An Evaluation of the Telehealth Broadband Pilot Program (2021 – 2024)

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RURAL TELEHEALTH EVALUATION CENTER

Cari A. Bogulski, PhD
M. Kathryn Allison, PhD, MPH
Chris Charlton, BSEE, PE, CPI
Corey J. Hayes, PharmD, PhD, MPH
Hannah C. McCoy, MPH
Rosario Silva, MPH
Deboleena Thakur, BPharm, MS
Hari Eswaran, PhD

Rural Telehealth Evaluation Center
RTEC
University of Arkansas for Medical Sciences

UAMS
Institute for Digital Health & Innovation

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Executive Summary

In the twenty-first century, a healthy and fulfilling life is often dictated by one's access to high-speed internet, as modern healthcare, education, employment, and other needs depend on connectivity. However, millions of rural Americans still lack access to reliable broadband coverage due to market deficiencies. On September 1, 2020, 3 federal departments launched the Rural Telehealth Initiative (RTI), an effort to promote high-quality internet access in rural areas and address health disparities. The Memorandum of Understanding and RTI collaboration resulted in the creation of Telehealth Broadband Pilot (TBP) Program that aimed to test the telehealth readiness of rural communities. The TBP Program received funding in January 2021 to assess the broadband capacity of 25 rural counties or county-equivalents through December 31, 2024.

The TBP Program developed an easy-to-install device (called a "pod") that automatically collected key broadband metrics at regular intervals to create a longitudinal dataset on broadband speeds and capacity in 25 counties. Additionally, semi-structured, qualitative interviews were conducted with local healthcare stakeholders, consumers, and Program staff as part of the TBP Program evaluation. These interviews helped to identify influences on clinical broadband and health, barriers to telehealth adoption, and barriers to Program implementation.

Pods deployed across the 25 TBP target geographies conducted more than 3.6 million speed tests—measuring median download speeds, upload speeds, and response times ("latencies")—across 378 locations across healthcare sites, consumer homes, businesses, and non-healthcare community anchor institutions (CAIs). These speed tests were compared against a benchmark threshold for high speed broadband set by the Federal Communications Commission (FCC) for advertised speeds: 100 megabits per second (Mbps) download speed, 20 Mbps upload speed, and 100 millisecond (ms) latency (henceforth 100/20/100). This threshold was introduced in March 2024, replacing the previous threshold of 25 Mbps download speed, 3 Mbps upload speed, and 100 ms latency (25/3/100).

These speed tests revealed that the only location categories by states with a majority of speed tests meeting or exceeding the 100/20/100 threshold were West Virginia healthcare locations and non-healthcare CAIs in Texas, although a majority of speed tests at most location categories across the TBP geographies surpassed the prior lower broadband definition threshold of 25/3/100. However, these data also revealed that even when locations met or exceeded the 100/20/100 threshold, the broadband quality was inconsistent. Broadband in Alaska was of particularly low quality, with most speed tests conducted at consumer, healthcare, and non-healthcare CAI locations falling below the 25/3/100 threshold. Consumer locations recorded the poorest-quality broadband across all 4 TBP states, with at least 31.9% of all consumer speed tests falling below the 25/3/100 threshold in each state. Although healthcare sites across all participating TBP states had much smaller percentages of speed tests falling below this threshold, no state reported that a majority of speed tests conducted at healthcare locations met or exceeded the highest-quality broadband threshold of 100/20/100.

These findings from the TBP Program suggest that broadband may be much more variable than aggregate measures suggest. In this context, critical telehealth service may be possible, but not always feasible at all times or locations.

Background and Program Description

The TBP Program began through the launch of the Rural Telehealth Initiative (RTI), which was created through a Memorandum of Understanding between the FCC, the United States (U.S.) Department of Health and Human Services (HHS), and the U.S. Department of Agriculture (USDA). In January 2021, HHS—through the Health Resources and Services Administration (HRSA)—awarded

$8 million for the TBP Program to assess the broadband capacity available to rural health care providers and patients to improve their access to telehealth services. The National Telehealth Technology Assessment Resource Center (TTAC), based out of the Alaska Native Tribal Health Consortium (ANTHC), received $6.5 million to implement the Program, and the Telehealth-Focused Rural Health Research Center through the University of Arkansas for Medical Sciences received $1.5 million to evaluate the Program.

The TBP Program's goal was to assess and address broadband services that limit access to telehealth services in rural and other underserved communities in the U.S. This evaluation relied upon several sources of data, including:

- Direct measurement of broadband speeds over time at healthcare sites, consumer homes, non-healthcare CAIs, and businesses
- Interviews with healthcare providers and stakeholders to assess broadband and telehealth facilitators and barriers
- Interviews with local consumers to assess broadband and telehealth facilitators and barriers
- Interviews with TBP Program staff to assess Program implementation facilitators and barriers

The TBP Program was implemented in 25 counties and county-equivalents (henceforth, counties) across 4 states: Alaska, Michigan, Texas, and West Virginia. Those counties and their 2020 populations[1] were:

Alaska
1. Aleutians West Census Area (2020 Population: 5,232)
2. Bristol Bay Borough (2020 Population: 844)
3. Dillingham Census Area (2020 Population: 4,857)
4. Nome Census Area (2020 Population: 10,046)
5. North Slope Borough (2020 Population: 11,031)
6. Northwest Arctic Borough (2020 Population: 7,793)

Michigan
7. Gladwin County (2020 Population: 25,386)
8. Manistee County (2020 Population: 25,032)
9. Missaukee County (2020 Population: 15,052)
10. Montmorency County (2020 Population: 9,153)
11. Osceola County (2020 Population: 22,891)
12. Oscoda County (2020 Population: 8,219)

Texas
13. Crosby County (2020 Population: 5,133)
14. Fisher County (2020 Population: 3,672)
15. Haskell County (2020 Population: 5,416)
16. Jones County (2020 Population: 19,663)
17. Lamb County (2020 Population: 13,045)
18. Mitchell County (2020 Population: 8,990)

West Virginia
  19. Calhoun County (2020 Population: 6,229)
  20. Clay County (2020 Population: 8,051)
  21. Jackson County (2020 Population: 27,791)
  22. Kanawha County (2020 Population: 180,745)
  23. Nicholas County (2020 Population: 24,604)
  24. Ritchie County (2020 Population: 8,444)
  25. Roane County (2020 Population: 14,028)

For the direct measurement of broadband speeds over time, the FCC's updated threshold for advanced broadband capacity set in March 2024 was used.[2] The Broadband Equity, Access, and Deployment (BEAD) Program, which seeks to expand high-speed internet access, used this new threshold to prioritize state-level funding allocations. Under the new threshold, Broadband Serviceable Locations (BSLs) are classified as "served" if they meet the 100/20/100 threshold and are not prioritized for BEAD funding.[3] BSLs that do not meet or exceed the 25/3/100 threshold are classified as "unserved" and receive the highest priority for BEAD investment. If a BSL's connection falls between these 2 thresholds, it is classified as "underserved" and receives second-highest priority for BEAD funding after unserved locations. If all unserved and underserved BSLs have received investment such that they meet the served threshold, then BEAD prioritizes funding to improve connections at Community Anchor Institutions (CAIs)—defined by the FCC as entities such as "schools, libraries, health clinics, health centers, hospitals or other medical providers, public safety entities, institutions of higher education, public housing organizations, or community support organizations that facilitate greater use of broadband service by vulnerable populations."[3]

The FCC's BSL Fabric contains data from all residential and business structures where broadband can be installed. Data from the FCC's BSL Fabric were generated and reviewed by experts and members of the public as part of the BEAD funding allocations. As of June 2024, Fabric data demonstrated a wide range of broadband quality across the 25 TBP target counties. The share of residential connections with access to minimum download speeds of 25 Mbps and minimum upload speeds of 3 Mbps ranged from 0.0% in Bristol Bay Borough, Alaska, to 95.5% in Crosby County, Texas. For speeds of at least 100 Mbps for download and at least 20 Mbps for upload among residential connections, percentages ranged from 0.0% in Bristol Bay Borough, Alaska, to 95.0% in Crosby County, Texas (see Table 1).

Table 1. Percentage of Broadband Serviceable Locations (BSLs) meeting download/upload speed thresholds for all wired and licensed fixed wireless residential connections in each of the 25 TBP target counties (data from June 2024).

