FOCUS: Broadband Affordability, Health, and Wellbeing in California

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January 2023

Abstract

This focus paper examines the connections between high broadband prices and broadband adoption and analyzes demographic and health outcomes in areas that lack broadband access. The Health Impact Analysis (HIA) methodology is used to examine the ways in which Californians who are most in need of broadband for healthcare and education are less likely to have access to broadband. The analysis uses quantitative and qualitative data on health determinants related to social and community context, economic stability, education, healthcare, and social services, as well as health outcome data. This paper finds that price is a major barrier to broadband adoption, and that areas who could benefit from access to online health services and education the most, including areas with higher proportions of people with disabilities and people with significant health conditions, are often less likely to have broadband service. This paper also finds that broadband service is becoming increasingly necessary for households to access healthcare and for youth to succeed educationally.

Contents

List of Figures

List of Tables

Key Terms

Broadband	High-speed Internet access that allows users to access the Internet and Internet-related services at significantly higher speeds than those available through "dial-up" services. This is currently defined as 25/3 Mbps. See https://www.fcc.gov/consumers/guides/getting-broadband-qa.
Broadband subscription rate	The percentage of total population with access to broadband service that subscribes to a broadband service.
Broadband adoption	Daily access to the Internet: • at speeds, quality and capacity necessary to accomplish common tasks, • with the digital skills necessary to participate online, and • on a personal device and secure convenient network. See Rhinesmith, Colin. (January 2016) "Digital Inclusion and Meaningful Broadband Adoption Initiatives." Evanston, IL: Benton Foundation. benton.org/broadband-inclusion-adoption-report, accessed September 2, 2022.
Broadband penetration rate	The ratio of residential broadband subscriptions to households compared to the total number of households in a given area. See California Broadband Report: A Summary of Broadband Availability and Adoption in California as of June 30, 2011 https://www.cpuc.ca.gov/-/media/cpuc-website/files/uploadedfiles/cpuc_public_website/content/utilities_and_industries/communications_-_telecommunications_and_broadband/reports_and_presentations/california-broadband-report-june-201
Social Determinant of Health (Health Determinant)	Any condition in the environments in which people are born, live, learn, work, play, worship, and age that affects a wide range of health, functioning, and quality-of-life outcomes and risks. See https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health#:~:text=Social%20determinants%20of%20health%20are%20conditions%20in%20the,of%20health%20of-life%20outcomes%20and%20risks.

Broadband Pricing, Adoption and Health Implications

Broadband access is essential to access healthcare

Broadband is an essential service for accessing healthcare, education, emergency services, employment, and social services.[1] This has been especially clear during emergencies like the COVID-19 pandemic and the several wildfires in the California. The Public Advocates Office at the California Public Utilities Commission (Cal Advocates) released a white paper examining broadband pricing and its impacts on the wellbeing of Californians called *Broadband Pricing Trends in California.* This paper examines pricing trends for large broadband providers and finds that California has some of the highest monthly recurring broadband prices in the nation. This paper also finds that since the start of the COVID-19 pandemic, the prices of some broadband plans have markedly increased. *The Broadband Pricing Trends in California* paper is supported by two focus papers: *Pricing Trends for California's Small Local Exchange Carriers*, which examines pricing trends for smaller broadband providers, and this paper, *Broadband Affordability, Health, and Wellbeing in California*.

The impacts that high broadband prices have on families' ability to purchase fast, reliable broadband service, and to access online services necessary for their health and wellbeing are critical to understanding the pricing trends examined in *The Broadband Pricing Trends in California* and *Pricing Trends for California's Small Local Exchange Carriers*. This focus paper examines the impacts of high broadband prices and broadband adoption and analyzes the important role broadband plays in the lives of Californians.

Price is a barrier to broadband adoption.

1 in 5 surveyed Americans were concerned about being able to pay their broadband bills in 2021.

National surveys have found that households increasingly rely on broadband service to access healthcare, education, employment, social connections and community support, and that this reliance increased during the COVID-19 pandemic. The Pew Research Center (Pew) April 2021 American Trends Panel Survey found that of the 4,623 American adults surveyed, 90% reported that broadband was essential or important during the COVID-19 pandemic.[2] 40% of people reported using digital technology or broadband in new or different ways since the

COVID-19 pandemic began, including video calling and conferencing, obtaining groceries, food, or related products, using essential services, and working remotely. 30%, 27% and 20% of respondents, respectively, also reported that video calls, email and social media helped "a lot" in staying connected with friends and family during the COVID-19 pandemic.

While increasingly relying on broadband service, households are experiencing significant issues regarding broadband service quality and price. In a 2021 Pew survey, 49% of American adults surveyed who had broadband at home reported often or sometimes having problems with broadband speed, reliability, or quality.[3] Of those who had broadband at home, 28% reported worrying about paying for their broadband service "a lot" or "sometimes."[4]

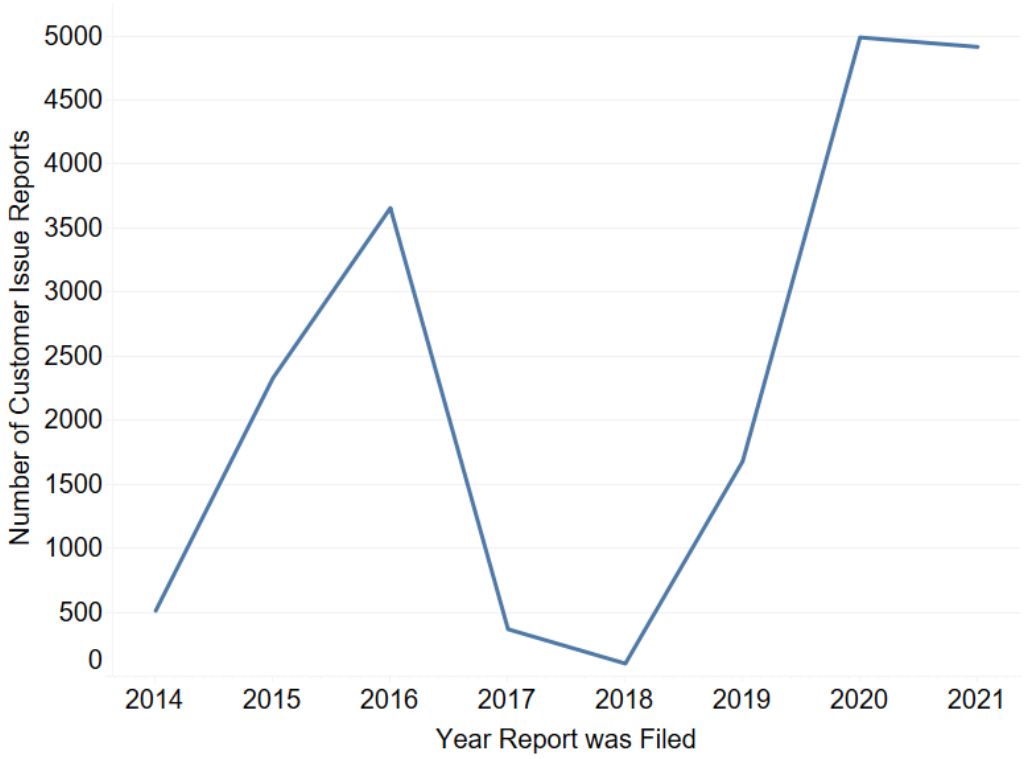
"I have been without cable and internet services for about a week. […] Cable and internet are essential services. Our children cannot complete their distant learning schoolwork without internet. […] [BROADBAND PROVIDER] should be accountable to provide reliable service. Their service is essential, especially during the pandemic. We rely on the services we pay for."

