

## **COVID-19, Technology, and the Digital Divide: Implications for NYS**

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### **INTRODUCTION**

This chapter presents an overview of the secondary impacts of COVID-19 from the perspective of technology adoption during the pandemic. The review combines two (2) years of research by the authors on the subject and discusses its implications for New York State (NYS). The first section discusses the general impact of COVID-19 as they relate to vulnerable populations. The reader will learn about the differences between the primary and secondary impacts in this section. The second section dives deeper into the use of technology as a mitigation and response measure to reduce the spread. In this section, the reader is reminded of how critical access to broadband wireless, technological devices, and digital literacy were during the height of the pandemic. In the third section, the authors' research and workgroup are introduced. In this section, the readers will learn about their holistic organization of the challenges (or benefits) people faced during the global reliance on technology during the pandemic. The fourth section discusses how technology can be seen as a super determinant of health, crossing all six current domains. In this section, a summary of the authors' findings is discussed across the six determinants of health. The fifth section discusses the considerations for various socially vulnerable populations. This section is separate from the previous one because many concerns cross different domains and determinants of health. Finally, the implications for individuals, communities, businesses, policy, and cultural norms in NYS are discussed as they relate to the use of technology during COVID-19.

### **1. COVID-19 and Vulnerable Populations**

COVID-19 had direct and indirect effects on individuals and households, like most disasters (Clay and Rogus, 2021). However, the primary impacts were directly health-related, including infection or mortality due to the virus (National Center for Health Statistics, 2016; Sternthal et al., 2011; Centers for Disease Control and Prevention [CDC], 2021). In contrast, secondary impacts were related to the indirect difficulties stemming from preparation or response to the threat and included loneliness and social isolation from COVID-19 social distancing policies or job loss due to layoffs (Gould and Wilson, 2020; Parker, Minkin, & Bennett, 2020; Novacek et al., 2020).

For example, racial and ethnic minorities (among the vulnerable populations in the US (United States)) have endured most of the primary and secondary impacts of COVID. African Americans were 2.8 times more likely to be hospitalized and two times more likely to die from the virus. Hispanic/Latino populations were also 2.8 times more likely to be hospitalized but 2.3 times more likely to die from the virus. Unemployment rates disproportionately show that racial and ethnic minorities were more likely to lose their jobs during the pandemic. The unemployment rate for Black workers was 16.7%, compared to 14.2% for white workers at the height of the pandemic (Gould and Wilson, 2020). These racial and ethnic minority populations are the least paid among all essential worker categories. Unemployment led to other financial burdens, such as using savings or retirement to pay bills, difficulty paying rent, and other bills. Black and Hispanic populations were far more likely to have these financial burdens during the pandemic (Parker, Minkin, & Bennett, 2020). This has led to additional stressors, such as mental health issues and social isolation (Novacek et al., 2020). The intersection of racial and ethnic minorities who are also essential workers with comorbidity is potentially remarkably high. They are less

likely to reap the benefits of the widespread use of information communication technologies (ICT) during the pandemic in the workplace.

In New York State (NYS), the Governor-issued executive order outlined a 10-point policy for social distancing. Called *New York State on Pause*, the order, among other things, mandated 100% closure of all non-essential businesses, with exceptions made for groceries and healthcare (Clay and Rogus, 2021; New York State Governor, 2020). In response, companies laid off or furloughed employees, while essential workers faced the threat of COVID-19 daily. Those laid off were disproportionately racial and ethnic minorities (US Bureau of Labor Statistics, 2020). According to the Economic Policy Institute, people of color make up 50% of essential workers in food and agriculture and 53% of crucial workers in industrial, commercial, and residential facilities and services (Celine McNicholas & Margaret Poydock, 2020).

