared to individuals with upper-income (48%) (Parker, Horowitz, & Minkin, 2020). Their concerns were not unfounded as low-income workers are disproportionately people of color, and their communities suffered the highest mortality rates compared to non-Hispanic white communities (CDC, 2021; Price-Haygood, Burton, Fort, & Seoane, 2020). Preliminary data indicate the disproportionate COVID-19 related death rate, which is age-standardized, for Hispanic group as 38% (a group compromising 19% of U.S. population) and 22% for non-Hispanic (a group compromising 12% of U.S. population) versus 32% for non-Hispanic White (a group compromising 59% of the U.S. population) (Centers for Disease Control and Prevention, 2020).

In a 2020 survey, the Pew Research Center found that 81% of adults who could work from home indicated using video calling or online conferencing services such as Zoom or WebEx, modalities that require broadband access, at least some of the time (Parker, Horowitz, & Minkin, 2020). It also reported that 26% of surveyed individuals had the technology or equipment needed to complete job responsibilities from home while concurrently in this sample, 74% reported that they did not (Parker, Horowitz, & Minkin, 2020). This shows the conflicting reality between the increased usage of conferencing technology with the need to access broadband equipment and the overall need for broadband connection--needing both to

complete job responsibilities but only having access to one or neither. It is important to keep in mind that those who can work remotely are still dependent on whether they have broadband access, tools, and home workspaces to complete their job responsibilities. Studies such as the one by the Pew Research Center estimate that only three-quarters of Americans have access to broadband while the other quarter does not, particularly racial minorities, older adults, rural residents, people with low-education, and low-income (Pew Research Center, 2021). This highlights the strong intersections between broadband access and long-standing socioeconomic inequities in the U.S.

In summary, the pandemic highlighted and amplified existing inequities in the U.S. and exacerbated the need for broadband access and usage. As it stands, there were significant broadband coverage gaps, widening a digital divide and leaving many individuals at a disadvantage during a critical public health crisis. Broadband access enables access to social determinants of health, making it crucial for health and life opportunities. This paper examines the overall roles broadband access plays and its impact on health opportunities and inequities. In addition, it will evaluate policies implemented to improve broadband access and the relationship of broadband access to the broader Social Determinants of Health (SDOH) framework.

II. COVID-19 PANDEMIC AND BROADBAND ACCESS

Broadband access became a critical factor for both educational and health care access during the COVID-19 pandemic. First, partial or complete school closures and the transition to online teaching resulted in many challenges for both students and teachers, primarily related to broadband access and associated issues like lack of technological devices or digital incompetence (Lieberman, 2021). This was especially true for low-income students (Lieberman,

2021). At the peak of school closures in the U.S., 55.1 million students from 124,000 private and public schools were affected (Education Week, 2020). Many were not able to successfully navigate online learning, further widening existing educational gaps similar to evidence noted at the international level (UNESCO, 2021). Lack of internet access had already been known to cause a "homework gap," in which students are unable to complete their school assignments. The Pew Research Center reported in 2018 based on an analysis of U.S. Census Data that 15% of all school-age children (ages 6-17) live in households without high-speed internet (Anderson & Perrin, 2018). Low-income Black (41%) and Hispanic (38%) households with school-age children (income of $30,000 or below) are more likely to not have home internet (Anderson & Perrin, 2018).

Overall, in this sample of U.S. teen students, 35% rely on a cellphone (35%) to complete their homework, 17% reported being unable to complete homework due to lack of a reliable computer or internet connection, and 12% reported having to use public Wi-Fi to do homework because they do not have home broadband connection (Anderson & Perrin, 2018). This disparity is especially pronounced for teens from Black (25%) and Hispanic (17%) households, who are less likely to have broadband at home and struggle to complete their schoolwork. As such, the socioeconomic factors impacted the barriers faced by different groups, especially Black and Hispanic students from low-income families, that had the highest rates of homework incompletion (Anderson & Perrin, 2018).

The ripple effect of the education gap places families and individuals further behind in the wealth gap, limiting their opportunities while significantly decreasing their ability to contribute to the country's economy. Consequently, the long-term effects of experiencing such

educational gaps due to lack of access to broadband are profound. For example, in the United States, it was estimated that the economic cost of a nationwide school closure for 12 weeks is 1% of the U.S. GDP (Lempel, Hammond, & Epstein, 2009). Studies are yet to show the impact of the current school closures on the U.S. GDP, considering the closures lasted for far longer than 12 weeks. But there is existing evidence that students who do not have access to home computers are less likely to graduate from high school when compared with students who did have computer access by 6-8% higher probability (Fairlie, Beltran, & Das, 2010). In addition, school closures caused teleworking parents to have difficulty completing their work while tending to their children and their needs now that they were learning from home (Parker, Horowitz, & Minkin, 2020). All of this demonstrates how broadband access is highly significant in relation to education and work during the pandemic, and the way it amplified existing barriers associated with education.

Because of the social distancing and lockdown policies mentioned earlier, many health services including mental health services, transferred from in-person to virtual interactions. Care continuity, especially during a pandemic, is highly important given that health conditions and chronic illnesses require constant management. During the last week of March 2020, telehealth services among four major telehealth providers increased by 154%, compared to the same period of 2019 (Koonin, et al., 2020). The estimates of the increase in telehealth usage vary substantially depending on the dataset used, but it ranges from 154% among the four major service providers to 4,081% among privately owned insured patients (Whaley, Pera, & Cantor, 2020). Though, these visits reflect an array of emergency policies that improved telehealth accessibility, like authorization for providers to offer telehealth services and reducing

or waiving cost-sharing for patients, it also shows the potential of telehealth in increasing overall healthcare access (Koonin, et al., 2020). However, limitations remain for utilizing telehealth, most importantly lack of access to broadband and technological devices (e.g., smartphone, tablet, computer) that are needed for a telehealth visit (Centers for Disease Control and Prevention, 2020). Improved access to telehealth services could have helped to further mitigate the pandemic's impact, as people struggled to mentally and emotionally cope. In June 2020, 40% of American adults reported struggling with mental health or substance use problems, a significant increase from 2019 (Czeisler, et al., 2020). Black and Hispanic individuals were more significantly impacted by COVID-19-related trauma/stress-related symptoms, at 30.4% and 35.1%, respectively, compared to White individuals (23.3%), who were also significantly impacted (Czeisler, et al., 2020). Similar patterns were seen in other aspects of mental health, which were more evident among Hispanic and Black individuals, essential workers, and unpaid caregivers (Czeisler, et al., 2020). Predictably, many of the groups experiencing more adverse mental health effects of the pandemic, were the same groups that were more likely to be without broadband access, and more likely to experience barriers to telehealth services.

The COVID-19 public health crisis highlighted many socioeconomic inequities of our society while driving us further into the digital realm. Low-income communities, communities of color, those with lower education levels, and those living in rural regions have been disproportionately impacted by the pandemic (i.e., incidence rates, mortality rates, hospitalization rates, and other related health outcomes) (CDC, 2021; Price-Haygood, Burton, Fort, & Seoane, 2020). These same groups also experience lack of access to broadband, which

refers to high-speed internet that is uninterrupted and faster than dial-up internet access. Broadband is often used interchangeably with internet, but broadband includes several high-speed internet transmission technologies such as digital subscriber line (DSL), cable modem, fiber, wireless, satellite, and broadband over powerlines (BPL) (Federal Communications Commission, 2014). There is significant evidence in the scientific literature that there are gaps in the availability and affordability of broadband in many regions in the U.S., resulting in broadband inequities associated with race, income, residence/location, and employment (Grubesic, Helderop, & Alizadeh, 2018) (Prieger & Hu, 2008). This is especially true for highly populated metropolitan cities that have broadband access but are underserved with regards to affordability of broadband service packages and speed (Grubesic, Helderop, & Alizadeh, 2018; Prieger & Hu, 2008).

Since 2000, the United States has had a significant increase in the use of broadband, in work and living spaces (Pew Research Center, 2021). Since the start of the COVID-19 pandemic, there has been an increased reliance on technology and high-speed internet to complete the most mundane tasks (e.g., grocery shopping, food delivery, etc.) as well as the most significant responsibilities (e.g., education, work, etc.) (UNCTAD, 2020; Koeze & Popper, 2020). A growing consensus among experts from the fields of technology, communications, and social change is that our “new normal” will rely much more heavily on technology and broadband (Anderson, Rainie, & Vogels, 2021) with both negative and positive impacts. It is expected to worsen economic inequality, as highly connected individuals are able to get ahead in comparison to those without it (Anderson, Rainie, & Vogels, 2021). At the same time, experts think the new era of digital dependence could spark social and racial justice reforms, enhance quality of life,

and enable old systems and structures to adapt and change technologically (Anderson, Rainie, & Vogels, 2021). Broadband access can be either a bridge or a barrier to the social determinants of health, with both education and health services serving as examples. The COVID-19 pandemic highlighted the deleterious social and economic inequities existing in access to broadband; however, it also offers a compelling opportunity to view the impact of such inequities with a holistic lens, offering the opportunity to address them.