-California Customer

Source: CPUC Customer Affairs Branch.

Households' increasing issues with broadband prices are also visible in customer reports made to the Federal Communications Commission (FCC) and the California Public Utility Commissions' (Commission) Customer Affairs Branch. California customer reports to the FCC about broadband billing, or pricing, increased by more than 350% from 2019 to 2021 (545 reports were made in 2019 and 1926 reports were made in 2021, see Figure 1). Of all issues related to broadband reported to the FCC in 2020-2022, issues related to billing accounted for 38%.

Figure 1: California customer broadband billing (pricing) issues reported to the FCC, 2014-2021[5]



Of the 501 customer issue reports pertaining to broadband issues received by the Commission's Consumer Affairs Branch from March 2020 to March 2022, 156 were reviewed in depth for their content. 43% of customers mentioned concerns about plan affordability, including increasing prices and companies' pricing policies. (See Table 1).

Table 1: Issues mentioned in customer issue reports made to the CPUC's Consumer Affairs Branch, 2015-2019

Report issue	Count
Affordability (concerns about increasing prices, companies' pricing policies, etc.)	67
Incorrect charges	45
Quality	27
Billing issues (transparency, reimbursement, discount)	20
Additional charges	16
Cancellation issues	16
COVID-19 (issues related to remote learning, shelter in place, working from home during the COVID-19 pandemic)	12
Education	5
Health and safety	2

Broadband penetration rates and Californians' health and wellbeing.

Cal Advocates used the Health Impact Assessment (HIA) model to examine the ways in which Californians who need healthcare, education and other social services the most are less able to access and subscribe to broadband. Cal Advocates examined households' ability to access important health determinants, which are conditions in the environments in which people live, learn, work, play, worship, and age that affects a wide range of health and quality-of-life outcomes and risks.[6] Cal Advocates reviewed key health determinants in the following categories: social and community context, economic stability, education, healthcare, and social services. Cal Advocates also completed more in-depth analyses on two health determinants: access to healthcare and access to education. Cal Advocates then examine how these health determinants overlapped with households' access to and subscription of broadband.

As the COVID-19 pandemic has shown, broadband is critical to accessing services that are necessary for health and wellbeing. Factors that influence people's health and wellbeing are correlated with broadband penetration rates, indicating that households who could benefit from online health and social services are often less likely to have broadband subscriptions. Many socio-economically disadvantaged communities face compounding issues that negatively impact their health.[7]

Households who could benefit from access to online health and wellbeing services the most may be less able to because they do not have broadband service.

There are many underlying causes related to whether an area has access to broadband and the area's health determinants and outcomes. This paper does not examine causal links between access to broadband and health determinants and outcomes. Instead, it examines associations between areas' health determinants and outcomes and their broadband penetration rates.

Areas in California with negative health determinants also had lower broadband penetration rates. Zip codes with lower median household incomes and lower percentages of the population with bachelor's degrees had lower rates of households subscribing to broadband. Zip codes with

higher percentages of people with disabilities, and higher unemployment rates, higher percentages of people using Medicaid (or other means-tested public health insurance), and higher percentages food stamp/Supplemental Nutrition Assistance Program (SNAP) use also had lower rates of households subscribing to broadband (see Table 2).

Table 2: Correlations between health determinants and broadband penetration rates by zip code in California, 2015-2019[8]

Factor	Coefficient[9]	P-value[10]	R^2 Value[11]	No. of modeled observations (n)
Median household income	0.0002	<0.001	0.4036	1627
Percent with a bachelor's degree	0.6348	<0.001	0.2453	1722
Percent on Medicaid or means-tested public health insurance coverage	-0.4496	<0.001	0.1985	1722
Percent on food stamps/SNAP	-0.6196	<0.001	0.1736	1722
Percent disabled	-0.5756	<0.001	0.1118	1722
Percent unemployed	-0.9294	<0.001	0.0464	1722

**All relationships are statistically significant at a 95% confidence level.*

Areas with higher rates of poor health outcomes also have lower broadband penetration rates (Table 3). Counties with higher percentages of people experiencing mental distress[12] and physical distress,[13] higher child mortality rates[14] and infant mortality rates[15] had lower percentages of households subscribing to broadband. Counties with populations that reported poorer physical and mental health also had lower percentages of households subscribing to broadband.

Table 3: Correlations between health outcomes and broadband penetration rates by county, 2015-2019[16, 17]

Factor	Coefficient	P-value	R^2 Value	No. of modeled observations (n)
Percent in mental distress[18]	-2.8728	<0.001	0.6715	58
Child mortality rate[19]	-0.2209	<0.001	0.6114	51
Number of poor mental health days[20]	-10.1395	<0.001	0.5945	58
Percent in physical distress[21]	-2.0576	<0.001	0.5181	58
Number of poor physical health days[22]	-7.2622	<0.001	0.4676	57
Infant mortality rate[23]	-2.3676	<0.001	0.4611	43
Percent in fair/poor health[24]	-0.6864	<0.001	0.2689	58