## **2. Technology Use amid the Pandemic**

Until the pandemic, ICT and Broadband wireless were considered a luxury or a choice, not a necessity like many of our utilities (e.g., electricity or water) (Olanoff, 2015; Mosteanu, 2020; Mookerjee, 2021). At the height of the pandemic (amid social distancing mandates, such as *New York State on Pause*), ICT, and broadband wireless became a critical lifeline enabling people worldwide to continue learning, working, accessing government services, and carrying out daily activities. Lack of access to technology contributed to the secondary impacts, furthering the disparities. Before the pandemic, several studies discussed the effects of unequal access to broadband wireless and ICT. As technology use increased from ad-hoc to near-ubiquitous during the pandemic, issues regarding the digital divide reemerged in public discourse. The digital divide is a "systematic inequality in access to technology" (Ong, 2020). The issue of the digital divide was evident before the pandemic and exacerbated during the pandemic. According to the US Census Bureau (US Census Bureau, 2020), 3.7 million households with students lack internet access, and 4.4 million lack consistent computer access. Several factors contribute to the impact of the digital divide, including age, gender, race, socioeconomic status, education, and geographic location. One of the more significant efforts to increase broadband wireless access was through the public library systems before the pandemic (Horrigan, 2021). However, libraries in NYS were closed and deemed non-essential during *NYS on Pause*. In NYS, approximately one-quarter of households did not have access to broadband wireless, with wider gaps among racial and ethnic minority households – nearly a third (Horrigan, 2021).

In a study characterizing racial/ethnic differences in health-related technology use among older Americans, results indicate that, in comparison to Whites, older Blacks and Hispanics were less likely to employ technology for health-related purposes after considering demographic characteristics, education, and health conditions. They were also "less likely to make or receive phone calls, use health management sites, search the web for health information, and use brain games for their health" (Mitchell, Chebli, Ruggiero, & Muramatsu, 2019). These findings further address the digital divide's issues and the importance of understanding the patterns of health-related technology used across racially and ethnically diverse populations to eliminate health disparities. These health outcomes differ regarding race and often exist even when compared and stratified for income (Dubay & Lebrun, 2012), education (Kawachi et al., 2005), and sometimes even comorbidities (Shahul et al., 2015). It is, therefore, little surprise in the overrepresentation of racial and ethnic minorities in COVID-19 deaths.

During the pandemic, racial and ethnic minorities face enormous challenges in their technology adoption. While mobile cellular technologies are used extensively in racial and ethnic minority communities, the lack of access to broadband wireless, desktop, or laptop computers puts these communities at greater risk for secondary impacts (Atske & Perrin, 2021). This can be attributed to their increased vulnerability because of the system inequities, low income, lack of access to resources, physical or social health, and geographics. Researchers have reported that "technology literacy is a necessity for civic and economic activity," and "teachers validate digital competency differently depending on students' race and class" (Dubois, Bright, & LaForce (2021, p. 14). They also mentioned that "Blacks in urban public schools have often been deprived of the resources and opportunities to engender technological ambition." (Dubois, Bright, & LaForce (2021, p. 15). This chapter summarizes the efforts of the *Technological Innovation amid the COVID-19* working group. It poses questions regarding the potential secondary impacts of the pandemic on racial and ethnic minority groups in New York State.

### **3. Workgroup: *Technological Innovation amid the Pandemic***

In April 2020, at the beginning of COVID-19, a working group of scholars convened to develop a research agenda regarding technological innovation during the pandemic. The group comprised an interdisciplinary team. The team reviewed extant literature and ongoing research using a modified ecology theory framework to determine the areas requiring future study across five domains of influence (macro-, exo-, meso-, techno-, and micro-levels).

The ecological model was used to explore the changes that occur because of the interaction between technology, our environments, and ourselves. Changes at the microsystem (individual and household levels) are impacted by our communities (meso-level) and the laws/policies developed (exo-level), all of which are affected by the macro-level. The macro-level considers society and culture and is only changed incrementally. Finally, the ecological model was adapted to include the techno-sublevel, which considers not just the use and implementation of technologies, but how the features of certain technologies impact the individual. The research questions identified for each of the five domains of influence were further segmented into those geared toward the widespread use of technology and others focused on privacy and security concerns.

While it may seem that the techno-level is redundant and unnecessary, it is included to discern differences in features among the technology at any level, which might benefit or present a barrier for specific populations. For example, previous research has discussed the challenges and advantages of video conferencing software for individuals or organizations. One may include these challenges under the micro- or meso-level domains of influence. However, studying the differences among video conferencing platforms for a multitude of domains, such as Teams vs. Zoom vs. Skype, would be included at the techno-level.

The research team met via video conferencing to discuss and craft the research agenda. The purpose of this manuscript is to fully describe each of the five domains of influence and the related research questions, as well as the subsequent publications derived from the working group as they relate to populations at risk.