III. BROADBAND COVERAGE GAPS

Broadband can be defined in a number of ways. The Federal Communications Commission (FCC) defines broadband connections as having the ability to download at least 25 megabits per second (Mbps) and upload at a minimum speed of 3 Mbps (Bauerly, McCord, Hulkower, & Pepin, 2019; Grubesic, Helderop, & Alizadeh, 2018). Broadband includes all of the different technological devices providing high-speed internet connections (Bauerly, McCord, Hulkower, & Pepin, 2019; Grubesic, Helderop, & Alizadeh, 2018). Picot and Wernick (2007), however, argue that defining broadband based only on bandwidth is insufficient, and it should be defined as "enabling fast and uninterrupted access to manifold services using different platforms and end-user devices." The defined speed is an essential factor when discussing broadband access because it sets limitations on the ability to access platforms such as video conferencing and complete tasks online essential to work, school, and other aspects of life. The standards set by the FCC are what broadband companies use and follow at a minimum, with higher speed subscriptions plans being more expensive. In many low-income and rural communities, only minimum speeds are available, leaving many families with slow internet speeds and low data capacity that expire quickly, causing constant interruptions (Holmes, Bell Fox, Wieder, & Zubak-Skees, 2016). In these communities, companies do not perceive the same opportunities for

return on investment from providing higher speeds. Therefore, these communities not only have to contend with barriers to access but also the quality of service to meet their needs in an increasingly digital society. In addition, companies such as Comcast do not connect households that are more than 150 feet away from main roads, leaving many customers in rural regions disconnected from the internet (Holmes, Bell Fox, Wieder, & Zubak-Skees, 2016).

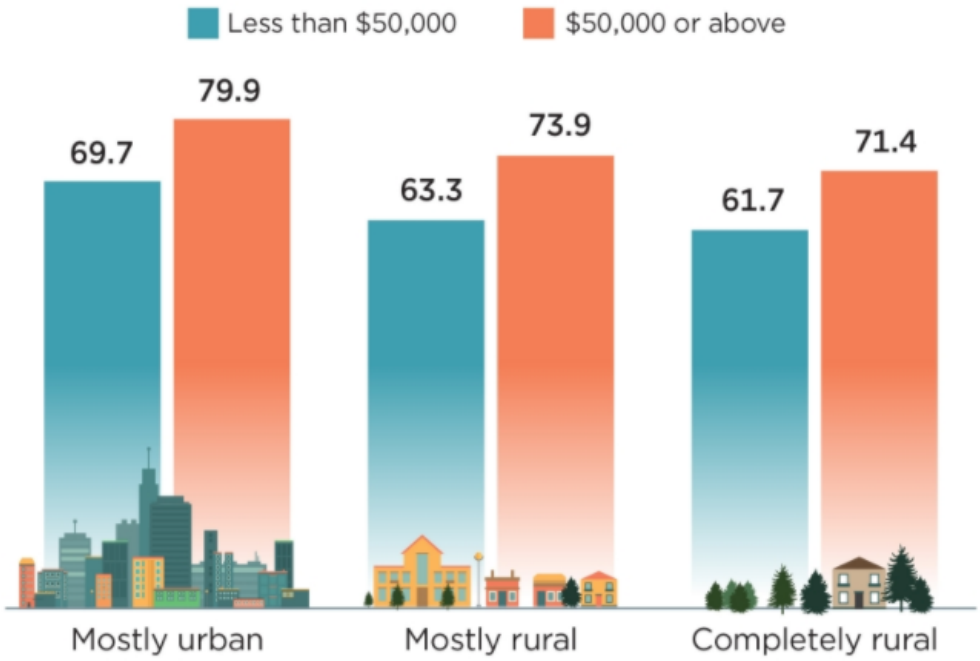
The United States is currently experiencing a significant digital divide, in which socioeconomic factors are powerful predictors of broadband access (Flamm & Chaudhuri, 2007). Research shows that the digital divide correlates strongly with other social determinants of health (SDOH)—the social, economic, political, physical conditions in which people live that affect health—and that low-income, poorly-educated, and racial and ethnic minority communities tend to be digitally excluded (Flamm & Chaudhuri, 2007). Approximately 24 million Americans reside in areas known as “digital deserts,” without broadband access. This includes 19 million Americans living in rural areas and 1.4 million Americans living on tribal lands (Bauerly, McCord, Hulkower, & Pepin, 2019). The Bureau of Indian Affairs (BIA) reports, based on the data from the FCC, that 34% of Native American who reside on rural tribal lands lack access to “sufficient broadband capabilities” (BIA, 2021). Though, data from the FCC is considered highly inaccurate. As will be further discussed in the next section, an independent study found that data shared by the FCC are underestimates and estimated the number of disconnected Americans to be 42 million (Busby & Tanberk, 2021).

Furthermore, it is estimated that one in four Americans do not have access to broadband or devices needed to engage in video calls (Benda, Ancker, Veinot, & Sieck, 2020). According to the Center for Public Integrity, 11.9% of Americans whose household median income is below

$34,783 live without broadband access compared to 2.6% of those with household incomes greater than $80,694 (Zubak-Skees & Wieder, 2016). Additionally, broadband and smartphone broadband access differ based on age, gender, race/ethnicity, disability status, income, and location. For example, a 2019 study by the Pew Research Center reported that 83% of adults in urban areas, 75% of adults in suburban areas, and 71% of adults in rural areas have access to smartphones. The same study showed that 75% of adults in urban areas, 79% of adults in suburban areas, and 63% of adults in rural areas have access to home broadband. (Pew Research Center, 2019). Smartphones are an important consideration to keep in mind because individuals without access to broadband often use their cellphones instead, such as students using cellphones to complete homework assignments (Anderson & Perrin, 2018).

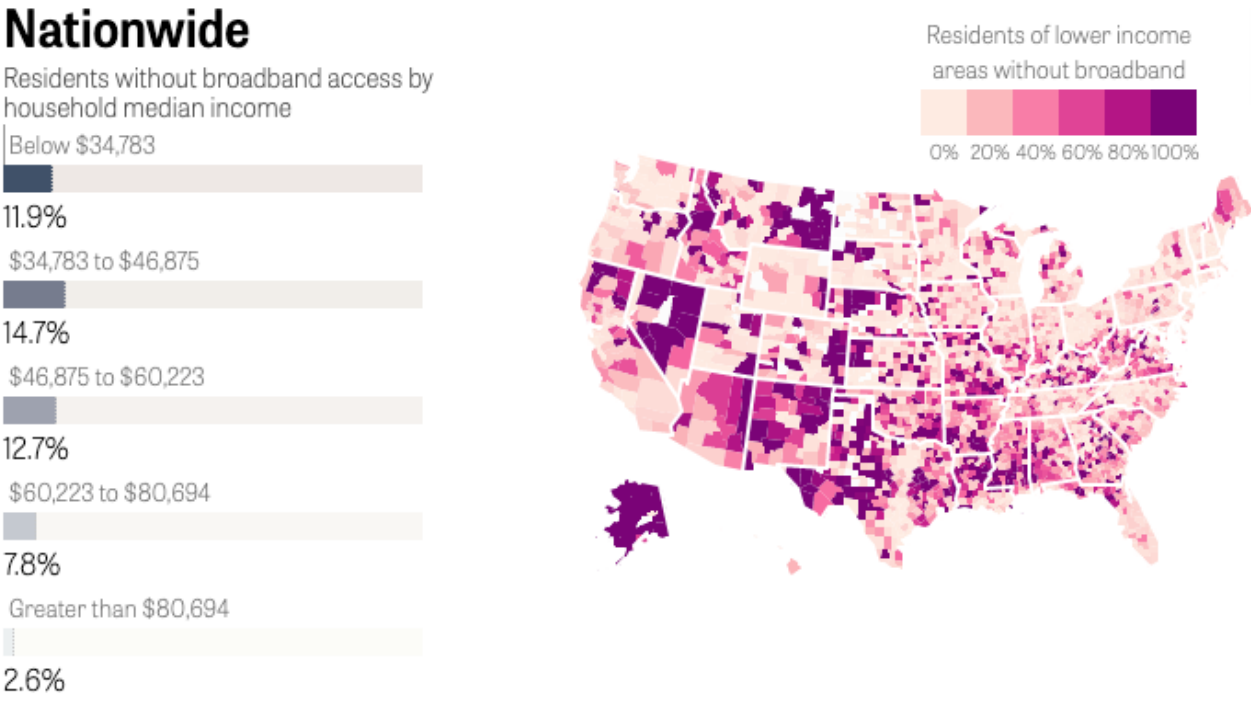
Recent data from the U.S. Census Bureau (2018) illustrates the stark differences in broadband access based on both income and residence location (Figure 1). 30.3% of households with incomes less than $50,000 are not subscribed to a broadband connection in urban settings, compared to 38.3% in rural regions of the country (US Census Bureau, 2018). When compared to urban households earning more than $50,000 per year, 20.1% of those in urban settings experience a lack of broadband access compared to 28.6% in rural areas (US Census Bureau, 2018). These data illustrate the current digital inequity in the U.S., one that is so large, long lasting, and multifaceted that the previous General Counsel to the FCC, Jon Sallet, is calling it the “digital chasm” (Wheeler, 2020).