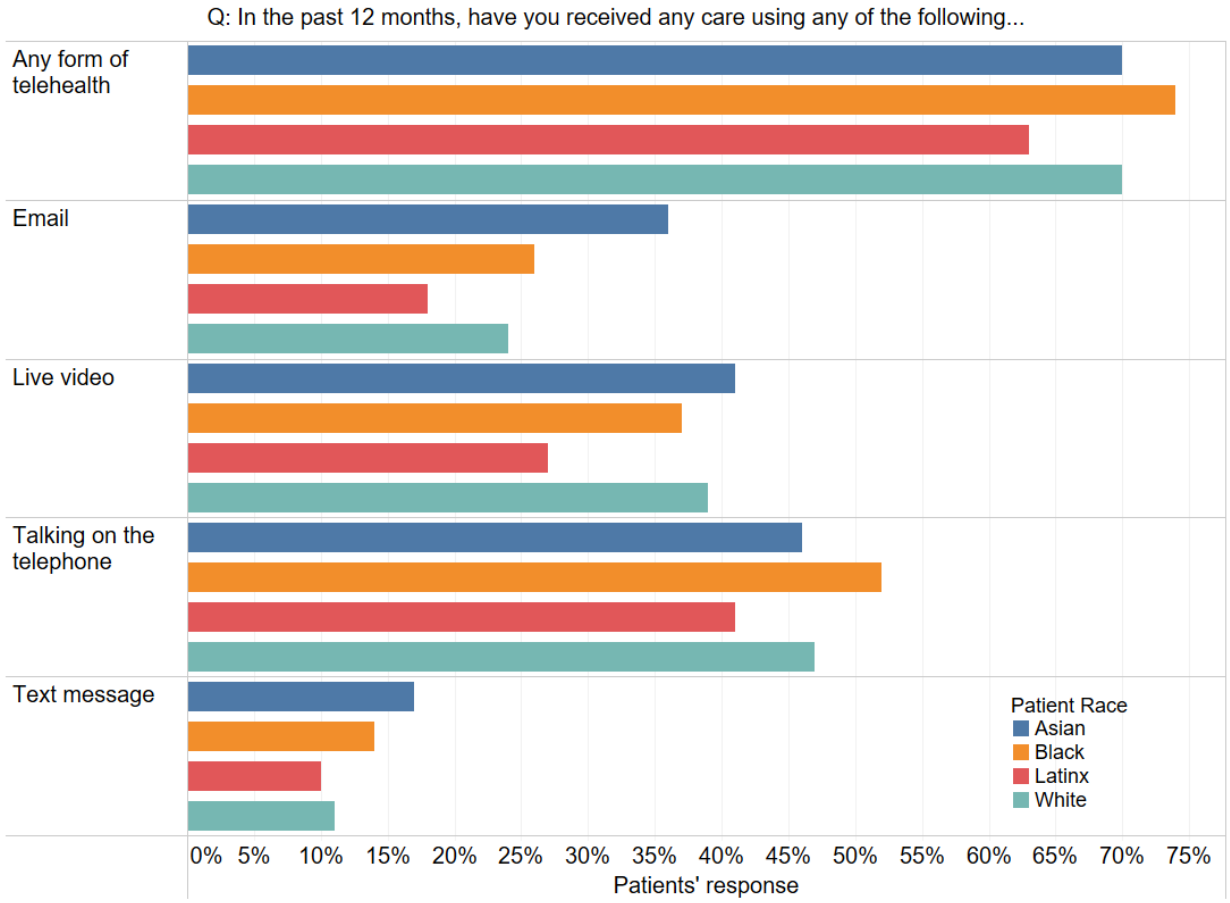
**All relationships are statistically significant at a 95% confidence level.*

These findings show that multiple negative health determinants and negative health outcomes disproportionately impact specific California communities. The analysis shows that areas facing factors that are detrimental to their health and experiencing negative public health outcomes also had lower percentages of households subscribing to broadband, meaning that households that could benefit from online healthcare and social services the most are less likely to be able to access these services. This analysis shows correlational relationships, not causal relationship, between health determinants, health outcomes, and broadband penetration, meanings that these factors are related, but the analysis does not show whether broadband penetration rates and health determinants and outcomes *influence* one another.

An affordable broadband connection is critical to access healthcare.

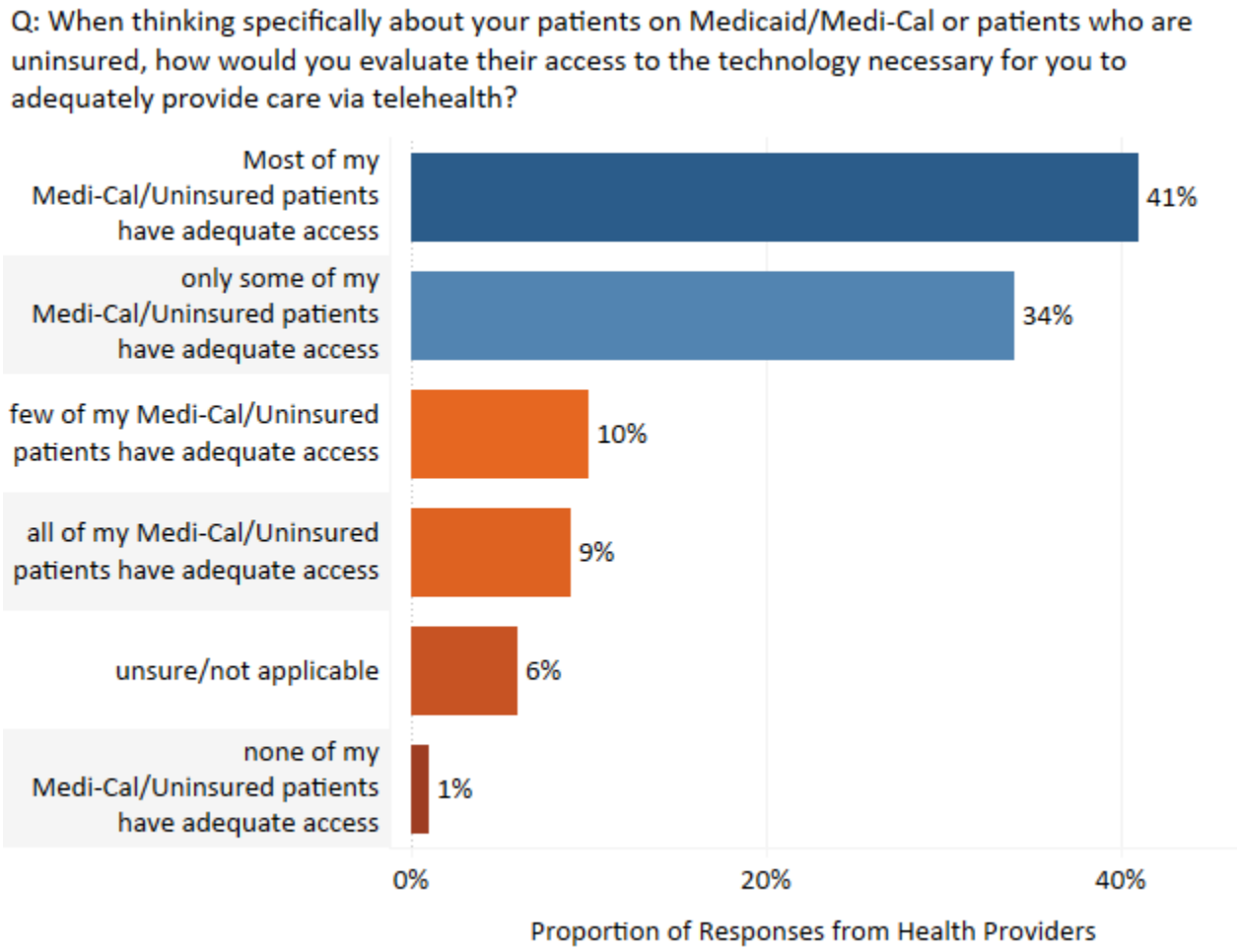
During the COVID-19 pandemic, California's patients and medical care providers increasingly relied on telehealth, which includes attending appointments over the phone or internet, or accessing healthcare records, information, or related services over the internet. However, many vulnerable patients do not have adequate access to the technology necessary to access the care they need. Based on the California Health Care Foundation's California Telehealth Patient and Care Provider Surveys that surveyed patients and health practitioners weekly during the beginning of the COVID-19 pandemic, 63-74% of patients had used some form of telehealth (see Figure 2).