State	TBP Target County/ County-Equivalent	Total BSLs	Percentage of BSLs with speeds at or above __ download (in Mbps) and __ upload (in Mbps)					
			.02/ .02	10/ 1	25/ 3	100/ 20	250/ 25	1000/ 100
Alaska	Aleutians West Census Area	1,557	60.0	59.1	40.0	40.0	40.0	0.0
	Bristol Bay Borough	1,186	85.9	85.9	0.0	0.0	0.0	0.0
	Dillingham Census Area	2,590	59.0	58.8	6.0	6.0	6.0	6.0
	Nome Census Area	4,625	81.9	42.9	36.5	31.7	31.7	0.0
	North Slope Borough	3,442	73.7	65.2	59.2	59.2	51.1	0.0
	Northwest Arctic Borough	2,655	85.1	32.2	32.2	32.2	32.2	0.0
Michigan	Gladwin County	19,706	86.5	75.1	72.1	68.2	63.7	1.2
	Manistee County	18,014	89.5	78.6	75.0	61.3	60.2	11.8
	Missaukee County	10,063	74.9	66.4	50.9	43.5	42.4	19.0
	Montmorency County	10,144	89.5	81.4	69.3	59.7	59.0	39.3
	Osceola County	14,774	67.1	45.0	43.4	39.3	30.1	21.3
	Oscoda County	8,685	86.9	76.8	64.5	59.3	59.2	47.2
Texas	Crosby County	3,806	97.2	96.2	95.5	95.0	89.0	74.3
	Fisher County	3,218	69.0	63.4	58.0	52.7	36.2	9.4
	Haskell County	4,706	90.8	89.5	88.0	79.3	78.6	78.6
	Jones County	9,796	85.7	77.7	58.3	55.4	53.4	25.8
	Lamb County	7,778	95.4	93.6	92.5	91.0	85.1	85.1
	Mitchell County	4,932	82.7	82.5	82.5	80.4	80.4	51.4
West Virginia	Calhoun County	4,367	44.5	35.2	24.3	20.8	1.2	1.2
	Clay County	5,129	65.4	53.5	27.7	16.9	15.6	3.7
	Jackson County	15,958	77.0	66.1	63.7	56.7	55.2	47.7
	Kanawha County	103,585	92.1	90.8	89.9	88.0	79.5	18.0
	Nicholas County	15,596	79.7	77.9	57.4	48.3	46.9	3.3
	Ritchie County	6,529	88.4	86.9	83.8	83.0	69.6	69.6
	Roane County	9,204	62.8	54.0	40.4	27.1	26.0	2.7

As part of the TBP Program evaluation, speed tests were collected for each county from pod devices and evaluated as to whether the observed download speed, upload speed, and latency fell below the 25/3/100 threshold, met or exceeded the 100/20/100 threshold, or fell between the two. Mobile speed tests were evaluated using the FCC's 7/1/100 and 35/3/100 thresholds for mobile data quality. These thresholds are used throughout this report because they are important benchmarks for broadband stakeholders to consider, but the use of these benchmarks by the FCC at the level of a BSL (fixed and licensed wireless) is not specific to individual speed tests as is the case in these reports, but rather to the download speeds, upload speeds, and latencies that are advertised to a BSL. Additionally, use of the mobile broadband data thresholds (7/1 and 35/3) is also not specific to individual speed tests, as is the case in this report, but rather to advertised speeds specific to an area of the U.S. Direct comparison between the TBP Program results and FCC Fabric data is not intended

or warranted, as the Fabric reports vender advertised speed and the TBP Program measured end user speeds.

Methodology and Program Implementation

The TBP Program was a first-of-its-kind pilot program aiming to improve access to healthcare and telehealth. As a result, partners and participants had to assess and evaluate strategies for effective program implementation across the 25 target counties. To successfully implement the TBP Program within the 4 target states, Community Lead Partners (CLPs) were identified among local organizations or institutions acting as community representatives, connection points, and advisors to implement the TBP Program. The 4 CLPs from each state adopted tailored strategies to recruit participants and gather data from devices deployed to collect automated broadband measurements (henceforth, "pods"). This flexibility in implementation allowed the CLPs to address the unique implementation challenges within the TBP target counties (see the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*, for more detail).

As the lead organization for Program implementation, TTAC formalized the community relationships and set goals prior to implementation, including the creation of Program organizational structure, the development of technologies to measure broadband, and oversight on the Program goal to deploy 25 pods per target county for each CLP team to understand broadband more thoroughly in each county. In addition, interviews with healthcare stakeholders, consumers, and Program staff were conducted to assess and contextualize the findings.

Development and costs of the TBP pods

To collect longitudinal broadband data from the TBP target counties, a method of recording key broadband measures at regular intervals was needed. After careful review of existing, off-the-shelf technologies, TBP leadership and staff decided to build custom pods. TBP leadership and staff felt available technologies did not meet several Program requirements, including the need for devices to be secure, highly usable, and trustworthy. TBP staff wanted to create pods that would require minimal set-up instructions for Program participants. Physical Raspberry Pi devices were developed by a contracted software consultant firm to implement automatic broadband speed testing throughout the day, including automated measurements of download speed, upload speed, and latency. These pods could be shipped to users with instructions for self-installation by plugging the pods into their home modems, or they could be installed by a CLP team member. Later in the implementation of the TBP Program, a software version of a pod was developed as a solution to several barriers encountered by some potential TBP Program participants with privacy or security concerns, (see the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*, for more detail).

The average overall cost to build a TBP pod, including parts as well as staff time to build the pod was $82.98 (taxes excluded). The average cost of shipping and supporting a TBP pod was $24.55. In approximately 20% of TBP pod deployments, additional accessories were required for the pod to successfully connect, record, and transmit data, including switches ($16.00), routers ($35.00), and power strips ($9.00). Assuming the average costs of these accessories across 20% of deployments, the overall total cost of a TBP pod, including hardware, build time, shipping, support, and accessories was $111.53.

In a default pod deployment, NDT7 (Measurement Labs) and Ookla speed test protocols were scheduled to run once an hour for as long as the pod and software was connected to the network,

making the frequency of tests unique to this Program. Measurement Labs tests were run on dedicated Measurement Labs servers on the open internet, whereas Ookla speed tests can run on any servers.[4] In some cases, this data collection schedule was modified to accommodate preferences of an Information Technology (IT) manager, business owner, or other stakeholder. In addition to actual upload and download speeds, CLP teams recorded advertised upload and download speed if known to the participant. Importantly, the pods could only measure download and upload speeds up to 1,000 Mbps (or 1 Gbps). Thus, any connections receiving speeds faster than 1 Gbps were not recorded accurately.

For the purposes of analysis, broadband data collected by the pods were aggregated at individual locations within the target TBP Program target counties. Some locations had more than 1 internet service provider (ISP), such as a healthcare site with both a primary broadband connection and a back-up failover connection. In these cases, data were analyzed separately, as each ISP could deliver different services to the same locations. Locations with fewer than 100 speed tests or fewer than 14 unique days of data collection were excluded from analysis. Additionally, locations were grouped into the following 4 categories: healthcare, consumer, non-healthcare CAI, and business. This evaluation was determined non-human subjects research by the University of Arkansas for Medical Science's Institutional Review Board (#262566).

Over the course of the Program, more than 400 pods were deployed across the 4 target states. A total of 378 locations met the criteria for inclusion in our analysis, resulting in 3,609,594 speed tests analyzed (see Table 2).

Table 2. Number of locations with pods deployed, number of locations included for analysis, and total speed tests included for analysis within the 25 TBP target counties across the 4 TBP target states.

State	Number of locations with pods deployed	Number of locations included for analysis	Total speed tests included for analysis
Alaska	59	52	194,183
Michigan	83	78	340,218
Texas	179	168	2,483,847
West Virginia	104	80	591,346
OVERALL	425	378	3,609,594

Contracted CLP costs of TBP Program implementation

CLP staffing costs include activities such as, but not limited to, identifying and testing individual implementation strategies, outreach and travel to recruit TBP Program participants, pod deployment and follow-up, as well as Program administration and support. The pilot nature of the TBP Program allowed TBP staff to explore multiple outreach strategies across all TBP states and target counties. Summaries of the most effective approaches are documented in the Results from Program Implementation Evaluation Interviews section of this document. Even for CLP teams that traveled extensively to implement an in-person, door-to-door outreach strategy, the largest overall cost to TBP Program implementation was staffing and services. Organizations seeking to replicate the TBP Program based on findings and best practices identified by this evaluation will likely have a more reduced staffing cost. More details can be found in the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*.

Interview and Technical Assistance Methods

Healthcare Stakeholder Interview Methods

Sixteen semi-structured, qualitative interviews with healthcare stakeholders were conducted to identify influences on broadband and telehealth adoption and use. Interviewees represented healthcare providers, clinic Chief Information Officers (CIOs) and IT managers, and other healthcare stakeholders, such as telehealth specialists and electronic health record (EHR) IT staff. Interviewees were recruited with assistance from TBP Program staff. More methodological details can be found in the white paper, *Healthcare stakeholder perceptions of broadband and telehealth influences in Telehealth Broadband Pilot Program communities*.