Figure 1: ***Average Subscription Rate for Urban/Rural Counties by Median Household Income (in percent)***



(US Census Bureau, 2018)

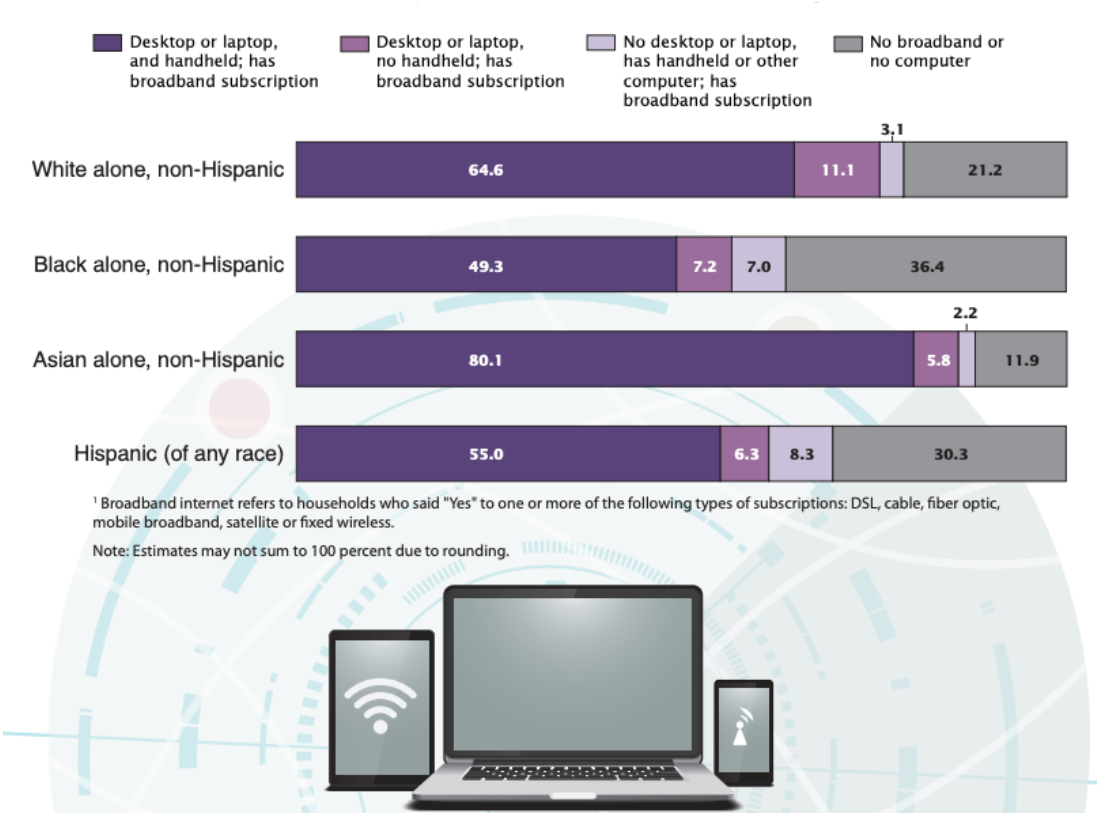
Figure 2: ***Nationwide Residents Without Broadband Access by Household Median Income***



(Zubak-Skees, C., & Wieder, B., 2016)

As previously noted, the digital divide is also visible between different racial and ethnic groups as well as different geographic regions. The United States Census Bureau's 2017 American Community Survey showed significant racial differences in the percentage of households with broadband subscription (Figure 3, grey bars). More than 30% of Hispanic and Black households do not have a computer or broadband subscription compared to 21% of White households and 11.9% of Asian households (US Census Bureau, 2017). Unfortunately, this is not a new trend and rather has been an ongoing trend. Over the past two decades, the Pew Research Center has been tracking internet usage for demographic indicators such as age, race, income, and education. The data collected reflects a similar trend: Hispanic and Black adults in the U.S. consistently use the internet less than White adults. In 2000, White persons used the internet on average by 53% whereas Black persons were at 38% but there was no data gathered for Hispanic groups. In 2010, White individuals using the internet increased to 78% and Black individuals increased to 68% while Hispanic individuals were first tracked in the data starting at 71%. By 2018, the differences between the groups decreased, yet remained: White (92%), Black (85%), and Hispanic (86%) (Pew Research Center, 2019). Similar trends were exhibited between the three racial groups for adopting home broadband subscriptions with White households in 2019 at 79% while Black households at 66% and Hispanic households at 61% (Pew Research Center, 2019). These data illustrate the continuing digital divide experienced by communities of color in the U.S., placing them at a disadvantage for work and life opportunities. These trends will continue unless access to broadband is addressed using a comprehensive approach to address these inequities.

Figure 3: ***The Digital Divide: Percentage of Households by Broadband Internet Subscription, Computer Type, and Race and Hispanic Origin***



(US Census Bureau, 2017)

A. Causes of coverage gaps

The causes of broadband coverage gaps include limited or inaccurate broadband data, outdated broadband infrastructure, and federal or state preemption laws or policies. Telecommunication companies resist providing information on service footprints, pricing, quality of service, and expansion plans for fears of losing competitive advantage or experience security threats (Grubesic, Helderop, & Alizadeh, 2018). As a result, they have failed to share accurate information with federal, state, and local authorities that are responsible for monitoring, evaluating, and further developing broadband infrastructure (Grubesic, Helderop,

& Alizadeh, 2018). Even though broadband providers are required to file reports indicating access to high-speed service at the census block-level (Federal Communications Commission, 2021), it is often inaccurate (Grubesic, Helderop, & Alizadeh, 2018). Thus, the current broadband mapping tools and broadband data offered by the FCC, including the National Broadband Map, lacks accuracy for pinpointing specific areas needing broadband. While the FCC's 2020 Broadband Development Report stated that nearly 18 million Americans are without broadband access, an independent review found that the agency underreported unserved Americans and estimated the number to be 42 million (Busby & Tanberk, 2021). These challenges limit our ability to investigate and ensure equitable access.

Current broadband infrastructure is also struggling to meet the increasing demand, especially during the COVID-19 pandemic. During the first stages of the pandemic's shelter-in-place policies and the surge of demand for broadband, the data demand peak under normal circumstances became the new norm (Levin, 2020). In March 2020, after the U.S. declared a State of Emergency, there was 20% more traffic reported by the U.S. data centers of Cloudflare, a cloud-based networking and cybersecurity company that tracks worldwide data usage (Poinsignon, 2020). While companies state that their networks are capable of handling surges, many experts disagree and recommend enhancing the current infrastructure (Reardon, 2020).

Currently, Americans fund wired and wireless phone infrastructure through monthly fees, which are supposed to also fund broadband expansion and adoption (Wheeler, 2020). Monthly fees are 21.2% of interstate and international call charges; but revenues from these fees are declining because demand has been declining for telephone services (Wheeler, 2020). This highlights the importance of updating and implementing broadband policies specific to current

needs and future growth rather than relying on revenue from declining telephone service plans (Wheeler, 2020).

Some cities without broadband access are attempting to build and increase their broadband access, however, state laws are preempting local expansion efforts and hinder the progress of broadband infrastructure (Bauerly, McCord, Hulkower, & Pepin, 2019). In many other cities and towns, the cable companies have franchise agreements, including provisions that the company must provide service if the construction costs per housing unit do not exceed $1,000 (Brodkin, 2017). If the costs exceed $1,000, then the homeowner would have to pay the additional costs to establish a cable line to their home (Brodkin, 2017). These barriers preclude communities from making decisions regarding their broadband service, especially in an environment that lacks provider competition (Community Broadband Networks, 2020). Presently, cable networks are increasing their capacity, but it is estimated that the future of broadband services will be limited to choices between a slow DSL, wireless options, and a moderately faster single cable connection (Community Broadband Networks, 2020).

States differ on their expansion plans, how they are executed, and what they include. Some states provide a generalist overview of broadband while others, such as Wisconsin, Georgia, and Tennessee, provide specifics for accomplishing broadband plans (de Wit, 2019). They also differ in their definitions of broadband services, and these definitions are important and tied to broadband deployment and expansion efforts as service providers meeting the minimum broadband defined standards and related incentives like tax cuts (de Wit, 2019). For example, Iowa uses the FCC broadband definition of 25 Mbps download and 3 Mbps upload (25/3) and

describes communities without access to the 25/3 ratio as “unserved” while Missouri defined communities without the 25/3 ratio as “underserved” (de Wit, 2019).

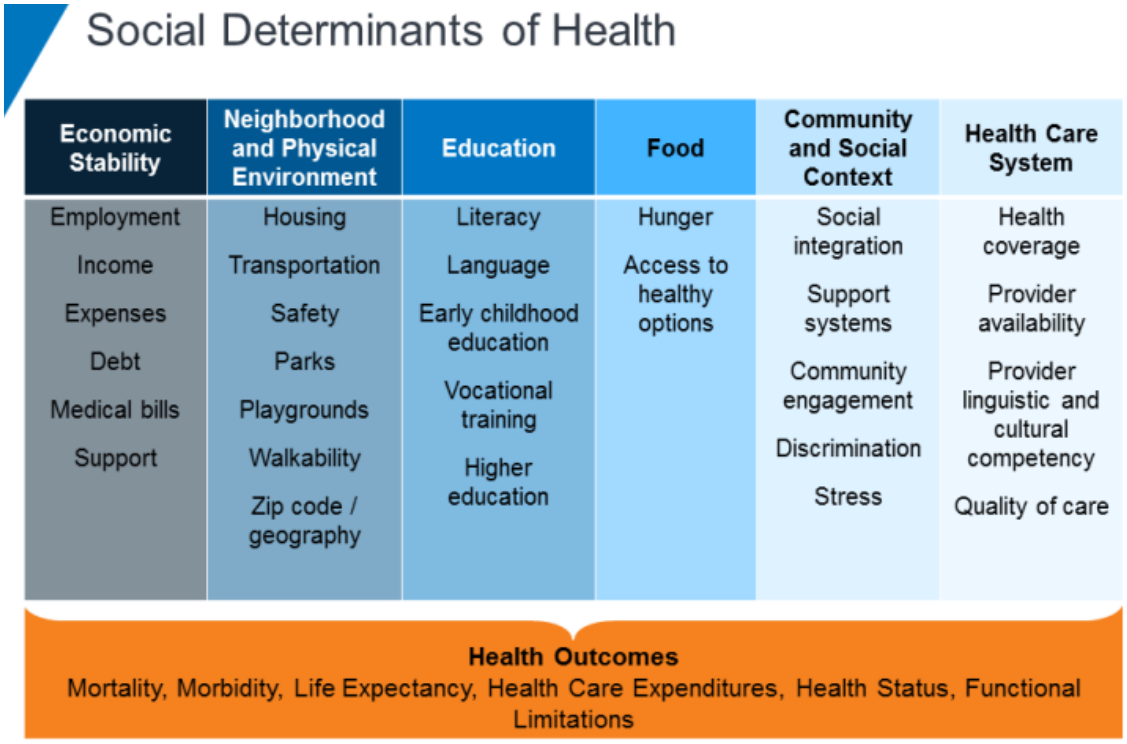
In summary, barriers to broadband access include the lack of clearly defined broadband definition at the state level for implementation, a lack of accurate and specific broadband data to precisely identify unserved communities, infrastructure and funding practices, and preemption policies that prevent local communities from being involved in the process of broadband adoption.