Figure 2: Patients' use of telehealth services by race, March-September, 2020[25]



Black and Asian patients had the highest use of telehealth of patients surveyed. Most healthcare providers reported they were likely to continue to use telehealth after the pandemic, indicating that telehealth will remain essential for accessing care.[26] However, a large percentage of practitioners (44%) reported that only some, few or none of their Medi-Cal or uninsured patients had adequate access to technology needed to use telehealth care (see Figure 3).[27] These findings indicate that now and for the foreseeable future patients require telehealth to access care, and that some demographics will be missing out from this form of care due to lack of broadband or broadband-connecting devices. Ensuring that all Californians have access to broadband at speeds necessary to use telehealth is critical.

Figure 3: Medi-Cal and uninsured patients' ability to access technology necessary to use telehealth [28] 2020



Areas with fewer healthcare providers are also more likely to need access to telehealth. However, broadband penetration rate in areas in California with primary care provider shortages is 7.2% lower than the average penetration rate in areas without primary care provider shortages.[29] This finding indicates that households who are already facing issues accessing healthcare and who could most benefit from telehealth may be less able to access telehealth services because they lack broadband service.

An affordable broadband connection is critical to access education.

Access to education and educational resources is critical to the short- and long-term health and wellbeing of youth, families, and adults. While learning initself has been shown to positively contribute to physical and mental health, schools also often offer students access to health-promoting resources, including consistent schedules, physical activity, meals, and basic wellness checks. In the long-term, educational attainment often increases peoples' ability to access health resources.[30]

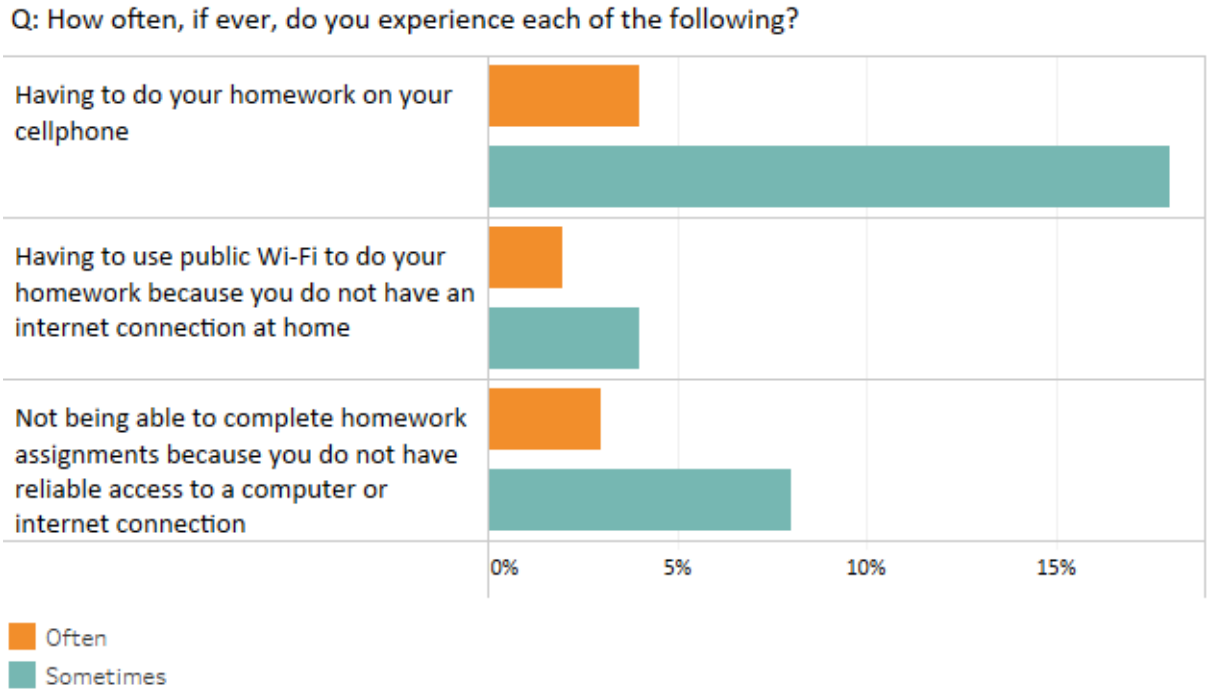
"I know the COVID-19 situation is paramount, but I think companies are taking advantage during the 'distractions' this pandemic is causing. I am in need of assistance [regarding the COVID-19 Remote Education Credit for Students]. With me only having service for 11 days, a $309.98 bill is unacceptable for something that was supposed to have been free. […] I have 4 children, 3 are in school and are in need of the internet […]. I would like for CPUC to reach out to [BROADBAND PROVIDER] and help them to honor their COVID-19 Remote Education Credit for Students[, t]o waive the activation fee and provide me 60 days of service for free[,] as it states."