Table 1: Select research questions from the working group organized by the domain of influence

<b>Domains of Influence</b>	<b>Micro-level</b>	Given the increased household utility use, how can lower-income households compete in education and employment or gain access to healthcare or COVID-19 messaging?
	<b>Meso-level</b>	How might non-adopters of technology become more vulnerable in the era of COVID-19?
	<b>Exo-level</b>	Given the current technologies and delivery methods, how can hospitals, government agencies, and private companies effectively address the health needs of populations at risk?
	<b>Techno-level</b>	To what extent and under what circumstances should technology solutions implemented during the pandemic replace standard practices in healthcare, education, government, and employment?
	<b>Macro-level</b>	How will COVID-19 have a lasting impact on lifestyle? What can we expect? Will things go back to normal (or a new normal)?

### 3.1 Meta-Analysis of Workgroup Publications and Findings

Most of the findings from this work focused on research gaps regarding the inclusion of marginalized populations, such as racial and ethnic minorities. These populations are often called the socially vulnerable. In disaster research, the term "socially vulnerable" describes individuals or groups who may have difficulty preparing for or recovering from an extreme event (Wisner et al., 2004). Socially vulnerable populations often face more problems during public health emergencies due to their income level, household composition, race/ethnicity status, housing type, and transportation (or lack thereof) (CDC, 2021). This section summarizes the findings regarding technology adoption and its impacts on different populations, starting with generalized impacts on socially vulnerable people.

#### *Technology Adoption*

Technologies were used in several ways during this pandemic, such as streamlining government and administrative services, assisting with lifesaving measures in the hospital setting, and providing continuity of educational opportunities (Bennett Gayle, Yuan, & Knight 2021, Dubois, Bright, & LaForce, 2021). The review of the technological deployments in response to the pandemic sheds light on the value of information and emerging technologies to individuals, organizations, and society. It also emphasizes the versatility of various technologies adopted across sectors, as summarized in Table 2. Common functionality of technologies across sectors is the ability to collect, analyze, process, and use enormous amounts of data about people in their various roles as citizens, students, patients, employees, and in every facet of our lives. Before the pandemic, privacy and security were known challenges in using emerging information communication technologies.

Table 2: Summary of technology deployments and uses (Source: Knight et al., 2020)

<i>Technology</i>	<i>Use</i>
Artificial Intelligence	social distancing detection and management; COVID-19 research; contact tracing apps

Mobile applications and devices	virus tracking and notification, contact tracing, and proof of vaccination
Drones	public hygiene, delivery of food and medicine; communication with the public, virus detection
Facial Recognition	identification and authentication of individuals
Gamification	learning assessment
Internet-of-Things	live-tracking and real-time updates on COVID-19, virus detection, contact tracing
Learning Management Systems	online learning delivery
Location Tracking (GPS, Bluetooth, RFID)	social distancing detection and enforcement, employee tracking
Robots	disinfecting public spaces, care, and support for the elderly and disabled
Employee Monitoring	monitor keystrokes, view messages, access, and view device in real-time
Telehealth/Telemedicine	health visits - treatment and diagnosis
Videoconferencing	live instruction, debriefing dialogues, meetings, health visits

#### 4. Impact across Social Determinants of Health Domains

Based on research from Benda et al. (2020), broadband internet access was critical during COVID-19, and lack of broadband internet access affected each of the six social determinants of health domains identified by the American Medical Association (Bennett et al., 2020), and an additional domain, access to credible information (see Figure 1).

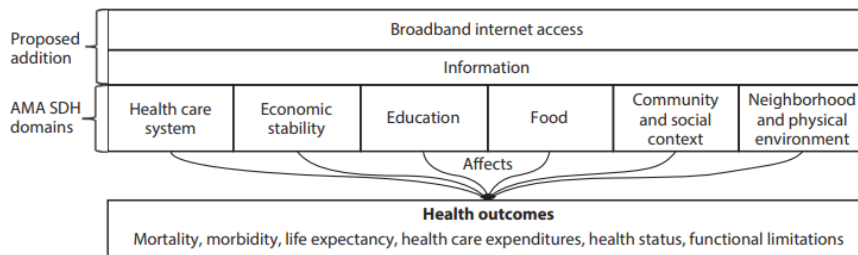


Figure 1: Proposed Extended Model of Social Determinants of Health (SDH) (adopted from Benda et al. (2020), source from American Medical Association (Bennett et al., 2020).