Consumer Interview Methods

Twenty-one consumer interviews across the 25 TBP target counties were conducted to identify facilitators and barriers to broadband and telehealth adoption. Consumers were identified and recruited through TBP community partners. Consumers were eligible to participate in an interview if they were aged 18 or older and resided in a target county. Consumers were mailed a $30 pre-paid gift card for their participation. More methodological details can be found in the white paper, *Consumer perceptions of broadband and telehealth across Telehealth Broadband Pilot Program counties*.

Technical Assistance Methods

Beginning in July 2024, contracted TBP staff identified sites in need of technical assistance and tailored intervention approaches based on needs identified from pod data as well needs identified by organizations or individuals within TBP target counties. Multiple technical assistance efforts were made by TBP Program leadership and staff to assist target counties with broadband-related issues, including:

- Excessive outages
- High retransmission
- High speed test variance
- Slower than average latency
- Rate limiting
- Speeds too slow for telehealth
- Unexpectedly slow available speeds

Program Implementation Evaluation Methods and Implementation Strategies

A systematic evaluation of the pod deployment efforts of TTAC and the CLPs was conducted to identify effective implementation strategies and inform any future broadband initiatives. In collaboration with TTAC and the CLP teams, a set of standardized metrics was developed based on the RE-AIM Framework to assess programmatic Reach, Effectiveness, Adoption, Implementation, and Maintenance.[5,6] These metrics helped to identify and describe the successful strategies used in the TBP Program implementation. These metrics, along with their associated RE-AIM domains and the data source used for each, can be found in Table 3. More methodological details can be found in the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*.

Table 3. Evaluation metrics for the TBP Program as mapped to the domains of the RE-AIM framework.

RE-AIM Domain	Metrics	Data Source
Reach	Number of individuals and organizations identified for TBP Program outreach	TBP Program records
Effectiveness	Successful strategies for TBP Program implementation	Semi-structured qualitative interviews with TBP Program staff
Adoption	Number of devices deployed and connected	TBP pod database
Implementation	Facilitators and barriers to TBP Program implementation	Semi-structured qualitative interviews with TBP Program staff
Maintenance	Number of devices collecting at least 100 speed tests over at least 14 unique days of observation	TBP pod database

Implementation Strategies in Alaska

The Alaska CLP team was contracted through the lead TBP Program implementation organization TTAC, which is affiliated with ANTHC, located in Anchorage, Alaska. TTAC, ANTHC, and the contracted Alaska CLP team all had existing relationships, networks, and partners located throughout the state and within the TBP target geographies. The Alaska CLP team had previously lived and worked in Alaska, including in some of the Alaska TBP target county-equivalents.

For TBP Program implementation, the Alaska CLP team was not able to travel directly to Alaska TBP Program target geographies because of high cost of travel required due to the geography and remoteness of the state (e.g., by plane), so they worked closely with TTAC to identify and recruit existing partner organizations and other potential Program participants. These efforts involved approximately 140 meetings, 4,400 phone calls, and more than 600 emails, resulting in contact with more than 350 businesses, 10 school districts, and 12 Tribal Health Organizations (THOs) (Reach).

These efforts led to successful pod deployments at 59 locations. Of these, 52 locations had at least 100 observations across 14 unique days of data collection. The deployments included:
- 49 healthcare locations (42 with ≥ 100 tests and ≥ 14 days of data collection)
- 5 consumer locations (5 with ≥ 100 tests and ≥ 14 days of data collection)
- 4 non-healthcare CAIs (4 with ≥ 100 tests and ≥ 14 days of data collection)
- 1 business location (1 with ≥ 100 tests and ≥ 14 days of data collection)

Implementation Strategies in Michigan

The Michigan CLP team was established through a collaboration between the Office of Information Technology and the Rural Health Equity Institute at Central Michigan University, an academic institution located south of the Michigan TBP program's target counties. The Michigan CLP team used a variety of implementation strategies over the course of the TBP Program, resulting in multiple metrics to assess Reach. Initially, the Michigan CLP team leveraged existing relationships and networks to recruit participants for the TBP Program. The team also contacted chambers of commerce and library associations to connect with members working in 1 of the 6 Michigan target counties. Later, the team conducted targeted outreach to 63 non-healthcare CAIs, including chambers of commerce, libraries, library associations, schools, and non-profit organizations. The team also attended 10 rural health and other health-related conferences, where 10 potential participants expressed interest.

Several strategies used by the Michigan CLP team took the form of direct or indirect outreach to participants. In total, the team conducted 6 outreach campaigns:

1. Direct outreach to targeted healthcare organizations located in TBP target counties, including 17 healthcare organizations, all of which were contacted multiple times.
2. Online outreach to consumers located in TBP target counties, yielding 16 users expressing interest in the Program from 1 social media post ([Link to social media post 1](#)).
3. Social media recruitment, which reached 7,378 users, generating 257 visits to the Michigan TBP Program website and 12 users expressing interest in Program participation.
4. Email outreach to a CLP organization alumni list with primary residence addresses located in TBP target counties, which included 1,776 individuals.
5. Two stories on local public radio stations ([Link to story 1 in June 2023](#); [Link to story 2 in February 2024](#)), 1 of which was further covered by several local news outlets with coverage in Manistee County ([Link to story 1 in June 2023](#); [Link to story 2 in November 2023](#)).
6. Promotion through a CLP organizational newsletter, yielding 11 individuals expressing interest in participating.

Additionally, the CLP team conducted a week-long, intensive in-person recruitment drive, first examining possible business locations within TBP communities using an online mapping application, and assessing recruitment potential by evaluating the number of business reviews. Once on site, the team spoke to staff and patrons to identify business locations that were frequented by residents, such as coffee shops and ice cream parlors. This approach helped identify the best locations to encounter locals as opposed to tourists, as only individuals with a primary residence in a TBP target county were eligible to participate in the Program. The Michigan CLP team then worked with those businesses to set up an outreach station to recruit potential participants. A one-week field visit implementing these strategies in Manistee, Missaukee, Montmorency, and Oscoda Counties identified 44 consumer prospects (Reach) who expressed interest in the Program. Thirty-nine of the 44 participants (89%) accepted and activated a pod (Adoption). Throughout all in-person recruitment, the Michigan CLP team drove 1,601 miles.

An additional small business cold-calling campaign was conducted, targeting 332 small businesses (Reach) located in Missaukee County that were identified using an online mapping application. TBP staff made 428 contact attempts to these businesses via phone, yielding 18 potential participants (Reach).

Across the 6 Michigan TBP counties, these combined efforts yielded successful pod deployments at 83 locations (Adoption). Of these, 78 had at least 100 observations across 14 unique days of data collection (Maintenance):

- 0 healthcare locations (0 with ≥ 100 tests and ≥ 14 days of data collection)
- 67 consumer locations (64 with ≥ 100 tests and ≥ 14 days of data collection)
- 4 non-healthcare CAIs (3 with ≥ 100 tests and ≥ 14 days of data collection)
- 12 business locations (11 with ≥ 100 tests and ≥ 14 days of data collection)

Implementation Strategies in Texas

The CLP team in Texas was contracted to Texas Tech University Health Sciences Center in Lubbock, TX. The Texas CLP team initially identified possible pod outreach sites, including healthcare organizations, non-healthcare CAIs, and businesses, using an online mapping application. The team concentrated their efforts on 1 target county at a time, finding that it was the most effective and efficient strategy to yield additional deployment sites. This snowball recruitment strategy allowed the CLP team to leverage successful pod deployments to facilitate additional deployments. After reaching saturation, the team would move to another TBP community and restart this outreach strategy.

Through this process, the Texas CLP team identified the following potential locations for TBP Program recruitment (Reach):
- 24 healthcare sites
    – Such as hospitals, family medicine clinics, nursing homes, rehabilitation centers, home health organizations, pharmacies, and dental practices
- 105 non-healthcare CAIs
    – Such as schools, churches, community organizations, museums, radio stations, and government offices
- 201 businesses

All 330 of these locations were contacted about participating in the TBP Program using a variety of strategies, including email, phone, and in-person outreach. Initially, the CLP team contacted identified sites via email or phone, then driving to the communities if a site committed to learn more about the TBP Program. However, the CLP team later modified this policy when they discovered that a boots-on-the-ground, door-to-door outreach approach worked well in these communities even without initial email or phone contact. These strategies proved effective in reaching healthcare sites, businesses, and non-healthcare CAIs in the 6 TBP target counties in Texas. In total, the Texas CLP team drove approximately 8,900 miles.