-California Customer

Source: CPUC Customer Affairs Branch.

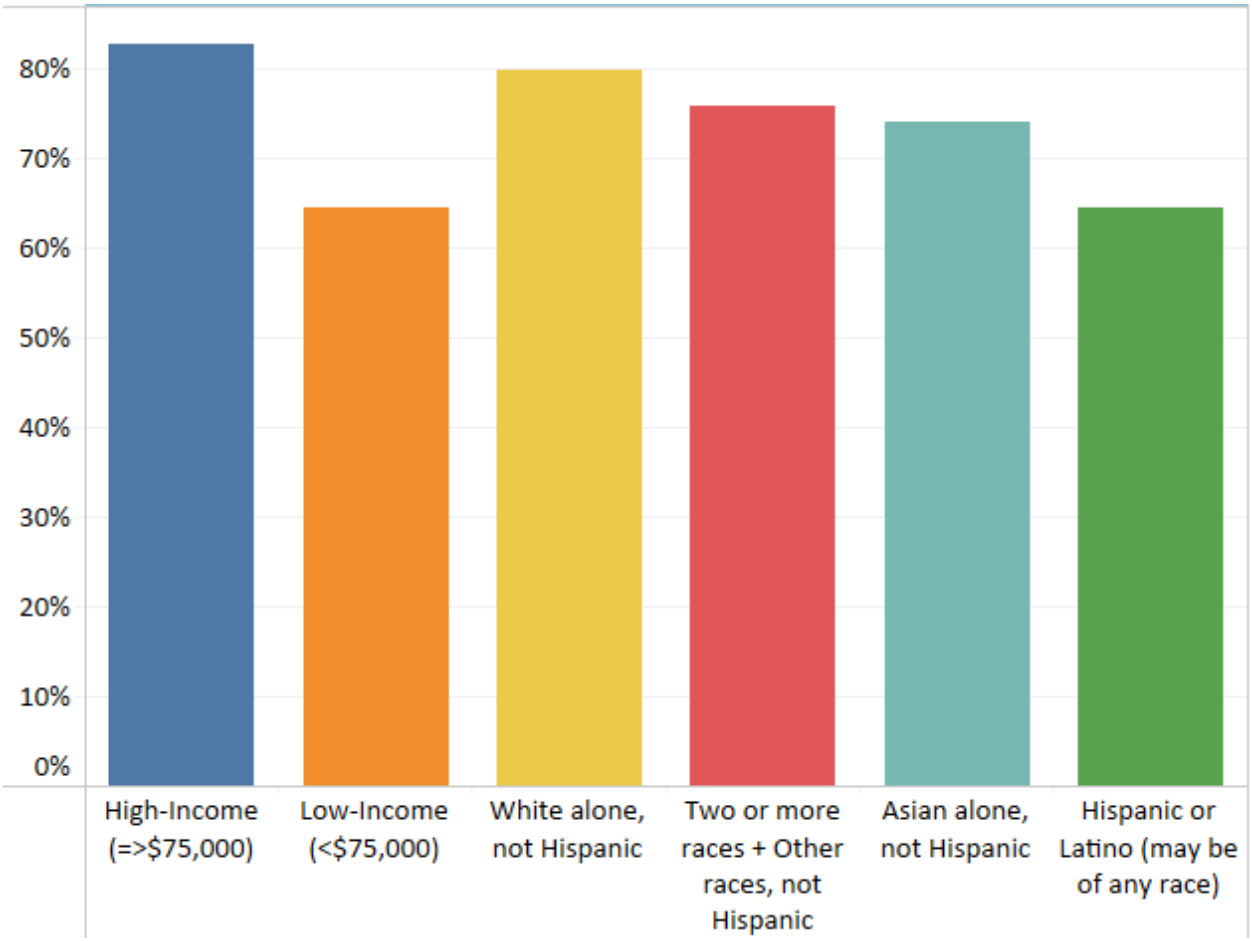
In a Pew survey conducted amongst teenage students across the U.S. in April and May 2021, 8% and 11% of students reported attending school either partially or completely online during the previous month.[31] In total, 11% of students reported often or sometimes not being able to complete homework assignments because they did not have reliable access to a computer or internet connection, while 6% reported often or sometimes needing to use public wi-fi to do homework because they did not have an internet connection at home (Figure 4).[41]

Figure 4: Teens' use of broadband to complete homework, 2021[32]



In California, K-12 students living in high income households or white households were more likely to have access to the internet for educational purposes than students in low-income households or households of color. 83% of K-12 students from households with incomes equal to or above $75,000 reported always having broadband available to students, while only 65% of student from low-income households (incomes < $75,000) had broadband. 80% of K-12 student households that were white has access to broadband, while only 65% of Latino households did (Figure 5).

Figure 5: Proportion of California households with students that have consistent access to broadband, Jan-March, 2021[33]



Educational outcomes are also correlated with broadband availability. Areas in California that had higher percentages of households subscribing to broadband also had higher average math and reading scores for third grade students. Counties with higher broadband penetration rates have lower percentages of youth between the ages of 16-19 who were not in school or working ("disconnected youth") (see Table 4).

Table 4: Correlations between broadband penetration rate and educational indicators by county, 2015-2019[34, 35]

Factor	Coefficient	P-value	R^2 Value	No. of modeled observations (n)
Grade 3 math scores	16.2086	<0.001	0.4351	57
Grade 3 reading scores	18.3769	<0.001	0.4155	56
Disconnected youth	-0.7658	<0.001	0.3454	46

**All relationships are statistically significant at a 95% confidence level.*

These findings indicate that broadband is increasingly essential for youth to go to and succeed in school, and lower-income and Latino students in California are less likely to have access to the broadband they need to complete homework and participate in distanced learning. The COVID-19 Pandemic showed the important role students' access to broadband has in their ability to participate in education, as well as the important role schools have in the health and wellbeing of students.

Conclusion

The impacts that high broadband prices have on families' ability to purchase fast, reliable broadband service, and the important role access to broadband plays in families' health and wellbeing are critical to understanding the increasing prices Californians are paying for broadband service. This paper finds that households that need broadband to access telehealth, education, and other social services are often not subscribing to broadband. Communities with negative health determinants, like lower household incomes and higher proportions of people with disabilities, often have lower broadband subscription rates. Communities with negative health outcomes, like high rates of physical and mental distress and high child and infant mortality rates, also often have lower broadband subscription rates. This paper also finds that access to broadband is increasingly necessary for households to access healthcare and youth to succeed educationally.