IV. BROADBAND AS A SOCIAL DETERMINANT OF HEALTH

Social determinants of health (SDOH) are “the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life” (WHO, n.d.). As reflected in Figure 4 below, the SDOH framework includes economic stability, neighborhood and physical environment, education, food, community and social context, and the health care system (Artiga & Hinton, 2018). Previous strategies and efforts put forth by experts focused on health care access to reduce health inequities (Artiga & Hinton, 2018); however, the SDOH framework recognizes the need to address the broader social, economic, and environmental drivers of life and health inequities to achieve health equity, which is “the absence of unfair, avoidable and remediable differences in health status among groups of people” (WHO, 2021).

There have been several initiatives to address SDOH through health in all policies--incorporating health into the policy decision-making process in non-health sectors, implementing cross-sector strategies to improve health, and other strategies implemented through the health care system (Artiga & Hinton, 2018). Like these strategies, it is crucial to consider the ways that broadband access interplays with the SDOH framework.

Figure 4: Social Determinants of Health (SDOH) Model



(Artiga, S., & Hinton, E., 2018)

Though broadband is not included in this Social Determinants of Health model, it touches and serves as a critical access bridge to almost all areas listed, from economic factors like employment to access to health care. This is because broadband technologies have permeated throughout the fabric of society, particularly as seen during the pandemic as many people moved to virtual platforms for work, school, purchasing of essential goods, and health care. Bauerly et al. (2019) argue that broadband is a "super-determinant," given its encompassing nature. As a result, disparities in broadband access, the digital divide, worsen existing health inequities. Similarly, eliminating disparities in broadband access helps to enable other areas of SDOH.

For example, during the pandemic, instead of in-person visits to health facilities, telehealth services were employed to promote and maintain access to health care infrastructure, flatten the curve, and improve surveillance (Centers for Disease Control and Prevention, 2020). Telehealth has been a critical strategy for providing access to health care during the pandemic, especially during periods when people were advised to shelter in place and avoid visiting emergency departments for non-urgent care (Centers for Disease Control and Prevention, 2020). Telehealth includes provider-patient asynchronous messaging through patient portals, monitoring devices for chronic diseases, synchronous provider-patient video calls, or phone calls (Benda, Ancker, Veinot, & Sieck, 2020). However, telehealth has limitations, especially for those with limited access to technological devices and limited access to broadband (Centers for Disease Control and Prevention, 2020). The COVID-19 pandemic pushed health care facilities to provide telehealth services that stand to benefit residents of rural or underserved communities that experience barriers to access to healthcare. However, these are often the same populations that lack broadband access and cannot take advantage of telehealth for their care (Bauerly, McCord, Hulkower, & Pepin, 2019). Among the populations disproportionately impacted by COVID-19, the digital barrier was far more common. Improved access to broadband could help address many of the SDOH barriers and support better health care access through telehealth.

Education is another important social determinant that intersects with broadband access. The COVID-19 pandemic and associated school closures left many students from low-income households unable to attend virtual classrooms, let alone complete assignments due to broadband access and affordability (National Center for Education Statistics, n.d.; Brenner,

Presley, Conradi, & Rodolfich, 2021). The education field was already moving towards increased online curricula and utilizing online resources for students, but the pandemic forced the field to fully merge itself with broadband as schools moved virtual. It is estimated that 70% of teachers assign homework that requires access to a broadband connection (Brenner, Presley, Conradi, & Rodolfich, 2021). During the peak of U.S. school closures and the transition to online learning, 55.1 million students from 124,000 K-12 private and public schools were affected (Education Week, 2020). An analysis by McKinsey & Company found that in the U.S., approximately 40% of Black students and 30% of Hispanic students from K-12 schools received no online instruction during the school closures in comparison to 10% of White students (Dorn, Hancock, Sarakatsannis, & Viruleg, 2020). Many low-income students, in both rural and marginalized urban settings found themselves excluded due to lack of broadband access.

The reality of learning during a pandemic without access to broadband is also complicated by issues of affordability, both in terms of affordability of broadband connections and access to technology and devices like laptops and tablets. According to a survey by Education Week (2020), 64% of school district leaders with student bodies consisting of more than 75% low-income students reported technology access as a major challenge. In comparison, only 21% of district leaders with student bodies consisting of no more than 25% low-income students reported technology access as a major challenge (Herlod, 2020). But both cost and geography are critical factors. Tyler Hansford, superintendent of Union City School District and chair of the Mississippi Rural Education Association, noted that “cost [of broadband] is usually one of the foremost concerns, but the cost is secondary…outside the city limits, the internet is not there” (Brenner, Presley, Conradi, & Rodolfich, 2021). Many school districts, including those in low-

income and rural districts in Mississippi were forced to piece together wireless coverage from different providers to ensure their students were able to continue their education while also providing them with laptops or tablets (Brenner, Presley, Conradi, & Rodolfich, 2021). It is well documented that without broadband access, individuals are limited in their ability to access different educational opportunities, increasing existing academic-achievement gaps (Bauerly, McCord, Hulkower, & Pepin, 2019; Benda, Ancker, Veinot, & Sieck, 2020). The U.S. academic-achievement gap, first identified in the 1966, has persisted, and now with the pandemic's school closures and online learning combined with limited broadband access, it is forecasted to increase and persist far longer (Dorn, Hancock, Sarakatsannis, & Viruleg, 2020).

As reflected in the discussion above, broadband clearly serves as a critical bridge and enabler with other SDOH indicators. As a result, it is recommended that broadband access be added, not as a separate social determinant as has been proposed elsewhere, but as a critical access bridge and modifier across all SDOH as reflected in the revised model in Figure 5. As operationalized here, "broadband access" includes the accessibility, affordability, and speed of internet connectivity as well as access to technological tools.

Figure 5: Revised Model of the Social Determinants of Health (SDOH) ***(Modifies Figure 4)***

SOCIAL DETERMINANTS OF HEALTH (Revised)					
Broadband Access					
Economic Stability	**Neighborhood & Physical Environment**	**Education**	**Food**	**Community & Social Context**	**Health Care System**
Employment	Housing	Literacy	Hunger	Social Integration	Health Coverage
Income	Transportation	Language	Access to Healthy Options	Support Systems	Provider Availability
Expenses	Safety	Early Childhood Education		Community Engagement	Provider Linguistic & Cultural Competency
Debt	Parks	Vocational Training		Discrimination	Quality of Care
Medical Bills	Playgrounds	Higher Education		Stress	
Support	Walkability				
	Zip Code/Geography				
Health Outcomes Mortality, Morbidity, Life Expectancy, Health Care Expenditures, Health Status, Functional Limitations					

V. ADDRESSING BROADBAND ACCESS

Federal Government

Policy actions have been taken at the federal, state, and local levels to address the issue of broadband access. Prior to the pandemic, the federal government had several programs targeted to addressing broadband access. The Telecommunications Act of 1996, while it focused on the competition of companies providing telephone services, cable programming, and video services, it was the first congressional direction to the FCC "to encourage the deployment on a reasonable and timely basis of advanced telecommunications capability for all Americans; also, to provide rural health care providers (HCPs) with an affordable rate for the services necessary for the provision of telemedicine and instruction relating to such services" (Federal Communications Commission, 2013). Following this Act, the federal government has provided funding to address broadband access for telehealth services in rural regions. For example, the FCC has a program called the Rural Health Care Program (RHCP), which provides funding for eligible health care facilities to have broadband and telecommunications services, improving quality of healthcare for rural communities (Bauerly, McCord, Hulkower, & Pepin, 2019; FCC, 2021). The program encompasses two sub-programs: The Healthcare Connect Fund Program (established 2012) and the Telecommunications Program (established 1997) (FCC, 2021). Funding for the RHCP program was capped at $571 million annually in 2018 from a historical $400 million cap, which supports both sub-programs (FCC, 2021). When the RHCP program was piloted in 2007, it reached over 6,000 health care centers across 42 states and 3 territories (Martin, 2007). The Healthcare Connect Fund supports broadband connectivity and networks for healthcare facilities, encourages use of public=private collaboration to save costs, and provides a 65% discount on broadband services and equipment, but requires a 35%

contribution from the participating health care facility (FCC, 2015). To the knowledge of this author, there has not been evaluations of program effectiveness, and the question remains as to what degree these programs have achieved their goals.

Further, in 2010, the FCC launched the National Broadband Plan, which provides a national roadmap to implement broadband in education, health care, homeland security, and more (Federal Communications Commission, 2010). As a result, it started the Measuring Broadband America (MBA) to measure the ongoing performance of fixed and mobile broadband services starting 2011. The tenth report was published in January 2021 and its key findings were: the maximum download speeds among service providers ranged from 24 Mbps to 940 Mbps, the average speed was 146.1 Mbps—a 8% increase from the ninth MBA report, and on average users experienced a consistency in service speed as advertised by providers (Federal Communications Commission, 2021). The report does not measure areas or regions in which broadband is implemented or not, but only measures speeds from selected service providers. However, this information is still valuable as it provides a broad snapshot on the current average provided broadband speed, potentially aiding in recognition of underserved areas that need increase of speed.