Education, employment, income, access to healthcare, and social connections are among the social determinants of health. The pandemic provided one of the few instances in which lack of access to technology was a primary indicator of people's health, well-being, and quality of life. People who were working from home, seeking employment, looking to connect to loved ones, or searching for mental healthcare required broadband wireless, primarily on personal technology devices. In addition, racial and ethnic minorities, and low-income populations, who before the pandemic were at a disadvantage in terms of access to technology, faced difficulties amid social distancing mandates during the pandemic. The impacts were only more pronounced when accounting for older adults, people with disabilities, and low-income households.

#### Education

During the global pandemic, digital learning tools and cloud-based learning management systems have been extensively adopted globally. Some technologies, e.g., the gamification of content, showed potential in not only engaging young students (Membrive & Armie, 2020) but also as a learning assessment tool. However, because of the concern about disengagement among students (Aldhafeeri & Alotaibi, 2022), there has been a debate about whether digital learning can be a potential replacement for face-to-face education. Aldhafeeri & Alotaibi, 2022 proposed an innovative DES approach and proved that it could improve the effectiveness and engagement of digital learning. Online learning has ranged from a live group or one-to-one instruction to work at your own pace or asynchronous classwork. Google Classroom was an effective tool for teaching and learning English at the college level (Syakur, 2020). However, a study in Israel identified potential barriers for students with learning disabilities and remote instruction (Ezra et al., 2021). In addition, Bao (2020) stressed that real-time lags in ASL interpretation on video conferencing contribute to learning difficulties for students with disabilities. Students from low-income households in the US had more barriers adjusting to online learning (Soria, Chirikov & Jones-White 2020). Similarly, a study on children in Nigeria reported that students from low-income communities had more barriers to remote instruction at home (Briggs, 2020).

#### *Income and Employment*

During the pandemic, the shift to remote working created a surge in the use of tracking software that measured employee productivity. Employee monitoring technologies included popular software that enabled a supervisor to view the employees' activities in real-time (Morrison, 2020), and those technologies tracked employee mouse movements and keyboard strokes and recorded the web pages they visited (Allyn, 2020). Jeske (2022) further proposed that using data generated by employee monitoring tools could be helpful for managers and health professionals to identify potential issues and make appropriate decisions. Such monitoring systems may have harmed women workers. During the pandemic, the burden on women increased because many struggled to balance work and household duties (Kaur & Sharma, 2020, Aldossari & Chaudhry, 2021). However, the use of technology at home presented some employment opportunities for women, people with disabilities, and others, which may make this new trend in access continue after the pandemic (Ali et al., 2020).

#### *Healthcare*

During the pandemic, people relied more on telemedicine and telehealth for treatment and communication with their healthcare providers (Bestsenny, Gilbert, Harris & Rost, 2020). Doctors' acceptance of video consultations to treat patients with both mild and severe virus-related symptoms increased (Greenhalgh et al., 2020). Some technologies adopted for patient care include robots, the Internet of things (IoT), artificial intelligence, data science, deep learning, and blockchain technology (Ting, Dzau, and Wong, 2020). Specifically, IoT was used for live tracking and real-time updates of COVID-19 cases in the United States, Singapore, the United Kingdom, and China (Ting, Dzau, and Wong, 2020). Scripps Research Translational Institute adopted wearable devices to track potential cases of COVID-19 in the Digital Engagement & Tracking for Early Control & Treatment (DETECT) study. Contact tracing apps must ensure information is provided in multiple formats and languages accessible to people with disabilities (World Health Organization [WHO], 2020). Blockchain technology was used to deliver medications to pharmacies and patients in their homes (Ting, Dzau, and Wong, 2020). Verdict Medical Devices

(2020) mentioned that the main types of healthcare robots were surgical, exoskeletons, care, and hospital robots. In a review of technology adoption in health professions education amid the COVID-19 Pandemic, Jeffries et al. (2022) addressed the need for federal and state governments to "incentivize health care insurers and providers to find innovative solutions that extend the reach of telehealth and community health support" to socially vulnerable populations.