Notes:

[1] *See* Decision (D.) 20-07-032 (2020, July 16), Decision Adopting Metrics and Methodologies for Assessing the Relative Affordability of Utility Service, pp. 27-32.

See also D.21-10-020, Rulemaking 20-09-001 (2021, October 21), Decision Resolving Phase I of Broadband for All Proceeding, p.2.

See also Executive Department, State of California (2020, August 14), Executive Order (E.O.) N-73-201.

[2] Pew Research Center. (2021, April 12-18). 2021 Pew Research Center's American Trends Panel, Wave 88, April 2021. https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2021/09/PI_2021.09.01_COVID-19-and-Tech_TOPLINE.pdf.

[3] Pew Research Center. (2021, April 12-18). 2021 Pew Research Center's American Trends Panel, Wave 88, April 2021. https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2021/09/PI_2021.09.01_COVID-19-and-Tech_TOPLINE.pdf.

[4] Pew Research Center. (2021, April 12-18). 2021 Pew Research Center's American Trends Panel, Wave 88, April 2021. https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2021/09/PI_2021.09.01_COVID-19-and-Tech_TOPLINE.pdf.

[5] It is unclear why there was a dip in reporting between 2016-2019. One potential reason may be that from 2014-2016, the FCC was deciding on net neutrality regulations and may have received an increase in customer reports related to this issue, causing an increase in customer reports from up to 2016.

[6] Healthy People. Social Determinants of Health Definition. https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health#:~:text=Social%20determinants%20of%20health%20are%20conditions%20in%20the,of%20health%2C%20functioning%2C%20and%20quality-of-life%20outcomes%20and%20risks.

[7] See Appendix A for more information about how these health determinants were selected.

[8] Agency for Healthcare Research and Quality (AHRQ) Social Determinants of Health dataset and County Health Ranking dataset.

[9] Coefficient value represents the direction and association of the relationship between the independent and dependent variable. For instance, with a 1% increase in proportion of the county that had a broadband connection, there is likely to be a 0.6348% increase proportion of the county with a bachelor's degree.

[10] The p-value is used to determine the probability of data occurring by random chance. A p-value of less than 0.05 is typically considered statistically significant.

[11] The R^2 value is used to represent the proportion of variance for a dependent variable that is explained by one or more independent variables in the regression model.

[12] Percentage of adults reporting 14 or more days of poor mental health per month.

[13] Percentage of adults reporting 14 or more days of poor physical health per month.

[14] Number of deaths among children under age 18 per 100,000 population.

[15] Number of all infant deaths (within 1 year), per 1,000 live births.

[16] Agency for Healthcare Research and Quality (AHRQ) Social Determinants of Health dataset and County Health Ranking dataset.

[17] Broadband subscription data was collected between 2015-2019, other data was collected within this time period.

[18] Mental distress data was collected in 2018.

[19] Child mortality rate was collected between 2016-2019.

[20] Number of poor mental health days data was collected in 2018.

[21] Physical distress data was collected in 2018.

[22] Number of poor physical health days data was collected in 2018.

[23] Infant mortality data was collected in 2013-2019.

[24] Fair/poor health data was collected in 2018.

[25] California COVID-19 Health Surveys: Data and Charts - California Health Care Foundation (chcf.org) https://www.chcf.org/project/california-covid-19-health-surveys/#physician-survey.

[26] California COVID-19 Health Surveys: Data and Charts - California Health Care Foundation (chcf.org) https://www.chcf.org/project/california-covid-19-health-surveys/#physician-survey.

[27] California COVID-19 Health Surveys: Data and Charts - California Health Care Foundation (chcf.org) https://www.chcf.org/project/california-covid-19-health-surveys/#physician-survey.

[28] California COVID-19 Health Surveys: Data and Charts - California Health Care Foundation (chcf.org) https://www.chcf.org/project/california-covid-19-health-surveys/#physician-survey.

[29] A T-test found a p-value of <0.001, and a 95% confidence interval of 6.7-7.5% difference in subscription rate between HPSA census tracts and non-HPSA census tracts.

[30] Hahn, R. A., & Truman, B. I. (2015). Education Improves Public Health and Promotes Health Equity. International journal of health services: planning, administration, evaluation, 45(4), 657–678. https://doi.org/10.1177/0020731415585986.

[31] Pew Research Center, (2022, May). 2022 Pew Research Center's Teens Survey. https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2022/05/PI_2022.06.02_teens-covid19-school_REPORT.pdf, p. 20.

[32] Pew Research Center, (2022, May). 2022 Pew Research Center's Teens Survey. https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2022/05/PI_2022.06.02_teens-covid19-school_REPORT.pdf.

[33] US Census Bureau Household Pulse Survey Data, Phase 3 weeks 22-33. https://www.census.gov/programs-surveys/household-pulse-survey/data.html#phase3.

[34] Agency for Healthcare Research and Quality (AHRQ) Social Determinants of Health dataset and County Health Ranking dataset.

[35] Broadband subscription and disconnected youth data was collected between 2015-2019, math and reading score data was collected in 2018.

Appendix A: Samples of Issue Reports made to the Commission's Customer Affairs Branch during the COVID-19 Pandemic

"I have been trying to cut the excessive costs of my cable programming and want to switch to internet only. I have been advised that having internet only will cost close to $200 per month [...]. It is impossible to see what their regular pricing is because they do not publish it anywhere. Their raising of internet prices during an emergency by what amounts to 70-100% is, by definition, price gouging."

"[BROADBAND PROVIDER] is capitalizing on the Coronavirus situation where people are mandated to stay at home by raising rates. As a California educator, this aggressive tactic against customers who rely on a monopolized internet access service for the area in which a person lives is unconscionable. While this company offers "free" internet to students, who are minors and cannot enter into a contract, they charge the teachers higher prices as well as other customers to offset the vendors "free" service. This company is purposely stonewalling customers and surge charging with no notification on the bill with NO ADDITIONAL services or changes in services requested or provided. [BROADBAND PROVIDER] then uses aggressive sales tactics to deny customers any recourse to maintaining their present area monopolized service at a higher rate than either advertised or notified. The timing of such increase in prices falls "mysteriously" in line with Coronavirus mandates to stay home."

"[BROADBAND PROVIDER] makes misleading statements and intentionally omits statements that amount to hidden fees and issues in their bill. I had bad service with them and I complained. I also complained [that] my bill is too high and I want to know how I can reduce it. They failed to tell me that I could save at least $5 a month by using my own router. They failed to tell me there were other discounted rates available. […] They have a monopoly on service here and I can't get service with anyone else."