Even more, the FCC implemented an initiative targeting telehealth in association to broadband as it established the Connect2HealthFCC Task Force in 2014 with a focus on ensuring that advanced healthcare solutions are accessible to all Americans (FCC, 2021). The task force implemented the Broadband Cancer Collaboration to help bridge the broadband health connectivity gap in Appalachia. It also employed the Mapping Broadband Health in America tool to enable data-driven decision making at the intersection of health and

broadband. Evaluation of these initiatives and programs is unavailable at the time of this research. Additionally, an independent study by the National Digital Inclusion Alliance (2020) found that FCC's funding and programming targeting rural regions of the U.S. to deploy broadband is counterproductive for reducing the nation's digital divide as it fails to address the highest numbers of broadband underserved populations in urban regions, which tend to be the most populated, disconnected, and predominately Black and other communities of color (Siefer & Callahan, 2020).

Other federal programs include the Department of Agriculture's Distance Learning and Telemedicine Program (Bauerly, McCord, Hulkower, & Pepin, 2019; USDA Press, 2021). This program is set to use $42.3 million to fund 86 projects giving five million rural residents access to health care and educational opportunities (USDA Press, 2021). Additionally, several other U.S. Departments and agencies have allocated funding to increase broadband access: U.S. Department of Commerce, U.S. Department of Housing and Urban Development, and U.S. Department of Labor, and the Institute of Museum and Library Services (Bauerly, McCord, Hulkower, & Pepin, 2019). The National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce offers a program called the Broadband Technology Opportunities Program (BTOP), which provides grants from a $4 billion funding received through the American Recovery and Reinvestment Act of 2009, helping in broadband infrastructure, expanding public computer centers, and encouraging sustainable broadband services in communities through various administered programs (National Telecommunications and Information Administration, 2020). An evaluation study of the BTOP found on average that communities receiving grants experienced an estimated 2% growth in broadband availability in

comparison to communities that did not; 95% reduction in prices in grantee institutions like schools and libraries, broadband infrastructure provided by BTOP created more than 22,000 long-term jobs and generated $1 billion in additional household income (NTIA Broadband USA, 2012).

Presently, the White House is proposing infrastructure-focused legislation that includes funding targeted to improving broadband access. The Biden administration promised to invest $100 billion to ensure broadband access for all Americans within the $2 trillion infrastructure package introduced on March 31st, 2021 (White House, 2021). Through this investment, broadband will be deployed throughout rural regions of the U.S. over eight years and there will be moves towards subsidizing broadband for low-income households (White House, 2021). As a result of the Coronavirus Aid, Relief, and Economic Security (CARES) Act, which provided $2 trillion as an economic stimulus, the Coronavirus Relief Fund (CRF) provided states with $150 billion to help in navigating the pandemic's impact. Many states chose to use these funds to support digital learning, telehealth, and public Wi-Fi, and residential broadband infrastructure (de Wit, States Tap Federal CARES Act to Expand Broadband, 2020). For example, Idaho used funds from CRF to expand their public Wi-Fi by expanding library Wi-Fi hotspots and Arizona elected to expand access, purchase internet devices, and provide technical support, while many other states (Delaware, Idaho, Kansas, Mississippi, New Hampshire, and South Carolina) used the funds to establish emergency broadband grants (de Wit, States Tap Federal CARES Act to Expand Broadband, 2020). Additionally, other states such as Vermont chose to use a portion of the CRF funds to build long-lasting Fiber broadband technology to increase access to its citizens (de Wit, States Tap Federal CARES Act to Expand Broadband, 2020). In an effort to better

identify the current status of broadband availability and address the coverage gaps, the FCC announced on March 22, 2021 that it will begin collecting first-hand accounts on broadband availability and service directly from consumers as part of its Broadband Data Collection program (Federal Communications Commission News, 2021).

State Governments

At the state level, there have been recent policies and initiatives to address broadband in the following categories: access, speed, funding and financing, and competition and regulation (de Wit, 2019). In the area of access and regulation, many states have assigned new offices or existing agencies with the responsibility for broadband deployment and expansion (de Wit, 2019). For example, Iowa is revitalizing its expansion coordination efforts by redefining its chief information officer's role to lead the broadband expansion in the state (Bauerly, McCord, Hulkower, & Pepin, 2019). Under the categories of access and funding, several states are funding the development of broadband infrastructure, providing tax credits, or encouraging expansion coordination efforts in their states to increase accessibility (Bauerly, McCord, Hulkower, & Pepin, 2019). Another example, Wisconsin is providing $24 millions of funding towards the state's Broadband Expansion Grant Program (PSC Wisconsin, 2020). Additionally, Idaho offered tax credits for its citizens who acquire enhanced broadband equipment. (Bauerly, McCord, Hulkower, & Pepin, 2019).

Other states have focused on access by addressing the infrastructure aspect of broadband, as well as how the private sector can have access to publicly owned infrastructure such as telephone poles and sidewalks. Minnesota has also implemented a law requiring broadband to be installed concurrently with ongoing infrastructure projects and facilitate

conduit deployment on state-owned lands (Bauerly, McCord, Hulkower, & Pepin, 2019; de Wit, 2019). Nevada follows a similar plan as Minnesota, but it adds to it by allowing the state's Department of Transportation to enter into agreement with service providers, giving them access to conduit installation in return for a payment that is allocated for their State Highway Fund or a fiber trade agreement (de Wit, 2019). Colorado and California notify the service providers prior to starting construction projects to allow the service provider to install broadband conduit (de Wit, 2019).

Lastly**,** Georgia launched the Georgia Broadband Deployment Initiative (GBDI) in 2018 to increase broadband access statewide and is coordinating activities among five state agencies: Department of Community Affairs, Department of Transportation, Department of Economic Development, Georgia Technology Authority, and State Properties commission (GA State, 2019). GBDI first entered phase one to analyze submitted FCC Form 477 data, which is submitted by providers, to identify unserved census blocks in Georgia. Then, it is evaluating the found unserved blocks given the inaccuracies in the FCC data, and will share the results with broadband service providers. GDBI first piloted this plan in three counties in the state and is attempting to repeat the process for all Georgia's counties by compiling a comprehensive Master Address File by county using and collecting data from local government, property appraisers, e911 coordinators, and power companies (GA State, 2019). During the pandemic, GBDI responded by providing a statewide map showing active Wi-Fi hotspot locations for public usage, supporting individuals and groups in education and telehealth. GBDI also plans to continue expanding broadband infrastructure while reducing barriers at the state and local levels through their intra-state agency collaboration and precise mapping tool (Georgia

Department of Community Affairs, 2020). While these state programs and policies differ in goals and execution, they all have one thing in common, which is that evaluation and analysis to examine impact in terms of increasing access and addressing broadband issues is yet to be completed due to their recent implementation.

As of July 1, 2020, 11 states explicitly preempt local governments, through what is known as express preemption, from setting policies to expand municipal broadband (The Policy Surveillance Program, 2020). In total, 19 states have barriers to discourage local communities from adopting municipal broadband (Mitchell & James, 2020). Virginia municipality laws, Colorado referendum laws, and Wisconsin policies prohibiting local governments from authorizing broadband are examples of state policies that contribute to restrictions on broadband expansion (Bauerly, McCord, Hulkower, & Pepin, 2019). It is important to consider these preemption laws as a hindrance to broadband deployment and adoption response.

Private Sector

Public discourse regarding broadband access and lawsuits, such as the AT&T lawsuit for failing to deploy broadband in Mississippi as promised to the U.S. government (Brodkin, 2020), are among the factors pushing the public sector to invest in and address the digital divide. For example, Comcast launched its Internet Essentials Program in 2011, offering high-speed internet to low-income households for $10 per month. Over the past decade, they have connected over 10 million households with home internet, 80% of whom were not connected previously, provided digital skills training, and subsidized or donated devices (Comcast Internet Essentials, 2021). Comcast also expanded its consumer options to include low-cost packages and increased speeds for low-income families (Benda, Ancker, Veinot, & Sieck, 2020). Recently,

it committed to invest $1 billion over the next decade to address the digital divide through helping 50 million low-income Americans with wi-fi and digital tools like laptops and desktops (Comcast, 2021). This initiative would support their existing Life Zone program that aims to provide more than 1,000 connected zones for local community centers, support low-income students participating in distance learning, remote working, and after-school care (Comcast, 2020; Comcast Internet Essentials, 2021).

Verizon also started a program called Verizon Innovative Learning in 2012 focused on increasing access to technology and skills to students. Through this program students in select middle and high schools receive a device with four years-worth of data and a mobile hotspot for students without home internet. They also provide technology training and support to teachers to leverage technology in the classroom. Per the company's website, since 2012, this program has supported 212,392 students and 14,311 teachers from 412 schools nationwide (Verizon Digital Promise, n.d.). Most recently, Verizon expanded its internet service to customers in rural areas to respond to the pandemic (Jay & Lawson, 2020). As of March 2021, Verizon expanded its 5th Generation (5G) network to ten more cities in addition to their current 18 cities. Verizon's goal is to provide 5G service to 100 million people within the next 12 months with no data limits and affordable plans (Verizon, 2021). Similarly, AT&T has been investing in technology in education through a program they started in 2008 called Aspire, through which they have invested $600 million in low-income schools and communities (Gillespie, 2020). During the pandemic, they responded by connecting nearly 400,000 students and teachers with mobile connectivity (Gillespie, 2020). Lastly, they have allocated funding to several existing

AT&T programs (Lifeline, Access from AT&T, K-12 Bridge to Broadband, Special Needs Distance Learning) and collaborations including the Khan Academy (Gillespie, 2020).