Across the 6 Texas TBP Program target counties, these efforts yielded successful pod deployments at 179 locations (Adoption). Of these, 168 had at least 100 observations across 14 unique days of data collection (Maintenance):
- 14 healthcare locations (13 with ≥ 100 tests and ≥ 14 days of data collection)
- 21 consumer locations (21 with ≥ 100 tests and ≥ 14 days of data collection)
- 86 non-healthcare CAI locations (78 with ≥ 100 tests and ≥ 14 days of data collection)
- 58 business location (56 with ≥ 100 tests and ≥ 14 days of data collection)

Implementation Strategies in West Virginia

In West Virginia, TTAC contracted the West Virginia Primary Care Association, a provider-focused, non-profit healthcare organization, as the CLP team. This team had existing relationships and networks with many healthcare organizations throughout the state, including:
- Calhoun County: 4 health centers or clinics, 4 School-Based Health Centers
- Clay County: 1 health center or clinic, 5 School-Based Health Centers
- Jackson County: 2 health centers or clinics, 1 School-Based Health Centers
- Kanawha County: 25 health centers or clinics, 10 School-Based Health Centers
- Nicholas County: 6 health centers or clinics, 6 School-Based Health Centers
- Roane County: 1 health center or clinic, 0 School-Based Health Centers
- Ritchie County: 1 health center or clinic, 4 School-Based Health Centers

The West Virginia CLP team leveraged existing relationships and networks with these and other known healthcare locations to recruit organizations to participate in the TBP Program as their primary recruitment strategy. Across the 7 West Virginia TBP Program target counties, these efforts yielded successful pod deployments at 104 locations (Adoption). Of these, 80 had at least 100 observations across 14 unique days of data collection (Maintenance):

- 28 healthcare locations (21 with ≥ 100 tests and ≥ 14 days of data collection)
- 53 consumer locations (42 with ≥ 100 tests and ≥ 14 days of data collection)
- 6 non-healthcare CAI locations (4 with ≥ 100 tests and ≥ 14 days of data collection)
- 17 business locations (13 with ≥ 100 tests and ≥ 14 days of data collection)

Centralized implementation strategies

To supplement efforts to reach individual consumer homes for pod deployments, the TBP Program lead organization and its contracted staff developed and utilized several additional implementation strategies that were implemented across multiple TBP Program target states. First, a target of 25 locations per target county or county-equivalent was set as a pod deployment goal for all CLP teams. Additionally, mailers were developed and sent out to residents of the TBP Program target counties, with an invitation to learn more about participating in the TBP Program by scanning a QR code or by reaching out directly to the CLP team. In both Texas and West Virginia, CLP teams conducted their own mailing campaigns for TBP Program recruitment, using their own internally-developed strategies, which is also reported here. These efforts resulted in the following Reach:

Alaska: 1,374 mailers printed (2 QR code scans, 0.1%)
- Michigan: 7,022 mailers printed (34 QR code scans, 0.5%)
- Texas
    – Phase 1 (CLP-led implementation): 3,000 mailers printed (98 QR code scans, 3.3%)
    – Phase 2 (centralized implementation): 1,372 mailers printed (5 QR code scans, 0.4%)
- West Virginia
    – Phase 1 (CLP-led implementation): 2,002 mailers printed (7 QR code scans, 0.3%)
    – Phase 2 (centralized implementation): 3,500 mailers printed (2 responses, 0.06%)

A speed test widget designed to collect one-time speed test measurements was also developed and embedded in multiple online locations. Users who completed a speed test were invited to complete a contact form to facilitate follow-up and recruitment to participate in the TBP Program. These efforts yielded the following Reach:

- TTAC (Alaska-based) website: 20 speed tests, 6 interest forms completed (30.0%)
- Alaska radio station: 19 speed tests, 9 participation forms completed (47.4%)
- Michigan CLP TBP Program website: 96 speed tests, 54 interest forms completed (56.3%)
- Northwest Regional Telehealth Resource Center (which serves a seven-state region, including Alaska) website: 22 speed tests, 1 interest form completed (4.5%)
- Texas CLP TBP Program website: 312 speed tests, 13 interest forms completed (10.0%)
- Software contractor website (based out of Washington state): 479 speed tests, 84 interest forms completed (4.2%)

An initial, externally-led cold calling campaign was initiated for TBP Program recruitment. This campaign piloted cold calling campaign to recruit consumers located within the 25 TBP Program target counties of the TBP Program and to set a benchmark for cold calling campaign performance. These learnings informed the building of an internal TBP Program cold calling campaign, which yielded the following Reach and Adoption metrics (note that the number of calls made during this campaign was unavailable to TBP Program staff, due to the external nature of those records):

- Michigan
  - Pod requests: 23 (Reach)
  - Confirmed pod activations: 5 (Adoption)
- Texas
  - Pod requests: 3 (Reach)
  - Confirmed pod activations: 0 (Adoption)
- West Virginia
  - Pod requests: 44 (Reach)
  - Confirmed pod activations: 2 (Adoption)

The subsequent internally-led cold calling campaign informed by the externally-led campaign was conducted across all four TBP Program target states. This cold-calling campaign involved systematic outreach to known residents of the 25 TBP Program target counties by phone to discuss potential participation in the TBP Program. These efforts yielded the following Reach measures:

- Alaska: 494 contacts called, 6 receptive to program participation (1.2%)
- Michigan: 1,033 contacts called, 11 receptive to program participation (1.1%)
- Texas: 140 contacts called, 1 receptive to program participation (0.7%)
- West Virginia: 2,595 contacts called, 64 receptive to program participation (2.5%)

Findings

Results from Program Implementation Evaluation Interviews

Due to the first-time nature of this program, the TBP Program implementation was evaluated to identify learnings from the current program work and to inform potential future work. Facilitators and barriers to TBP Program implementation were identified through semi-structured, qualitative interviews with TBP Program staff. Key facilitating influences included the perception of a benefit for participating in the TBP Program (e.g., data, incentives, or broadband intervention), a centralized approach with diverse CLP teams and skill sets, an easy-to-use and adaptable device ("pod"), clear and achievable goals, and establishing trust with potential Program participants. Several outreach and marketing strategies were also identified as facilitating program implementation and driving successful TBP participant recruitment, such as leveraging existing relationships and networks, utilizing multiple outreach strategies, an in-person recruitment approach, and an expert-led cold-calling campaign.

Many of the barriers to program implementation identified by TBP staff were the inverse of identified facilitators, including a lack of interest in the Program, no perceived benefit for participating in the Program, a lack of clarity in Program goals, a de-centralized approach to program implementation, and a lack of trust between TBP staff and potential Program participants. Additional implementation barriers included geographic limitations of counties included in TBP Program scope, reprioritization based on changes in allowable program activities, urgent priorities for state broadband offices deprioritizing connection with TBP Program, variation in organizational approval and review processes, staffing challenges, low digital literacy among existing TBP Program participants, and delays in identifying and implementing effective solutions. Barriers related to outreach and marketing

strategies included general resistance to Program participation, low digital literacy among potential TBP Program participants, a lack of centrally-developed outreach materials, ineffectiveness of some strategies across participants and communities, a lack of a community champion, insufficient existing relationships and networks to maximize Program participation, non-expert cold-calling center recruitment, and resource intensiveness of Program recruitment and follow-up.

For more detail on the facilitators and barriers to TBP Program implementation, please refer to the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*.

Results from TBP Pods

Across the 25 TBP target counties, 3,609,594 speed tests were conducted as of September 2024. Only 6 of the 25 target counties met the 25 pod deployments target, with 5 of these 6 counties in Texas (see prior section, Results from Program Implementation Evaluation Interviews, and the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*, for more detail). Data on pod deployments, total speed tests, and median speeds are reported in Table 4 (by county) and Table 5 (by location category). The median download speed, upload speed, and latency was first calculated for each location. Then, the median of these location medians was calculated by county and by location category. Medians were chosen to reduce the influence of locations with extremely high or low values.

Table 4. Total locations with pod deployments, total speed tests, median download speed (in Mbps), median upload speed (in Mbps), and median latency (in ms).