"I was informed that they were raising my contract pricing for Internet and phone service by $15 per month. I certainly would expect that in good times, but I have a problem accepting the fact that they are doing so during this particular period [COVID-19 Pandemic]. […] We either need more competition for internet services, or we should force them to hold down their prices during this period when people are being laid off [from] their jobs right and left. Personally, I think that their actions border on criminal. I would like all price increases rescinded until this coronavirus pandemic is over. That way, at least I have a reasonable possibility of contacting other providers who may be able to provide less expensive service […]."

"[BROADBAND PROVIDER] changes rates without giving notice to customers. For example my rate went from $25/mo to $55/mo for the same 10 MB basic internet only service. […] I want [BROADBAND PROVIDER] to publish a rate plan that consumers can refer to without their sales gimmicks."

Appendix B: Methodology

Health Impact Analysis

Cal Advocates used the Health Impact Assessment (HIA) model to better understand the ways in which Californians' ability to access and subscribe to broadband relate to their public health, safety and wellbeing.[36] A HIA is an approach used to determine the potential health effects of a condition, policy, program or project on a population. HIAs are often used on issues that touch on public health but are not squarely within the public health field. They can be used to engage stakeholders, members of the public and decision makers in considering public health impacts related to a situation or proposal.

First, Cal Advocates reviewed and hypothesized whether having access to high speed, reliable broadband would impact a set of 35 health determinants in the following categories: built environment, social and community context, economic stability, education, healthcare and social services, and other.[37] Based on this review, Cal Advocates hypothesized that not having a broadband subscription could negatively impact 19 or the 35 health determinants. Cal Advocates then reviewed literature based on the hypothesized health impacts related to broadband access, and based on this review, Cal Advocates limited the analysis to focus on general health determinants and outcomes, with more in-depth analyses on two health determinants: access to healthcare and access to education.

Developing the Assessment

Cal Advocates then reviewed available data based on the above topics, and limited the analysis to understanding broadband penetration, which is the percentage of the total population that subscribes to a broadband service, compared to access to general health determinants, access healthcare and education. Based on the cursory research explained above, Cal Advocates developed the following research questions:

1. Are populations with lower rates of broadband penetration also less likely to have access to positive health determinants?
    a. Are populations with lower rates of broadband penetration also likely to have less access to healthcare?

b. Are populations with lower rates of broadband penetration also likely to experience poor educational determinants?

2. Are populations with lower rates of broadband penetration also likely to have poorer health outcomes?
3. How have customers' experiences with broadband service impacted their access to health resources?

To answer these questions, Cal Advocates compiled the following datasets:

Dataset	Time period	Geographic area	Summary of Dataset
Agency for Healthcare Research and Quality (AHRQ) Social Determinants of Health dataset[38]	2018	county and zip code	Includes publicly available data from 17 sources[39] on population distribution, age, race/ethnicity, social vulnerability, segregation, living conditions, workforce/employment, poverty, income, education, physical infrastructure, environment, crime, housing, food access, transportation, healthcare access, healthcare quality, health insurance status, health behaviors, health status, healthcare utilization, healthcare system characteristics and mortality.
County Health Ranking dataset[40]	2015-2019	county	Includes publicly available data from 15 sources[41] on length of life, quality of life, diet and exercise, alcohol and drug use, other health behaviors, access to healthcare, education, income, family and social support, community safety, housing and transit, demographics.
Health Resources and Service Administration Health Professional Shortage Area data	2022	Primary Care Health Professional Shortage Areas	Primary Care Health Professional Shortage Areas are determined by the Health Resources and Service Administration as areas where there are fewer than 1 primary care physician per 3,500 people, or 3,000 people if the population is indicated as having high health needs.
California Public Utilities Commission's Consumer Affairs Branch customer issue reports	March 2020-April 2022	Individual address, California	Telecommunications customers' reports to the Commission's Consumer Affairs Branch (CAB) regarding issues they are experiencing with telecommunications service.
FCC customer issue reports	March 1, 2020-April 1, 2022	State and city	Telecommunications customers' reports to the FCC regarding issues they are experiencing with telecommunications service.
California Health Care Foundation's California	March – September, 2020	State	Surveys were conducted with patients and healthcare providers to determine the impact of the COVID-19 pandemic on healthcare access.

Telehealth patient and care provider survey			Surveys were conducted between March-September 2020.
Pew Research Center American Trends Panel Survey	April 2021	National	The American Trends Panel is a nationally representative sample of randomly selected U.S. adults. Participants take the survey via self-administered web surveys. Participants who do not have internet access at home are provided with a tablet and wireless internet connection. Interviews are conducted in both English and Spanish. The April 2021 sample size was 4,623.
Pew Research Center Teen Survey	April/ May 2022	National	Pew Research Center surveyed 1,316 pairs of U.S. teens and their parents – one parent and one teen from each household. The survey is weighted to be representative by age, gender, race, ethnicity, household income and other demographic factors.

Based on the data available, Cal Advocates increased the specificity of the research questions and followed the methodologies described below.

Research question 1: Are zip codes with lower rates of broadband penetration also less likely to have positive health determinants?

Using the AHRQ Social Determinants of Health dataset, Cal Advocates compared percentages of households that had a broadband penetration from American Community Survey (ACS) 2015-2019 five-year estimates to median household income, the percentage of the population that is unemployed, the percentage of the population who received Medicaid, the percentage of the population who received food stamps, the percentage of the population with a bachelor's degree, and the percentage of the population that is disabled by zip code in California. Cal Advocates ran linear regressions between the listed factors above to determine whether these factors were correlated and the strength of the correlation.

Research question 1a: Are census tracts with lower rates of broadband penetration also likely to be in health professional shortage areas?

Cal Advocates used California shapefiles for "Health Professional Shortage Area" (HPSA), a designation from the Health Resources and Service Administration that indicates whether a given area has a shortage of primary care physicians. Cal Advocates used ArcGIS to

determine which census tracts fall within HPSAs. Then, Cal Advocates used RStudio to join HPSA census tracts to broadband data by census tracts and ran a hypothesis test comparing the mean percentage of households with a broadband penetration in HPSA census tracts to the mean percentage in non-HPSA census tracts.

Research question 1b: Are counties with lower rates of broadband penetration also likely to experience poor educational determinants?

Cal Advocates merged the AHRQ Social Determinants of Health dataset and County Health Ranking dataset by county, then compared percentages of households with broadband penetration to average math and reading scores for grade three students in each county, and the percentage of youth aged 16-19 who are not in school and not working. Cal Advocates ran linear regressions between the listed factors above to determine whether these factors were correlated and the strength of the correlation.