#### *Social Isolation*

Many people suffered from social isolation during the pandemic and incurred mental health traumas (Clay and Rogus, 2021). The isolation, however, provided an opportunity for mental health options via mobile health apps, video conferencing to connect with loved ones, and the use of social robots. However, several researchers noted that mobile apps for mental health and behavior change are limited with regard to accessibility (Torous et al., 2020, Echegaray, 2020, Garrett et al., 2020). Specifically, the augmented and virtual realities may produce more inequities for people with disabilities and older adults. Additionally, some of the technology used may require user training; however, this may have been an obstacle during the pandemic due to social distancing guidelines (Garrett et al., 2020).

#### **Implications for specific socially vulnerable populations**

Bennett Gayle, Yuan, and Dubois (2021) suggested more research is needed that focuses on the similarities in benefits or challenges among marginalized populations or on the dimensions of vulnerability, such as race/ethnicity, low-income populations, or gender. Specifically, a wider range of technologies should be investigated beyond telehealth devices, tools, or platforms and tools for online learning (Bennett Gayle & Yuan, 2021). Through a systematic review, Yuan et al. (2021) indicated a considerable gap in research on the use, adoption, and perception of Artificial Intelligence [AI] technologies by communities that have previously experienced inequities. In addition, this review found that most AI-related research does not pay attention to marginalized populations. The COVID-19 pandemic has caused a global mental health crisis because of the isolation, stay-at-home orders, and preventive measures implemented to curb the spread. Dubois and Yuan (2021a) investigated the mental health challenges that socially vulnerable populations face during crises and identified factors affecting these populations during the COVID-19 pandemic.

#### *Racial and Ethnic Groups*

Dubois, Bright, and LaForce (2021) examined the technology adoption of racial and ethnic minority students in the US during the COVID-19 pandemic and found that "technology literacy is a necessity for civic and economic activity" and "teachers validate digital competency differently depending on students' race and class" (p. 14). However, they also mentioned that "Black students in urban public schools have often been deprived of the resources and opportunities to engender technological ambition" (p. 15).

The COVID-19 pandemic has disproportionately affected racial and ethnic minorities through technology-facilitated violence and racism (Bailey, Flynn & Henry, 2021), including Black and Asian American populations (Ruiz, Horowitz, & Tamir, 2020, Yang, Tsai, & Pan 2020). Pew Research Center (2020) reports that the effects on Black and Asian American populations were far-reaching beyond health and income, with nearly 40% of this collective population feeling that others were uncomfortable around them, that they had been subject to jokes, or felt threatened that

someone might attack them (Ruiz, Horowitz, & Tamir, 2020). However, Asian American adults felt this the most, over 30% (Ruiz, Horowitz, & Tamir, 2020). The anti-Asian rhetoric and stigmas have worsened their mental health amid the pandemic. Dubois and Yuan (2021b) examined the theory of interactionism and its relation to the nature of the disparities faced by Asian Americans during the crisis. Several disparities rooted in historical racism, socioeconomic state, and culture were identified and used as a baseline to highlight recommendations to mitigate the mental health challenges of associating COVID-19 with people of Asian descent. Research from Yang, Tsai, and Pan indicates that social media platforms were used to convey anti-Asian sentiment and discrimination during COVID-19 against Asian Americans residing in the US.

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#### *Older Adults*

Dubois et al. (2021) reported that (a) older adults' use of technology for health decision-making is predominate, b) while technologies for decision-making are positively received, access and usability present challenges, and c) there is limited focus on older adults' use of technology in the context of decision making across all life choices. In a study identifying privacy factors surrounding older adults' interactions and perceptions of technology and emphasizing the types of technology studied, Knight et al. (2021) indicate that researchers focus on designing technologies to support a need or function and investigate users' perceptions of a class or category of technologies. They further emphasized that at the heart of these studies is a spectrum of emerging technologies to address physical, psychological, or social needs. The study also identified micro-level privacy concerns, including the opaqueness of passive data collection, level of control in data collection, and the intrusiveness of surveillance technologies as barriers to technology adoption. The salience of privacy and security concerns present in most of the studies suggests they are critical factors that must be addressed when catering to older adults' technology needs.