State	County	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Alaska	Aleutians West Census Area	8	60,873	36.3	8.1	68.5
	Bristol Bay Borough	3	6,783	25.3	25.2	47.3
	Dillingham Census Area	14	68,186	27.2	19.1	47.8
	Nome Census Area	16	44,079	25.4	16.5	55.8
	North Slope Borough	1	176	86.9	9.4	78.1
	Northwest Arctic Borough	10	14,086	43.2	10.9	61.1
Michigan	Gladwin County	9	35,990	20.6	2.8	31.3
	Manistee County	20	70,046	339.5	11.3	11.0
	Missaukee County	16	82,642	114.0	11.1	15.8
	Montmorency County	13	50,786	18.8	1.5	21.7
	Osceola County	7	48,755	341.6	11.1	23.3
	Oscoda County	13	51,999	357.2	11.5	18.5
Texas	Crosby County	29	495,198	91.2	42.1	19.7
	Fisher County	33	452,143	30.1	7.6	20.0
	Haskell County	28	362,445	91.8	91.5	7.1
	Jones County	31	534,846	92.2	92.9	18.3
	Lamb County	26	442,785	520.2	539.4	13.0
	Mitchell County	21	196,430	245.1	101.3	12.8
West Virginia	Calhoun County	4	51,030	387.3	329.7	20.7
	Clay County	17	82,968	21.4	1.7	27.7
	Jackson County	2	44,991	528.9	51.5	26.9
	Kanawha County	29	216,463	304.3	36.7	20.6
	Nicholas County	4	13,508	19.5	6.9	30.2
	Ritchie County	4	70,514	89.5	91.4	19.2
	Roane County	20	111,872	15.3	2.6	29.6

*Medians reported are the medians of all median values calculated for each location.

Table 5. Total locations, speed tests, median download speed, median upload speed, and median latency for all locations in the 4 TBP target states by category of location.

State	Category	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Alaska	Business	1	2,242	4.3	3.9	37.1
	Consumer	5	30,203	14.2	2.9	52.6
	Healthcare	42	124,974	27.1	14.4	53.2
	Non-healthcare CAI	4	36,764	77.6	67.3	68.1
Michigan	Business	11	79,932	123.5	11.1	12.2
	Consumer	64	220,653	107.1	11.2	19.0
	Non-healthcare CAI	3	39,633	18.8	11.4	25.0
Texas	Business	56	649,495	52.1	24.6	15.4
	Consumer	21	196,827	21.6	7.6	19.7
	Healthcare	13	117,950	81.3	80.5	18.3
	Non-healthcare CAI	78	1,519,575	372.5	210.9	12.8
West Virginia	Business	13	49,449	30.8	3.6	27.7
	Consumer	42	264,839	71.0	5.3	27.3
	Healthcare	21	258,417	101.0	50.8	22.5
	Non-healthcare CAI	4	18,641	17.7	8.7	24.1

*Medians reported are the medians of all median values calculated for each location.

To examine variability of the user experience of broadband at participating TBP Program locations, the percentage of speed tests that fell below the 25/3/100 threshold, fell between the 25/3/100 and 100/20/100 threshold, and met or exceeded the 100/20/100 threshold was also calculated for each location category (healthcare, non-healthcare CAI, consumer, and business) and by state. In these aggregated calculations, each location was equally weighted, such that locations with more speed tests had the same weight as locations with fewer speed tests (although all included locations met the inclusion criteria of having at least 100 speed tests). The number of speed tests conducted at a single location included in our analysis ranged from 103 to 79,519. The percentages of tests meeting these thresholds for all location types across the TBP Program area can be found in Figure 1. Location categories with 1 or fewer locations within a state are not presented.

Figure 1. Percentage of speed tests recorded at less than 25/3/100, between 25/3/100 and 100/20/100, and met or exceeded 100/20/100 for business, consumer, healthcare, and non-healthcare CAI locations in the 4 TBP target states (each location equally weighted).
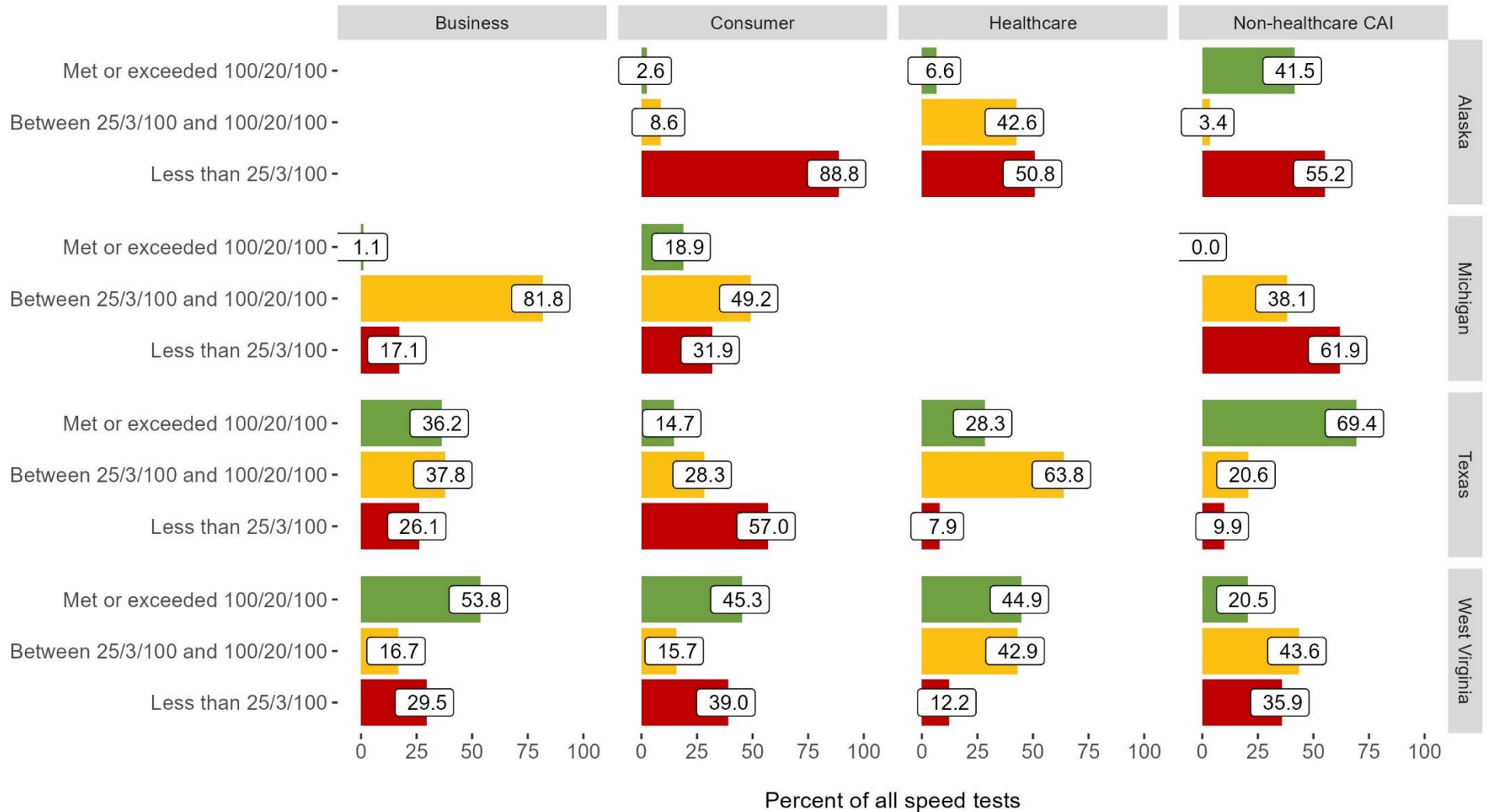
In general, broadband connections in Alaska were of the poorest quality, with median speeds falling below the 100/20/100 threshold for all location categories. Median speeds for consumer connections across all 4 states also fell below the 100/20/100 threshold. In Alaska—the state with lowest median download and upload speed for consumers—88.8% of all consumer speed tests fell below the 25/3/100 threshold. In Texas, more than half (57.0%) of consumer speed tests fell below the same threshold. In Michigan, the median consumer download speed exceeded the 100 Mbps benchmark, but the median upload speed fell well below the 20 Mbps threshold. These results suggest that many consumers across the TBP target counties lack sufficient broadband to consistently and reliably access important services, such as telehealth.

When evaluating by location type, healthcare locations had the highest-quality broadband, but only healthcare locations in West Virginia produced median speeds meeting the 100/20/100 benchmark. In Texas, non-healthcare CAIs showed high-quality speeds, well above the 100/20/100 threshold, but the data aggregation across many locations may cloud the complete experience of broadband capacity for users at these locations.

The percentage of speed tests by state and location category show a large degree of variability across the target counties that the measurements may have masked. For instance, although the median download speeds for consumers in West Virgina (71.0 Mbps) and Michigan (107.1 Mbps) appeared to be high-quality or close to that threshold, approximately a third of all speed tests (31.9% in Michigan and 39.0% in West Virginia) fell below the 25/3/100 threshold. However, an examination of the percentage of all speed tests meeting these thresholds show that the experience of broadband for consumers in these states varies, with broadband sometimes meeting the high-quality threshold (18.9% of all consumer speed tests in Michigan and 45.3% of consumer speed tests in West Virginia), but frequently falling well below even the outdated broadband benchmarks of 25/3/100.