Research question 2: Are counties with poor health outcomes less likely to subscribe to broadband?

Cal Advocates merged the AHRQ Social Determinants of Health dataset and County Health Ranking dataset by county, then compared the percentage of county populations subscribing to broadband and the percentage of the population reporting being in mental distress,[42] physical distress,[43] fair/poor physical health,[44] the average number of days that county populations reported being in poor mental and physical health per month, child mortality rate,[45] and infant mortality rate.[46] Cal Advocates ran linear regressions between the listed factors above to determine whether these factors were correlated and the strength of the correlation.

Research question 3: how have customers' experiences with broadband service impacted their access to health determinants?

Cal Advocates requested customer issue reports made to the Consumer Affairs Branch (CAB data) under the following parameters:

- Name of utility/entity – all telecommunications providers,
- Subject matter – broadband,
- Industry – telecommunications,
- Time period – March 1, 2020-April 1, 2022,
- Case type – all contacts, including misdirected contacts,

- Geodata.

Based on these parameters, Cal Advocates received data on 3634 issue reports. Cal Advocates filtered these reports by "Non-Jurisdictional Internet" as a way of filtering for reports regarding customers' broadband service (501 in total). This dataset should be seen as a sample and non-inclusive of all customers reports regarding broadband from this time period.[47] Of the 501 reports, Cal Advocates reviewed specific customer language from 156 reports and coded this language based on the content of the reports using inductive coding. From this process, the following Cal Advocates developed the following codes: additional charge, affordability, billing issue (transparency, reimbursement, discount), COVID-19, education, incorrect charge, pricing policy, quality, cancellations, collections, education, health, and safety. Cal Advocates then uploaded analyzed data based on when reports were made, types of reports, and content of reports.

Cal Advocates accessed customer issue reports reported to the FCC[48] then filtered data by date (March 1, 2020 – April 1, 2022) location (California) and service type ("Broadband Story" and "Internet"). The FCC data includes codes of customer reports but not specific language about the issue being reported. Cal Advocates analyzed FCC data based on when the reports were made, and the types of reports made.

Cal Advocates reviewed findings from the following surveys: California Health Care Foundation's California Telehealth patient and care provider survey, Pew Research Center American Trends Panel Survey and Pew Research Center Teen Survey for findings regarding broadband access or adoption and respondents' access to healthcare, education, government-provided social services, emergency services, employment, and social connections and community support.

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[36] A Health Impact Assessment is an approach used to understand the potential health effects of a policy, program or project on a population, particularly on vulnerable or disadvantaged groups. It is an established method used in public health research and practice, particularly for plans, projects, and policies that fall outside traditional public health arenas. See; Center for Disease Control, "Healthy Places - Health impact assessment (HIA)" https://www.cdc.gov/healthyplaces/hia.htm, accessed on June 16, 2022; and World Health Organization, "Health Impact Assessments" https://www.who.int/tools/health-impact-assessments#:~:text=Health%20Impact%20Assessment%20%28HIA%29%20is%20a%20practical%20approach,a%

20population%2C%20particularly%20on%20vulnerable%20or%20disadvantaged%20groups., accessed on June 16, 2022.

[37] The list of health determinants was developed using a combination of two HIA screening tools: Grinnell, Sophie "Liverpool Health Impact Assessment Screening Tool and Support Notes", November 2013 https://www.semanticscholar.org/paper/Liverpool-HIA-Screening-Tool-and-Support-Notes-Grinnell/0084239307a7376299b3f0ed6178cccf3fff6fb4, and "Complete Screening Grid" accessed in

Online Course: Health Impact Assessment, Step by Step, Module 2, https://ccnpps-ncchpp.ca/online-course-health-impact-assessment-step-by-step/.

[38] "Social Determinants of Health (SDOH) Beta Data Files Data Source Documentation", https://www.ahrq.gov/sites/default/files/wysiwyg/sdohchallenge/data/sdoh_data_file_documentation.pdf.

[39] Including American Community Survey (ACS), Area Health Resources Files (AHRF), amfAR Opioid & Health Indicators Database (amfAR), U.S. Census Bureau County Adjacency File (CAF), U.S. Census County Business Patterns (CCBP), U.S. Census Bureau, TIGERweb and COVID-19 Demographic and Economic Resources (Census), Centers for Disease Control and Prevention (CDC) Interactive Atlas of Heart Disease and Stroke (CDC Atlas), CDC Wide-ranging Online Data for Epidemiologic Research (CDC Wonder), County Health Rankings (CHR), Civil Rights Data Collection (CRDC), Medicare Advantage Penetration Files (MAP), Economic Research Service (ERS), National Environmental Public Health Tracking Network (NEPHTN), National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme, Nursing Home Compare (NHC), Social Vulnerability Index (SVI), U.S. Cancer Statistics (USCS) Social Determinants of Health (SDOH) Beta Data Files Data Source Documentation (ahrq.gov).

[40] "2022 Measures" County Health Rankings & Roadmaps," https://www.countyhealthrankings.org/2022-measures.

[41] National Center for Health Statistics - Mortality Files, CDC Behavioral Risk Factor Surveillance System, United States Diabetes Surveillance System, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, Feeding America Map the Meal Gap data, USDA Food Environment Atlas, US Census Bureau's Small Area Health Insurance Estimates, Center for Medicare & Medicaid Services National Provider Identification, US Department of Education EDFacts, American Community Survey 5-year estimates, Stanford Education Data Archive, US Census Bureau's Small Area Income and Poverty Estimates, National Center for Education Statistics, EPA EJSCREEN: Environmental Justice Screening and Mapping Tool, and Census Population Estimates.

[42] The percentage of adults reporting 14 or more days of poor mental health per month (age-adjusted).

[43] Percentage of adults reporting 14 or more days of poor physical health per month (age-adjusted).

[44] The percentage of adults reporting being in fair or poor health (age-adjusted).

[45] The number of deaths among children under age 18 per 100,000 population.

[46] The number of all infant deaths (within 1 year), per 1,000 live births.

[47] The dataset does not include other reports that were categorized as "jurisdictional - billing" (which could include internet bundled packages), "non-jurisdictional rebates and promotions," "non-jurisdictional equipment," "non-jurisdictional inability to serve," and others that may apply.

[48] FCC "Customer Complaints Data" https://opendata.fcc.gov/Consumer/CGB-Consumer-Complaints-Data/3xyp-aqkj.