In summary, there are several ways that the federal and state governments have responded to addressing the digital divide along with the private sector. Federal and state governments have taken the approach of focusing on overall increasing access through policies and trickle-down funding to programs whereas the private sector focused on improving access among targeted groups such as students and the low-income households. However, as it stands, there seems to be no well-established comprehensive plan conducted within the public sector or concurrently with the private sector.

VI. DISCUSSION AND RECOMMENDATIONS

Discussion

Broadband access has traditionally been treated more as a luxury rather than a necessity; however, the COVID-19 pandemic has highlighted the critical importance of broadband access to all aspects of daily life. Historically, there has been a digital divide associated with income, race and ethnicity, and geography. While there have been both public and private efforts to address this divide and the associated coverage gaps in the past, the current pandemic has highlighted the ways in which lack of broadband access impacts all the social determinants of health and health equity.

To address broadband access and its encompassing issues of affordability and speed, a coordinated and comprehensive approach is needed across public and private sectors to ensure equitable access to all Americans. Policy actions on the deployment and expansion of broadband must be coordinated efforts between sectors, clearly defining and setting objectives

to serve both the unserved and the underserved. Currently, the social determinants of health (SDOH) framework does not include broadband access. However, to address the digital divide through effective and equitable policies, broadband access must be included as an overarching predictor in the SDOH model; thus, ensuring its incorporation and implementation across sectors.

Furthermore, if not adequately addressed in both rural and urban settings, broadband access has the potential to become one the most impactful factors perpetuating structural racism, as recent governmental investments and deployment subsidies target non-Hispanic White individuals in rural settings while not addressing the underserved in urban settings (Siefer & Callahan, 2020). Since the largest percentage of those who are digitally disconnected reside in urban settings, are low-income, and identify as a racially or ethnically minority, policies must address the affordability and broadband speed for these underserved communities. Failing to address the needs of both urban and rural broadband access will further widen the digital divide and its ripple effect will be seen in worsening inequities in education, job access, health care access, and social equity.

As evidenced by the public and private sectors' efforts to address broadband access and the lack of clear benchmarks and metrics to evaluate the impact of policies and programs, more needs to be done to acknowledge broadband access' shift from a luxury service to an essential service. Thus far, there have been ways in which the federal and state governments endeavored to address the digital divide along with the private sector. Federal and state governments have taken the approach of focusing on increasing overall access through policies and trickle-down funding to programs for rural regions whereas the private sector focused on

improving access among targeted groups such as students and low-income households in both urban and rural settings. While these examples from the private and public sectors show potential initiatives to address broadband access in the U.S., they lack cohesion in objectives, planning, and implementation processes. It is critical to modify and continue these programs along with recent federal funding and initiatives to re-build and expand American broadband infrastructure while also targeting affordability, speed, and digital literacy to increase access equitably.

Limitations and Opportunities for Future Research

Limitations of this capstone include the lack of evaluation reports and studies on governmental policies and initiatives to fully understand and analyze their impact. Further research is needed to analyze federal and state initiatives and programming, especially the most recently implemented programming as it will help in improving the programs to ensure the reduction in coverage gaps. Additionally, state-level policy analysis is needed to compare and evaluate the approaches states have taken to narrow the digital divide. Findings from such analysis will aid in comparing how states have attempted to define and address broadband access. A suggestion for future research could include research targeted to input directly from the residents who are disconnected regarding their experiences with broadband availability, affordability, tools, and literacy. It is critical to include the voices of the communities who are impacted the most from the digital divide. Lastly, mapping tools should be improved beyond the current FCC's mapping tool and incorporate layers of health data such as significant health problems and SDOH predictors.

Recommendations

Given the uncertainty of the COVID-19 pandemic, and Americans continued dependence on broadband to complete daily tasks and activities, it is important to employ the following policies immediately. First, the federal and state governments should prohibit broadband service providers from enforcing data caps and overage fees as people are using more videoconferencing, streaming services, and overall engaging in unprecedented online activity (Levin, 2020; Holmes, Bell Fox, Wieder, & Zubak-Skees, 2016). Second, they should also prohibit communications shutoffs due to inability to pay broadband service bills during the pandemic as has been done with CDC's eviction moratorium, especially since it forced many people into unemployment (CDC, 2021; Public Knowledge, 2020; Benda, Ancker, Veinot, & Sieck, 2020). Federal and state governments should mandate service providers to increase minimum speeds offered nationwide, particularly in low-income regions, without compromising the affordability of the service packages (Public Knowledge, 2020). They should also encourage competition to prevent ongoing regional monopolies and duopolies by service providers, which limit the broadband choices and maintain existing slower speeds (Community Broadband Networks, 2020). In such regions where communities are unserved or underserved, state governments should relax their laws to not preempt local cities from establishing a community network (Community Broadband Networks, 2020).

Further, to solidify and maintain current efforts, the public and private sectors must continue their collaboration on several fronts. Particularly, they need to simultaneously provide tax-free subsidies for low-income Americans while stimulating fair competition among broadband providers (Public Knowledge, 2020). To build a reliable, resilient infrastructure that can withstand damages (e.g., severe weather and increased usage surges), both sectors should

continue collaborating to ensure broadband conduits are built throughout the U.S. as noted in Minnesota and Nevada (de Wit, 2019; Public Knowledge, 2020). To address the gaps in obtaining technological tools among low-income Americans, both sectors can provide subsidies and incentivized programming to provide free to low-cost tools that close the gaps in broadband accessibility and digital literacy, similar to programming done by Comcast, Verizon, and AT&T. Lastly and most importantly, better broadband data collection tools and methods should be implemented between both sectors to accurately and precisely identify communities that are disconnected in order to address them. Overall, we must continue past and current steps taken to expand accessibility of broadband while addressing barriers and eliminating the existing digital gap through an updated social determinants of health model (SDOH), one that includes broadband access as the overarching predictor of health. Doing so will not only reduce the digital gap but also aid in achieving health equity and eliminating health disparities in the U.S.

VII. CONCLUSION

The COVID-19 pandemic placed a spotlight on the present inequities in American society and revealed the importance of broadband access. As America and the rest of the world transferred work, school, health visits, and other activities virtually, the dependence on broadband use grew exponentially (Levin, 2020; Koeze & Popper, 2020). Data has shown that rural regions are unserved, not having access to service providers, while urban regions are underserved, unable to afford nor have higher speeds options (Busby & Tanberk, 2021; Bauerly, McCord, Hulkower, & Pepin, 2019). Additionally, the population groups that have been disproportionately impacted by the pandemic have been the same low-income populations and

communities of color that lack access to broadband and thus, are disconnected (Bauerly, McCord, Hulkower, & Pepin, 2019). Socioeconomic barriers have prevented these groups historically from accessing broadband; however, the pandemic and the current high dependence on it has pushed broadband as a critical bridge for daily life. Failure to address the barriers and increase broadband access in both rural and urban settings will allow it to grow into one of the most impactful functions of structural discrimination (Siefer & Callahan, 2020). Many Americans lack access to this vital service, which intersects with and perpetuates existing inequities falling under the social determinants of health (SDOH) model. To address broadband access and its encompassing issues such as affordability and speed, an approach that is cohesive and comprehensive will be needed across public and private sectors to ensure equitable access to all Americans. Policy actions on the deployment and expansion of broadband must be coordinated between public and private sectors, clearly defining and setting objectives, and employing creativity in their planning and implementation (Public Knowledge, 2020). More importantly, broadband access must be included as an all-inclusive factor in the social determinants of health (SDOH) framework, warranting its consideration in the policymaking process across heath and non-health sectors.

VIII. REFERENCES

Adedoyin, O. B., & Soykan, E. (2020, September 2). Mental Health, Substance Use, and Suicidal Ideation During the COVID-19 Pandemic — United States, June 24–30, 202. *Interactive Learning Environments, 69*(32), 1049-1057.

Anderson, J., Rainie, L., & Vogels, E. (2021, February 18). *Experts Say the 'New Normal' in 2025 Will Be Far More Tech-Driven, Presenting More Big Challenges*. Retrieved from Pew Research Center: https://www.pewresearch.org/internet/2021/02/18/experts-say-the-new-normal-in-2025-will-be-far-more-tech-driven-presenting-more-big-challenges/

Anderson, M., & Perrin, A. (2018, October 26). *Nearly one-in-five teens can't always finish their homework because of the digital divide*. Retrieved from Pew Research Center Fact Tank: https://www.pewresearch.org/fact-tank/2018/10/26/nearly-one-in-five-teens-cant-always-finish-their-homework-because-of-the-digital-divide/

Artiga, S., & Hinton, E. (2018, May 10). *Beyond Health Care: The Role of Social Determinants in Promoting Health and Health Equity*. Retrieved from Kaiser Family Foundation (KFF): https://www.kff.org/racial-equity-and-health-policy/issue-brief/beyond-health-care-the-role-of-social-determinants-in-promoting-health-and-health-equity/

Bauerly, B. C., McCord, R. F., Hulkower, R., & Pepin, D. (2019, Summer). Broadband Access as a Public Health Issue: The Role of Law in Expanding Broadband Access and Connecting Underserved Communities for Better Health Outcomes. *Public Health and the Law, 47*(S2), 39-42.

Benda, N. C., Ancker, J. S., Veinot, T. C., & Sieck, C. J. (2020, August). Broadband Internet Access Is a Social Determinant of Health. *American Journal of Public Health, 110*(8), 1123-1125.