Pod measurements from healthcare locations across the target states showed similar variability. Most healthcare speed tests fell below the high-quality, 100/20/100 threshold. West Virginia was the only state where the median results met the 100/20/100 threshold, although only 44.9% of individual tests did. In the other 2 states with participating healthcare locations (Alaska and Texas), only 6.6% and 28.3% of all healthcare location speed tests met or exceeded the 100/20/100 threshold.

Even the best served location categories across the TBP Program target counties still demonstrated significant issues with consistency and reliability of broadband connections. Across 78 non-healthcare CAI locations in Texas, aggregated measurements showed very high-quality broadband, with a median download speed of 372.5 Mbps, a median upload speed of 210.9 Mbps, and a median latency of 12.8 ms. However, nearly a third of all non-healthcare CAI observations in Texas fell below the 100/20/100 threshold. This variability suggests that non-healthcare CAIs in Texas may have access to the highest quality connections but can still experience poor quality broadband for a significant amount of time.

Results from Healthcare Stakeholder Interviews

Given the TBP Program aim, interviewing healthcare stakeholders in TBP target counties was essential to understand the challenges, barriers, and benefits of accessing telehealth and broadband in a healthcare setting. Semi-structured, qualitative interviews with healthcare stakeholders revealed several influences, issues, and benefits of broadband for healthcare providers and staff practicing from clinics and from home. Several benefits of quality broadband named by interviewees included increased types of services offered, more patients served, less paperwork, more reliable healthcare service delivery, and increased revenue. However, these benefits were only realized if broadband was

high-quality. Without high-quality broadband, healthcare stakeholders observed delays in workflow and healthcare service delivery, as well as increased workloads and decreased healthcare service quality. Poor quality home broadband for providers and staff also delayed workflow and healthcare service delivery, but was compounded by issues with virtual private network (VPN) connections to securely access patient health information. Further, limited choices of internet service providers (ISPs) and high service costs can make broadband less feasible in a healthcare context. To improve broadband for healthcare, interviewees recommended filtering network traffic to keep broadband open for healthcare, Low Earth Orbit satellite adoption, and the implementation of backup networks and systems.

Healthcare stakeholder interviewees were also asked about telehealth influences, and identified providers, patients, and clinic staff as having a role in telehealth adoption and usage, Collaborative decision-making among multiple stakeholders was described as influencing the choice of available telehealth tools and software. Interviewees identified multiple benefits of using telehealth for both patients and providers, including providers' ability to practice outside of the clinic, reductions in patient travel time, increased access to quality and specialty healthcare, and improvement in the timeliness of care. However, interviewees also identified multiple barriers to telehealth adoption and usage, including patient and provider resistance to change, poor or inconsistent broadband access and quality, unreliable or out-of-date telehealth devices, having multiple telehealth software systems, low digital literacy among providers and patients, challenges with provider and staff telehealth training, and staffing shortages. Influences that facilitated telehealth included the COVID-19 Public Health Emergency (PHE), telehealth champions, user-friendliness of telehealth tools, and billing and reimbursement for telehealth services. Two additional facilitating influences were identified by interviewees, specifically in the Alaskan healthcare context: shifts in the role of the Community Health Aide (CHAP), and a history and culture of remote work and care.

For more detail on the influences on broadband and telehealth identified through interviews with healthcare stakeholders in TBP target counties, please refer to the white paper, *Healthcare stakeholder perceptions of broadband and telehealth influences in Telehealth Broadband Pilot Program communities*.

Results from Consumer Interviews

Facilitators and barriers to consumer broadband and telehealth adoption identified through semi-structured, qualitative interviews with consumers residing in TBP target counties can be found in Table 6.

Table 6. Identified facilitators and barriers to consumer broadband and telehealth adoption across 25 TBP target counties.

	Facilitators	Barriers
Broadband	• Low cost • Availability of quality service due to geographic proximity • Perception of value in broadband • High quality of broadband service • High quality of broadband connection	• High cost • Lack of quality service availability due to geographic proximity • Perception of a lack of value in broadband • Poor quality of broadband service • Poor quality of broadband connection
Telehealth	• Perception of a decreased patient burden • Prior positive telehealth experiences • Telehealth service availability	• Perception of a lack of value in telehealth • Lack of sufficient broadband connection • High cost or the perception of a lack of coverage • Perception of a lack of telehealth availability • Low digital literacy

For more detail on the influences on broadband and telehealth identified through interviews with healthcare stakeholders in TBP target counties, please refer to the white paper, _Consumer perceptions of broadband and telehealth across Telehealth Broadband Pilot Program counties_.

Results from Technical Assistance Interventions

As a part of the TBP Program, entities from each of the TBP target states were offered technical assistance to help improve broadband. This included varied types of assessments using information such as the broadband data from the pods and working with organizations and individuals in TBP communities to identify challenges. Some interventions provided by TBP staff required significant time and collaboration with organizational IT teams to build sufficient trust around broadband changes. Other interventions did not require involvement from an IT team and were faster and less resource-intensive to implement. Examples of these interventions included:

- Alaska: Improved broadband connection quality for telehealth connections after pod data showed bandwidth as lower than advertised.
- Michigan: Resolved connection disruptions due to frequent and delayed Wi-Fi access point switching, which improved user experience at healthcare clinics.
- Texas: Contacted 12 organizations and provided technical solutions after data indicated broadband issues.
- West Virginia: Reduced the number of audio/video telehealth call disruptions after TBP staff identified poor signal quality within a health clinic and recommended the installation of a Wi-Fi mesh set-up.

More information describing technical assistance interventions can be found in Appendices B (Alaska), C (Michigan), D (Texas), and E (West Virginia).

Discussion

The recent speed threshold change in the definition of broadband by the FCC demonstrates a recognition of the need for higher quality broadband to pursue activities such as work, education, and telehealth.[2] In a report describing the rationale for this definition change, the FCC highlighted telehealth as an activity that may not be feasible with upload speeds of 3 Mbps or lower.[7] Many areas of the TBP target counties have healthcare gaps that telehealth could reasonably fill. Thus, the results

from the TBP Program evaluation raise concerns for telehealth stakeholders who may champion telehealth services as a way to increase healthcare access in rural and other underserved communities. In 24 of the 25 TBP Program target counties, no specialty hospitals exist.[8] In 7 of these counties, no acute care hospitals exist.[8] With limited access to healthcare delivery locations, telehealth could provide a mechanism to increase healthcare access for the people in these communities. However, if a consumer home only has broadband at or above the 100/20/100 less than half of the time (as was the case for consumer locations in all TBP Program target states), the feasibility of some telehealth services is in question.

Across more than 3.6 million speed tests conducted in the 25 TBP target counties, broadband quality in consumer and healthcare locations often fell below the new 100/20/100 threshold and was frequently unreliable or inconsistent.[2] In Michigan, consumers had median download speeds exceeding 100 Mbps, but median upload speeds slower than 20 Mbps. Additionally, consumers in Alaska and Texas reported median download speeds below the outdated broadband speed benchmark set by the FCC nearly 10 years ago.

Even though median broadband download speeds in Michigan (107.1 Mbps) and West Virginia (71.0 Mbps) well exceeded the 2015 broadband download speed threshold, nearly a third of individual speed tests still fell below it. In Alaska and Texas—where median measures of consumer broadband were already slower—more than half of the observed speed tests at consumer homes fell below the 25/3/100 threshold. Indeed, interviews conducted with consumers living in TBP communities cited lack of quality broadband service availability and poor-quality broadband connections as barriers to obtaining and maintaining high-quality internet access.

Healthcare locations participating in the TBP Program did see relatively higher broadband quality than consumers, but there was still significant inconsistency. Only 44.9% (West Virginia), 28.3% (Texas), and 6.6% (Alaska) of healthcare location speed tests recorded broadband measurements meeting the 100/20/100 threshold. Interviews with healthcare stakeholders revealed that broadband issues delay patient care and can heighten risk to patients. Interviewees also named poor broadband quality and outdated hardware as barriers to more widespread adoption of telehealth services, among other influences.

It is important to note that pods deployed by the TBP Program were intended to collect longitudinal broadband data over time, and those data are not directly comparable to speeds reported in the latest BSL Fabric, which report advertised speeds available at locations where broadband may be delivered.[9] Data from the FCC's BSL Fabric demonstrates broadband access at the level of individual BSLs, which is the most comprehensive data set of broadband access to date. However, data collected by the TBP Program are an important complement to the Fabric data, as they demonstrate more closely the experience of broadband to an individual user, not the general quality of services that may be available to them.