#### *People with Disabilities*

COVID-19 and the subsequent reliance on technology influenced access to every aspect of daily life (Bennett Gayle & Yuan, 2021). It was notable that the lack of access to assistive technologies has caused concern for people with disabilities once we collectively changed to home and online (Echegaray, 2020). Some students with disabilities required more accessible technology approaches to continue their education from home (Bennett Gayle, Yuan, and Knight, 2021). Specialized accessible and assistive technology, once available in the workplace, was not available at home without high personal financial cost (Bennett Gayle, Yuan, and Knight, 2021). In terms of access to daily services, some organizations did not have access to the proper technology to be fully accessible to people with disabilities (Bennett Gayle, Yuan, and Knight, 2021).

### **5. Conclusion: Implications for NYS**

Findings from this work show that many marginalized (or socially vulnerable) populations may have faced secondary effects and difficulties during the pandemic due to the use of technology. As noted, the inability to use, adopt, or access technology during the over 19-month prolonged pandemic in NYS may have implications for health disparities, given the number of social determinants of health domains impacted, such as education, income, employment, social connections, and mental health. To summarize our insights for racial and ethnic minorities in NYS, we highlight the domains of influence, using the ecological model to show how changes are needed for the individual, communities, businesses, governments, device manufacturers, and



policymakers to tackle the digital divide problems that disadvantaged households and families during COVID-19.

#### *Micro-level (Individual and Household) Implications*

At the individual and household level, racial and ethnic minorities who are also older adults, living with a disability or low income in New York State should actively seek out opportunities to expand their digital and technical literacy. Several municipalities have provided students and older adults with mobile devices that include temporary paid broadband access, basic email, and Internet training (Bennett Gayle, Yuan, and Knight, 2021). For example, in October 2020, the New York State Office for New Americans announced the launch of a new initiative, Immigrants Can Code – Digital Literacy Pilot, that ensures immigrants have access to digital literacy education and training (NY DOS, 2020).

#### *Considerations at the Techno-sublevel*

Individuals, community organizations, and policymakers should be aware of the accessibility differences and needs in terms of language, (dis)ability, culture, or age. Additionally, other factors such as privacy and security concerns may limit the use and adoption of different technologies employed. As new initiatives to provide equitable Internet access are considered, cybersecurity education and training should be a necessary component (Exec. Order No. 14028, 2021).

#### *Meso-level (Community and Business) Implications*

Community organizations and businesses moving online should be aware of the digital and technical literacy needs of those employed by them, as well as those they serve. To encourage these types of opportunities, the New York Digital Inclusion Fund launched exciting new grant opportunities for New York-based digital inclusion work. The fund will support innovative partnership models accelerating digital inclusion across New York State (Cooper Benjamin, 2021). Furthermore, community organizations may also want to consider the lack of computer devices or assistive devices among those they serve. Conversely, for those who gain more opportunities due to online and work-from-home environments (such as some women and individuals with disabilities), any move to reverse this opportunity can put them at a disadvantage. Companies such as PepsiCo (headquartered in Purchase, NY) have implemented a new 'Work that Works' program to allow half of its office staff to work from home permanently (Sorenson and Hockett, 2021). Similarly, bankers on Wall Street are now able to work from home after having the experience during the height of the pandemic (Nyugen, 2021).

#### *Exo-level (Policy and Government) Implications*

Government agencies, cities, and municipalities may want to consider unique opportunities for constituents to broaden broadband access and increase access to needed technologies to assist with employment concerns, education, and daily services. New York City, for instance, in collaboration with T-Mobile, provided 10,000 tablets to older adults with preinstalled applications to help manage social isolation (Department for the Aging, 2020; New York City Council, 2020). Additionally, the New York State Education Department provided a compiled list of resources to assist career and technical education teachers during extended closures due to COVID-19. Other agencies, businesses, or organizations should have been able to do the same (NYSED, 2020).

#### *Macro-level (Cultural and Societal) Implications*

The pandemic not only highlighted the digital divide but also challenged the notion of access to the Internet as a luxury. In response to COVID-19, policies such as *NYS on Pause* made information and communication technologies and access to broadband wireless a necessity for everyone. New legislation introduced seems to reinforce this new cultural and societal shift in thinking about Internet access. Telecom leaders hope that \$65 billion in broadband funding contained in the \$1.2 trillion bipartisan infrastructure bill will allow NYS to be a leader in providing universal access to high-speed broadband wireless (DeMola, 2021).

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