BIA. (2021, January 15). *2021 National Tribal Broadband Strategy*. Retrieved April 2021, from Indian Affairs: Tribal Broadband: https://www.bia.gov/bia/ots/broadband

Brenner, D., Presley, B., Conradi, J., & Rodolfich, W. (2021). Get Connected Now: A Conversation with School Leaders and Policy Makers about Expanding Rural Broadband Access. *The Rural Educator, 41*(3), 57-62.

Brodkin, J. (2017, January 17). *When home Internet service costs $5,000—or even $15,000*. Retrieved April 2021, from ARS Technica: https://arstechnica.com/information-technology/2017/01/when-home-internet-service-costs-5000-or-even-15000/

Brodkin, J. (2020, October 1). *AT&T took $283 million but didn't deploy required broadband, Mississippi says*. Retrieved April 2021, from ARSTechnica: https://arstechnica.com/tech-policy/2020/10/att-took-283-million-but-didnt-deploy-required-broadband-mississippi-says/

Busby, J., & Tanberk, J. (2021, April 7). *FCC Reports Broadband Unavailable to 21.3 Million Americans, BroadbandNow Study Indicates 42 Million Do Not Have Access*. Retrieved April 2021, from Broadband Now Research: https://broadbandnow.com/research/fcc-underestimates-unserved-by-50-percent

Centers for Disease Control and Prevention. (2020, August 19). *Social Determinants of Health: Know What Affects Health*. Retrieved March 2021, from About Social Determinants of Health (SDOH): https://www.cdc.gov/socialdeterminants/about.html

Centers for Disease Control and Prevention. (2020, december 10). *COVID-19 Racial and Ethnic Health Disparities*. Retrieved April 2021, from Centers for Disease Control and

Prevention: https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/racial-ethnic-disparities/disparities-deaths.html

Centers for Disease Control and Prevention. (2020, June 10). *Using Telehealth to Expand Access to Essential Health Services during COVID-19 Pandemic*. Retrieved February 2021, from CDC: https://www.cdc.gov/coronavirus2019-ncov/hcp/telehealth.html

Centers for Disease Control and Prevention. (2021, April 13). *Temporary Halt in Residential Evictions to Prevent the Further Spread of COVID-19*. Retrieved April 2021, from Centers of Disease Control and Prevention: https://www.cdc.gov/coronavirus/2019-ncov/covid-eviction-declaration.html

Centers for Disease Control and Prevention. (2021, February 12). *Health Equity Considerations and Racial and Ethnic Minority Groups*. Retrieved from Centers for Disease Control and Prevention: https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/race-ethnicity.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fneed-extra-precautions%2Fracial-ethnic-minorities.html

Chakraborty, J., & Bosman, M. (2005). Measuring the digital divide in the United States: Race, income, and personal computer ownership. *The Professional Geographer, 57*(395-410).

Comcast Internet Essentials. (2021, March). *10 Years of Internet Essentials*. Retrieved April 2021, from Comcast: https://update.comcast.com/wp-content/uploads/sites/33/dlm_uploads/2021/03/IE-ProgressReport_FINAL.pdf

Comcast. (2020, September 17). *Comcast Announces Multiyear Effort to Roll Out 1,000+ WiFi-Connected 'Lift Zones' in Local Community Centers Nationwide.* Retrieved April 2021,

from Comcast Internet Essentials: https://corporate.comcast.com/press/releases/comcast-announces-1000--liftzones-in-community-centers-in-us-cities

Comcast. (2021, March 24). *Comcast Commits to Investing $1B Over Next 10 Years to Reach 50M Low-Income Americans With Tools and Resources to Succeed In Digital World.* Retrieved April 2021, from Comcast Internet Essentials: https://corporate.comcast.com/press/releases/comcasts-internet-essentials-program-hits-ten-year-mark

Community Broadband Networks. (2020, January 1). *Community Broadband.* Retrieved 2021 April, from Muninetworks: https://muninetworks.org/sites/www.muninetworks.org/files/2page-comty-bb.pdf

Cucinotta, V. M. (2020, March). WHO Declares COVID-19 a Pandemic. *Acta Bio-medica: Atenei Parmensis, 91*(1), 157-160.

Czeisler, M., Rashon, L., Petrosky, E., Wiley, J., Christensen, A., Njai, R., . . . Rajaratnam, S. (2020, August 14). Mental Health, Substance Use, and Suicidal Ideation During the COVID-19 Pandemic — United States, June 24–30, 202. *MMWR Morb Mortal Wkly Rep 2020, 69*, 1049–1057. Retrieved from MMWR Morb Mortal Wkly Rep 2020: https://www.cdc.gov/mmwr/volumes/69/wr/mm6932a1.htm#suggestedcitation

de Wit, K. (2019, December 17). *How State Policy Shapes Broadband Deployment*. Retrieved April 2021, from The PEW Charitable Trusts: https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2019/12/how-state-policy-shapes-broadband-deployment

de Wit, K. (2020, November 16). *States Tap Federal CARES Act to Expand Broadband*. Retrieved April 2021, from PEWTrusts: https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2020/11/states-tap-federal-cares-act-to-expand-broadband

Dorn, E., Hancock, B., Sarakatsannis, J., & Viruleg, E. (2020, June 1). *COVID-19 and student learning in the United States: The hurt could last a lifetime*. Retrieved April 2021, from McKinsey & Company: https://www.mckinsey.com/industries/public-and-social-sector/our-insights/covid-19-and-student-learning-in-the-united-states-the-hurt-could-last-a-lifetime

Education Week. (2020, March 6). *Map: Coronavirus and School Closures in 2019-2020*. Retrieved April 2021, from Education Week School & District Management: https://www.edweek.org/leadership/map-coronavirus-and-school-closures-in-2019-2020/2020/03

Fairlie, R., Beltran, D., & Das, K. (2010, July). HOME COMPUTERS AND EDUCATIONAL OUTCOMES: EVIDENCE FROM THE NLSY97 and CPS*. *Economic Inquiry, 48*(3), 771-792.

Federal Communications Commission News. (2021, March 22). *Fcc Announces New Outreach To Collect Consumer Broadband Availability Experiences*. Retrieved April 2021, from FCC News from the Federal Communications Commission: https://docs.fcc.gov/public/attachments/DOC-370978A1.pdf

Federal Communications Commission. (2010, March 17). *National Broadband Plan.* Retrieved April 2021, from Federal Communications Commission: https://www.fcc.gov/general/national-broadband-plan

Federal Communications Commission. (2013, June 20). *Telecommunications Act of 1996*. Retrieved April 2021, from Federal Communications Commission: https://www.fcc.gov/general/telecommunications-act-1996

Federal Communications Commission. (2014, June 23). *Types of Broadband Connection*. Retrieved April 2021, from Federal Communications Commission: https://www.fcc.gov/general/types-broadband-connections#:~:text=The%20term%20broadband%20commonly%20refers,Cable%20Modem

Federal Communications Commission. (2015, February). *Healthcare Connect Fund*. Retrieved April 2021, from Federal Communications Commission: https://docs.fcc.gov/public/attachments/DOC-319092A1.pdf

Federal Communications Commission. (2021, April 12). *Fixed Broadband Deployment Data from FCC Form 477*. Retrieved April 2021, from Federal Communications Commission Economics and Analytics: https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477

Federal Communications Commission. (2021, April 15). *Connect2HealthFCC*. Retrieved April 2021, from Federal Communications Commission: https://www.fcc.gov/about-fcc/fcc-initiatives/connect2healthfcc

Federal Communications Commission. (2021, April 9). *Summary of the Rural Health Care Program*. Retrieved April 2021, from Federal Communications Commission: https://www.fcc.gov/general/rural-health-care-program

Federal Communications Commission. (2021, January 4). *Tenth Measuring Broadband America Fixed Broadband Report*. Retrieved April 2021, from Measuring Fixed Broadband - Tenth Report: fcc.gov/reports-research/reports/measuring-broadband-america/measuring-fixed-broadband-tenth-report

Flaherty, C. (2020, May 8). *Reserved: Internet Parking*. Retrieved April 2021, from InsideHigherEd: https://www.insidehighered.com/news/2020/05/08/parking-lot-wi-fi-way-life-many-students

Flamm, K., & Chaudhuri, A. (2007). An analysis of the determinants of broadband access. *Telecommunications Policy, 31*, 312-326.

Georgia Department of Community Affairs. (2020, September 16). *2020 Broadband Report.* Retrieved April 2021, from Georgia Broadband Deployment Initiative: file:///Users/mohabib/OneDrive%20-%20Georgia%20State%20University/MPH%20CLASSES/SPRING%202021%20Classes/Capstone/2020-broadband-report.pdf

Georgia State. (2019). *Georgai Broadband Deployment Initaitive - Georgia Broadband Plan.* Atlanta: The State of Georgia - GBDI.

Gillespie, E. (2020, November 12). *Closing the Homework Gap and Bridging the Digital Divide*. Retrieved April 2021, from AT&T Public Polcy: https://www.attpublicpolicy.com/universal-service/closing-the-homework-gap-and-bridging-the-digital-divide/

Grubesic, T. H., Helderop, E., & Alizadeh, T. (2018, April 21). Closing Information Asymmetries: A Scale Agnostic Approach for Exploring Equity Implications of Broadband Provision. *Telecommunications Policy, 43*, 5-66.