The results from this analysis demonstrate that even when broadband connections can produce download speeds, upload speeds, and latencies meeting the 100/20/100 threshold, they do not always do so consistently. It is beyond the scope of the TBP Program evaluation to determine the cause of every individual poorer quality speed test, which can be influenced by many factors within and outside of a location. However, these results do highlight the need to consider broadband reliability and consistency in addition to broadband connection access.

If broadband is, in fact, a super determinant of health necessary for activities such as work, education, and healthcare, it is important and worth the investment to have uninterrupted access to those activities. Without consistent reliable broadband in consumer homes and healthcare locations, the feasibility of telehealth diminishes. If a consumer home only has broadband at or above the

100/20/100 threshold less than half of the time (as was the case for consumer locations in all TBP target states), telehealth services become harder to reliably operate.

Factors for Consideration and Recommendations

For those interested in measuring the user experience of broadband in communities, the findings of the TBP Program implementation study have generated several factors to consider for any similar future broadband program implementations:

1. Identify direct benefits of participation for potential participants and communicate this benefit clearly in outreach materials so that these benefits are understood by all potential participants, including those with low digital literacy who may lack specific broadband knowledge.
2. Include additional geographies in allowable program locations to encourage greater participation, especially among people with regional or statewide interests.
3. Identify and communicate clear program goals and strategies with program leadership, the funding agency, program partners, and across all program implementation staff and teams.
4. Create a centralized repository of materials, resources, strategies, and ideas for all implementation teams to use, adapt, and learn from (such as flyers, mailers, website copy, digital forms, project management tools, call centers).
5. Recruit dedicated program staff members who share the program's identified value proposition, possess diverse skill sets, and have sufficient time to address program needs.
6. Use multiple outreach strategies, including an in-person, door-to-door approach for business, consumer, and non-healthcare CAI locations, and leverage existing relationships and networks for healthcare site deployments.
7. Identify community champions to facilitate program participation.
8. Prioritize building trust in outreach strategies and interactions with potential program participants and ensure all outreach strategies and materials inspire trust.

In light of results from the data collected in the 25 target counties across the TBP Program, this evaluation supports the following recommendations to improve the user experience of broadband for those communities:

A. Provide support for *consistent*, high-quality broadband connections for healthcare, consumer, non-healthcare CAI, and business connections to facilitate broadband-dependent critical services, such as telehealth.
B. Consider how frequently speeds meet broadband thresholds for high-quality experiences to ensure that services such as telehealth are reliably accessible to healthcare providers and patients.
C. Further investigate the causes of the variability in the user experience of broadband.
D. Create a centralized resource to help consumers, businesses, non-healthcare CAIs, and healthcare organizations provide broadband education, navigate locally available broadband options, and troubleshoot technical connectivity challenges.

Appendix A: Introduction to State-Level Reports of Telehealth Broadband Pilot Program Target County Activations and Learnings

The Telehealth Broadband Pilot (TBP) Program started through the launch of the Rural Telehealth Initiative (RTI), which was created through a Memorandum of Understanding between the Federal Communications Commission (FCC), the U.S. Department of Health and Human Services (HHS), and the U.S. Department of Agriculture. Through HHS, the Health Resources and Services Administration funded the Program in January 2021 through December 2024 to assess broadband that may limit access to telehealth services in rural communities. The TBP Program was implemented in 25 counties across the 4 states of Alaska, Michigan, Texas and West Virginia. As a part of the implementation, Community Lead Partners (CLPs) were identified in each state to support the implementation of the Program within the local communities.

In order to evaluate broadband in the target counties, the TBP Program measured broadband speeds using physical Raspberry Pi devices that conducted automatic broadband speed tests of key measures, including download speed, upload speed, and latency. These devices are referred to as "pods" and were shipped with instructions for users to plug into their home modems themselves or to be installed by a CLP team. Additionally, a software deployment version of a pod was developed later in the implementation of the TBP Program as a solution to privacy and security concerns raised by potential Program participants (see the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*, for more detail).

In a default pod deployment, NDT7 (Measurement Labs) and Ookla speed test protocols were scheduled to run once an hour for as long as the pod or software was connected to the network. Measurement Labs tests were run on dedicated Measurement Labs servers on the open internet, while Ookla speed tests could run on any servers.[4] In a small number of cases, this data collection schedule was modified to accommodate preferences of an IT manager, business owner, or other stakeholder. The primary outcome measures were download speed, upload speed, and latency, in line with the key measures the FCC uses to define broadband quality as part of the Broadband Equity, Access, and Deployment (BEAD) funding allocation. Advertised upload and download speed were also recorded by the CLP teams if known to the participant. Importantly, the pods deployed were only able to measure download and upload speeds to 1,000 Mbps (or 1 Gbps). Thus, the pods deployed for the TBP Program could not accurately record any connections receiving speeds faster than 1 Gbps. This hourly, longitudinal data collection of broadband as experienced by users was a unique contribution of the TBP Program (although see the FCC's Thirteenth Measuring Broadband America Fixed Broadband Report for a summary of some longitudinal measurement of service delivered to consumer homes, which does not include measurements in Alaska[10]).

For the analysis, broadband data were collected from pods and aggregated at individual locations. Some locations had more than 1 internet service provider (ISP), such as a healthcare site with a primary broadband connection and a back-up failover connection. In these cases, data were analyzed separately, as each ISP could deliver different services to the same locations. Any locations with fewer than 100 speed tests or with fewer than 14 unique days of data collection were excluded from analysis. Additionally, locations were grouped into the following 4 categories: healthcare, consumer, non-healthcare CAIs, and business.

In March 2024, the FCC changed the threshold for broadband speeds from at least 25 Mbps download, 3 Mbps upload, and 100 ms latency or better (25/3/100) to 100 Mbps download, 20 Mbps upload, and 100 ms latency or better (100/20/100).[2] These benchmark measurements are also used to prioritize BEAD funding allocations. Locations are classified as "unserved" if they lack access to connections meeting the 25/3/100 threshold, and are assigned the highest priority for broadband investment through BEAD funding.[3] Locations with access to connections that meet or exceed the 100/20/100 new broadband definition threshold are classified as "served" and are not prioritized by BEAD for broadband investment. For those locations with access to connections that fall between these 2 thresholds, they are classified as "underserved" and have second-highest priority for BEAD funding after unserved locations. If all unserved and underserved locations have received investment such that they meet the served threshold, then BEAD prioritizes funding to be spent improving connections at Community Anchor Institutions (CAIs) with service below 1 Gbps download and upload. CAIs are defined by the FCC as entities "such as schools, libraries, health clinics, health centers, hospitals or other medical providers, public safety entities, institutions of higher education, public housing organizations, or community support organizations that facilitate greater use of broadband service by vulnerable populations."[3]

Each speed test measured by TBP pods was compared to the 25/3/100 and 100/20/100 thresholds set by FCC. Every mobile speed test collected by the CLP teams using an Android-based application was evaluated using the 7 Mbps download / 1 Mbps upload (7/1) and 35 Mbps download / 3 Mbps upload (35/3) thresholds, which were set by the FCC for evaluating mobile broadband data quality. Throughout Appendices B (Alaska), C (Michigan), D (Texas), and E (West Virginia), these thresholds offer important benchmarks for broadband stakeholders to consider. However, the use of these benchmarks by FCC at the level of a Broadband Service Location (BSL) (fixed and licensed wireless) is not specific to individual speed tests, but rather the advertised download speeds, upload speeds, and latencies. Additionally, use of the FCC Fabric mobile broadband data thresholds (7/1 and 35/3) are not specific to individual speed tests, but rather to advertised speeds specific to an area of the US. Direct comparison between the TBP Program results and FCC Fabric data is not intended or warranted, as the Fabric reports vender advertised speed and the TBP Program measured end user speeds.

Appendix B: Alaska Telehealth Broadband Pilot Program Summary Report: Activations and Learnings from 6 County-Equivalents

Executive Summary

The Telehealth Broadband Pilot (TBP) Program measured broadband quality across 6 Alaskan county-equivalents at 52 individual locations, including 42 healthcare sites, 5 consumer homes, 4 non-healthcare community anchor institutions (CAIs), and 1 business location. Overall, these participating locations demonstrated poor broadband quality, which was unable to support critical services such as telehealth, particularly at healthcare locations. Although a small number of locations could possibly offer such services, inconsistent broadband quality and other variable factors could make important services such as audio-video connections not feasible at all times.

Through the TBP Program, median download speeds of 27.1 megabits per second (Mbps) at healthcare sites, 77.6 Mbps at non-healthcare CAIs, and 14.2 Mbps at consumer homes were observed. Median upload speeds of 14.4 Mbps were also observed at healthcare sites, 67.3 Mbps at non-healthcare CAIs, and 2.9 Mbps at consumer homes.