Herlod, B. (2020, April 10). *The Disparities in Remote Learning Under Coronavirus (in Charts)*. Retrieved April 2021, from EducationWeek: https://www.edweek.org/technology/the-disparities-in-remote-learning-under-coronavirus-in-charts/2020/04

Holmes, A., Bell Fox, E., Wieder, B., & Zubak-Skees, C. (2016, May 12). *Rich People Have Access to High-Speed Internet; Many Poor People Still Dont*. Retrieved March 2021, from Public Integrity: https://publicintegrity.org/inequality-poverty-opportunity/rich-people-have-access-to-high-speed-internet-many-poor-people-still-dont/

Jay, K., & Lawson, A. (2020, July 30). *Verizon expands home Internet options to customers in rural areas*. Retrieved from Verizon: https://www.verizon.com/about/news/verizon-home-internet-rural-areas

Kearney, A., & Muñana, C. (2020, May 1). *Taking Stock of Essential Workers*. Retrieved April 2021, from Kaiser Family Foundation: https://www.kff.org/policy-watch/taking-stock-of-essential-workers/

Kochhar, R. (2020, June 11). *Unemployment rose higher in three months of COVID-19 than it did in two years of the Great Recession*. Retrieved February 2021, from Pew Research Center: https://www.pewresearch.org/fact-tank/2020/06/11/unemployment-rose-higher-in-three-months-of-covid-19-than-it-did-in-two-years-of-the-great-recession/

Koeze, E., & Popper, N. (2020, April 7). *The Virus Changed the Way We Internet*. Retrieved March 2021, from The New York Times :

https://www.nytimes.com/interactive/2020/04/07/technology/coronavirus-internet-use.html

Koonin, L., Hoots, B., Tsang, C., Leroy, Z., Farris, K., Jolly, T., . . . Harris, A. (2020). Trends in the Use of Telehealth During the Emergence of the COVID-19 Pandemic — United States, January–March 2020. *MMWR Morb Mortal Wkly Rep, 69*, 1595-1599.

Lempel, H., Hammond, R., & Epstein, J. (2009, September 30). *Costs of School Closures.* Retrieved February 2021, from https://www.brookings.edu/wp-content/uploads/2016/06/0930_school_closure_presentation.pdf

Levin, B. (2020, March 30). *COVID-19 proves we need to continue upgrading America's broadband infrastructure*. Retrieved from Brookings: https://www.brookings.edu/blog/the-avenue/2020/03/30/covid-19-proves-we-need-to-continue-upgrading-americas-broadband-infrastructure/

Lieberman, M. (2021). The Big Pandemic Tech Challenge: Reliable, HighQuality Internet Experiences for All. *Education Week, 40*(25), 1-25.

Martin, K. (2007, November 13). *Rural Health Care Pilot Program.* Retrieved April 2021, from Federal Communications Commission: https://www.fcc.gov/general/rural-health-care-pilot-program

Mitchell, C., & James, E. (2020, January 30). *Community Network Map*. Retrieved from Institute for Local Self-Reliance: https://muninetworks.org/communitymap

National Center for Education Statistics. (n.d.). *Computer and Internet Use*. Retrieved February 2021, from IES - NCES: https://nces.ed.gov/fastfacts/display.asp?id=46

National Telecommunications and Information Administration. (2020). *Broadband Technology Opportunities Program*. Retrieved February 2021, from National Telecommunications and Information Administration: https://www.ntia.doc.gov/category/broadband-technology-opportunities-program

Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., . . . Agha, R. (2020, June). The socio-economic implications of the coronavirus pandemic (COVID-19): A review. *International Journal of Surgery, 78*, 185-193.

NTIA Broadband USA. (2012, June 30). *BTOP Evaluation Study*. Retrieved April 2021, from Broadband USA Connecting America's Communitites: https://www2.ntia.doc.gov/broadband-resources#evaluation

Parker, K., Horowitz, J., & Minkin, R. (2020, December 9). *How the Coronavirus Outbreak Has – and Hasn't – Changed the Way Americans Work*. Retrieved March 2021, from Pew Research Center: https://www.pewresearch.org/social-trends/2020/12/09/how-the-coronavirus-outbreak-has-and-hasnt-changed-the-way-americans-work/

Pew Research Center. (2019, June 12). *Internet/Broadband Fact Sheet*. Retrieved March 2021, from Pew Research Center: https://www.pewresearch.org/internet/fact-sheet/internet-broadband/

Pew Research Center. (2019, June 12). *Majorities of American have a smartphone, subscribe to broadband, but this varies by education, income*. Retrieved February 2021, from Survey of U.S. Adults Conducted Jan. 8-Feb. 7, 2019: https://www.pewresearch.org/internet/2019/06/13/mobile-technology-and-home-broadband-2019/pi_2019-06-13_broadband_0-03/

Picto, A., & Wernick, C. (2007). The role of government in broadband access. *Telecommunications Policy*, 660-674.

Poinsignon, L. (2020, March 17). *On the shoulders of giants: recent changes in Internet traffic*. Retrieved April 2021, from The Cloudfare Blog: https://blog.cloudflare.com/on-the-shoulders-of-giants-recent-changes-in-internet-traffic/

Price-Haygood, E. G., Burton, J., Fort, D., & Seoane, L. (2020, June 25). Hospitalization and Mortality among Black Patients and White Patients with Covid-19. *N Engl J Med*(382), 2534-2543.

Prieger, J. E., & Hu, W.-M. (2008). The broadband digital divide and the nexus of race,competition, and quality. *Information Economics and Policy, 20*, 150-167.

PSC Wisconsin. (2020, June 8). *Broadband Expansion Grants*. Retrieved April 2021, from Wisconsin State Government: https://psc.wi.gov/Pages/Programs/BroadbandGrants.aspx

Public Knowledge. (n.d.). *Communications Policy Solutions for the Pandemic*. Retrieved April 2021, from Public Knowledge: https://www.publicknowledge.org/communications-policy-solutions-for-the-pandemic/#broadband1

Reardon, M. (2020, March 23). *Coronavirus transforms peak internet usage into the new normal*. Retrieved April 2021, from CNET: https://www.cnet.com/news/coronavirus-has-made-peak-internet-usage-into-the-new-normal/

Siefer, A., & Callahan, B. (2020, June). *Limiting Broadband Investment to "Rural Only" Discriminates Against Black Americans and other Communities of Color*. Retrieved April

2021, from National Digital Inclusion Alliance (NDIA): https://www.digitalinclusion.org/digital-divide-and-systemic-racism/

Sim, K., Choon Chua, H., Vieta, E., & Fernandez, G. (2020, April). The anatomy of panic buying related to the current COVID-19 pandemic. *Elsevier B.V., 288*.

The Policy Surveillance Program. (2020, July 1). *State Preemption Laws*. Retrieved April 2021, from The Policy Surveillance Program: A LawAtlas Project: http://lawatlas.org/datasets/preemption-project

Torpey, E. (2020, September). *Essential work: Employment and outlook in occupations that protect and provide*. Retrieved April 2021, from U.S. Bureau of Labor Statistics Career Outlook: https://www.bls.gov/careeroutlook/2020/article/essential-work.htm

United Nations Conference on Trade and Development (UNCTAD). (2020, October 08). *COVID-19 has changed online shopping forever, survey shows*. Retrieved from United Nations Conference on Trade and Development: https://unctad.org/news/covid-19-has-changed-online-shopping-forever-survey-shows

United Nations Educational, Scientific, and Cultural Organizations (UNESCO). (2021, January). *Global education coalition gender flagship: highlights of action in 2020*. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000375256

US Census Bureau. (2017, September 11). *The Digital Divide: Percentage of Households by Broadband Internet Subscription, Computer Type, Race and Hispanic Origin*. Retrieved March 2021, from US Census Bureau: https://www.census.gov/library/visualizations/2017/comm/internet.html

US Census Bureau. (2018, December 06). *Broadband Subscription Rate for U.S. Counties*. Retrieved March 2021, from United States Census Bureau: https://www.census.gov/library/visualizations/2018/comm/broadband-counties.html

US Department of Agriculture (USDA) Press. (2021, February 25). *USDA Invests $42 Million in Distance Learning and Telemedicine Infrastructure to Improve Education and Health Outcomes*. Retrieved April 2021, from U.S. Department of Agriculture: https://www.usda.gov/media/press-releases/2021/02/25/usda-invests-42-million-distance-learning-and-telemedicine

Verizon Digital Promise. (n.d.). *Verizon Innovative Learning Schools*. Retrieved April 2021, from Verizon Innovative Learning: https://verizon.digitalpromise.org/

Verizon. (2021, March 11). *On heels of C-Band results, Verizon expands 5G Home Internet to 10 more cities.* Retrieved April 2021, from Verizon News Center: https://www.verizon.com/about/news/c-band-verizon-expands-5g-home-internet

Whaley, C., Pera, M., & Cantor, J. (2020). Changes in Health Services Use Among Commercially Insured US Population During COVID-19 Pandemic. *JAMA Netw Open, 3*(11), E20204984-E20204984.

Wheeler, T. (2020, May 27). *5 Steps To Get The Internet To All Americans: COVID-19 And The Importance Of Universal Broadband*. Retrieved April 2021, from Brookings: https://www.brookings.edu/research/5-steps-to-get-the-internet-to-all-americans/

White House. (2021, March 31). *FACT SHEET: The American Jobs Plan*. Retrieved April 2021, from The White House Briefing Room: https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/

World Health Organization (WHO). (2021). *It's Time to Build a Fairer, Healthier World for Everyone, Everywhere.* https://cdn.who.int/media/docs/default-source/world-health-day-2021/health-equity-and-its-determinants.pdf?sfvrsn=6c36f0a5_1&download=true: World Health Organization.

World Health Organization (WHO). (n.d.). *Social Determinants of Health*. Retrieved March 2021, from World Health Organization: https://www.who.int/health-topics/social-determinants-of-health#tab=tab_1

Zubak-Skees, C., & Wieder, B. (2016, May 12). *Where Broadband Access is Unequal*. Retrieved March 2021, from Center for Public Integrity: https://publicintegrity.org/inequality-poverty-opportunity/where-broadband-access-is-unequal/