To assess the variability of these measurements, each speed test was sorted according to the thresholds used by the Federal Communications Commission (FCC): 1) below 25 Mbps in download speed, *or* 3 Mbps in upload speed, *or* latency greater than 100 milliseconds (ms) (25/3/100); 2) meeting or exceeding 100 Mbps in download speed, 20 Mbps in upload speed, and latency less than or equal to 100 ms (100/20/100); 3) falling between these 2 thresholds. According to these benchmarks, 5.4% of healthcare sites, 40.7% of non-healthcare CAIs, and 7.6% of consumer homes met or exceeded the 100/20/100 threshold. However, 44.3% of tests at healthcare sites, 55.4% of tests at non-healthcare CAIs, and 63.6% of tests at consumer homes fell below the 25/3/100 threshold. Additionally, all 27 Alaskan healthcare sites with known advertised broadband speeds saw most measured speed tests falling below the advertised speeds.

Background

Although Alaska is the largest state in the U.S. by area, it is the third smallest by population, with approximately 733,000 people, nearly a third of whom live in rural county-equivalents (32.6%).[1,11,12] The large geographic area, difficult terrain, and sparse population of Alaska make broadband infrastructure more difficult, as long and expensive connections are required to connect a relatively smaller number of people. In 2023, Alaska was allocated more than $1.017 billion in Broadband Equity, Access, and Deployment (BEAD) funding—the 19th largest amount allocated to any state or territory.[13] According to its 5-year BEAD action plan, out of Alaska's 275,813 Broadband Serviceable Locations (BSLs), 88,188 have been classified as unserved (32.0%) and 17,378 have been classified as underserved (6.3%), making the total percentage of unserved or underserved BSLs in the state 38.3% (105,566).[14] This funding amount was the highest allocated BEAD funding cost per unserved or underserved BSL for any TBP target state: $9,635.11 (see *A summary of Broadband Equity, Access, and Deployment [BEAD] Program plans for the 4 Telehealth Broadband Pilot Program states* for more detail).

The 6 Alaskan county-equivalents selected for inclusion in the TBP Program were:[1]

- Aleutians West Census Area (2020 population: 5,232)
- Bristol Bay Borough (2020 population: 844)
- Dillingham Census Area (2020 population: 4,857)
- Nome Census Area (2020 population: 10,046)
- North Slope Borough (2020 population: 11,031)
- Northwest Arctic Borough (2020 population: 7,793)

Healthcare and Telehealth in Alaska TBP County-Equivalents

Of the 6 county-equivalents, 4 contain 1 Critical Access Hospital administered by Tribal Healthcare Organizations (Dillingham Census Area, Nome Census Area, North Slope Borough, and Northwest Arctic Borough),[8] but none contained a specialty hospital. Residents of these areas must receive specialty care via telehealth or by traveling to facilities in urban areas, such as Anchorage.[8] Tribal Healthcare Organizations (THOs) operate clinics inside each of the 6 county-equivalent communities. Further, there are 6 Federally Qualified Health Center service delivery sites in the Aleutians West Census Area, 5 in the Bristol Bay Borough, 10 in the Dillingham Census Area, 14 in the Nome Census Area, 1 in the North Slope Borough, and 11 in the Northwest Arctic Borough.[15]

In a random sample of Medicare beneficiaries with Parts A and B coverage who aged into the Medicare program and lived in 1 of the 6 Alaska TBP county-equivalents throughout all months of 2018, 2019, 2020, and 2021, beneficiaries used the following types of healthcare services:

- In-person primary care: 89.3%
- Emergency department care: 52.9%
- Telehealth: 58.0%

Existing Broadband in Alaska TBP County-Equivalents

According to data from the FCC's Broadband Serviceable Location (BSL) Fabric, few locations in the 6 county-equivalents have access to advertised download speeds of at least 25 Mbps download speed and 3 Mbps upload speed for all wired and licensed fixed wireless connections. Among the 6 county-equivalents, access to broadband at this threshold ranged from 0.0% (Bristol Bay Borough) to 59.2% (North Slope Borough) for residential connections, and between 0.0% (Bristol Bay Borough) to 40.0% (Aleutians West Census Area) for business connections. The percentage of locations with access to advertised download speeds of at least 100 Mbps download speed and 20 Mbps upload speed for all wired and licensed fixed wireless connections ranged from 0.0% (Bristol Bay Borough) to 59.2% (North Slope Borough) for residential connections, and between 0.0% (Bristol Bay Borough) to 40.0% (Aleutians West Census Area) for business connections (see Table 7).

Table 7. Percentage of Broadband Serviceable Locations (BSLs) meeting download/upload speed thresholds for all wired and licensed fixed wireless residential and business connections in each of the 6 Alaska TBP target county-equivalents.

Alaska TBP Target County-Equivalent	Total BSLs	Location Type	Percentage of BSLs with speeds at or above __ download (in Mbps) and __ upload (in Mbps)					
			.02/ .02	10/ 1	25/ 3	100/ 20	250/ 25	1000/ 100
Aleutians West Census Area	1,557	Residence	60.0	59.1	40.0	40.0	40.0	0.0
Bristol Bay Borough	1,186	Residence	85.9	85.9	0.0	0.0	0.0	0.0
Dillingham Census Area	2,590	Residence	59.0	58.8	6.0	6.0	6.0	6.0
Nome Census Area	4,625	Residence	81.9	42.9	36.5	31.7	31.7	0.0
North Slope Borough	3,442	Residence	73.7	65.2	59.2	59.2	51.1	0.0
Northwest Arctic Borough	2,655	Residence	85.1	32.2	32.2	32.2	32.2	0.0
Aleutians West Census Area	1,557	Business	42.7	42.1	40.0	40.0	40.0	0.0
Bristol Bay Borough	1,186	Business	85.9	85.9	0.0	0.0	0.0	0.0
Dillingham Census Area	2,590	Business	59.0	58.8	6.0	6.0	6.0	6.0
Nome Census Area	4,625	Business	55.4	40.4	33.9	31.7	31.7	0.0
North Slope Borough	3,442	Business	56.9	53.8	19.6	19.2	13.5	0.1
Northwest Arctic Borough	2,655	Business	85.1	32.2	32.2	32.2	32.2	0.0

Mobile coverage also varied widely across the target county-equivalents (see Table 8). Although most US mobile carriers began the phase-out process of their Third Generation (3G) cellular network coverage in 2022,[16] some areas within Alaska still have significant 3G coverage, such as Bristol Bay Borough (53.8% 3G coverage in an outdoor stationary environment and 41.8% 3G coverage in an in-vehicle mobile environment). The FCC's BSL Fabric map shows that most locations in the 6 Alaskan target county-equivalents do not have access to Fourth Generation Long-Term Evolution (4G LTE) in an outdoor stationary environment, with reports ranging from 0.7% (Nome Census Area) to 40.1% (Bristol Bay Borough). In-vehicle mobile coverage for 4G LTE was even lower, ranging from 0.5% (Nome Census Area) to 22.2% (Bristol Bay Borough). Fifth Generation New Radio (5G-NR) coverage was uniformly low across all 6 Alaska TBP target county-equivalents, with 3 Alaska TBP target county-equivalents recording 0.0% coverage at both mobile thresholds (Bristol Bay Borough, Dillingham Census Area, and North Slope Borough). The other 3 target county-equivalents all recorded below 1.0% coverage for 5G-NR at the FCC thresholds.

Table 8. Percentage of total area of the 6 Alaska TBP target county-equivalents with 4G LTE, 5G-NR (at speeds of at least 7 download/1 upload, Mbps), and 5G-NR (at speeds of at least 35 download/3 upload, Mbps).

| Alaska TBP Target County-Equivalent | Total Area (in km²) | Percentage of area for which providers report mobile broadband service | | | | | | | |
| | | Outdoor stationary environment | | | | In-vehicle mobile environment | | | |
		3G	4G LTE	5G-NR, (7/1 Mbps)	5G-NR, (35/3 Mbps)	3G	4G LTE	5G-NR, (7/1 Mbps)	5G-NR, (35/3 Mbps)
Aleutians West Census Area	37,603.9	1.7	1.0	0.9	0.8	1.2	0.7	0.7	0.6
Bristol Bay Borough	2,506.5	53.8	40.1	0.0	0.0	41.8	22.2	0.0	0.0
Dillingham Census Area	59,132.5	9.6	3.7	0.0	0.0	5.6	2.5	0.0	0.0
Nome Census Area	71,716.5	10.2	0.7	0.1	0.1	5.6	0.5	0.1	0.1
North Slope Borough	237,753.4	4.2	5.7	0.0	0.0	2.9	3.1	0.0	0.0
Northwest Arctic Borough	101,821.8	8.8	9.3	0.4	0.4	6.4	4.4	0.2	0.2

Alaska Outreach Methods
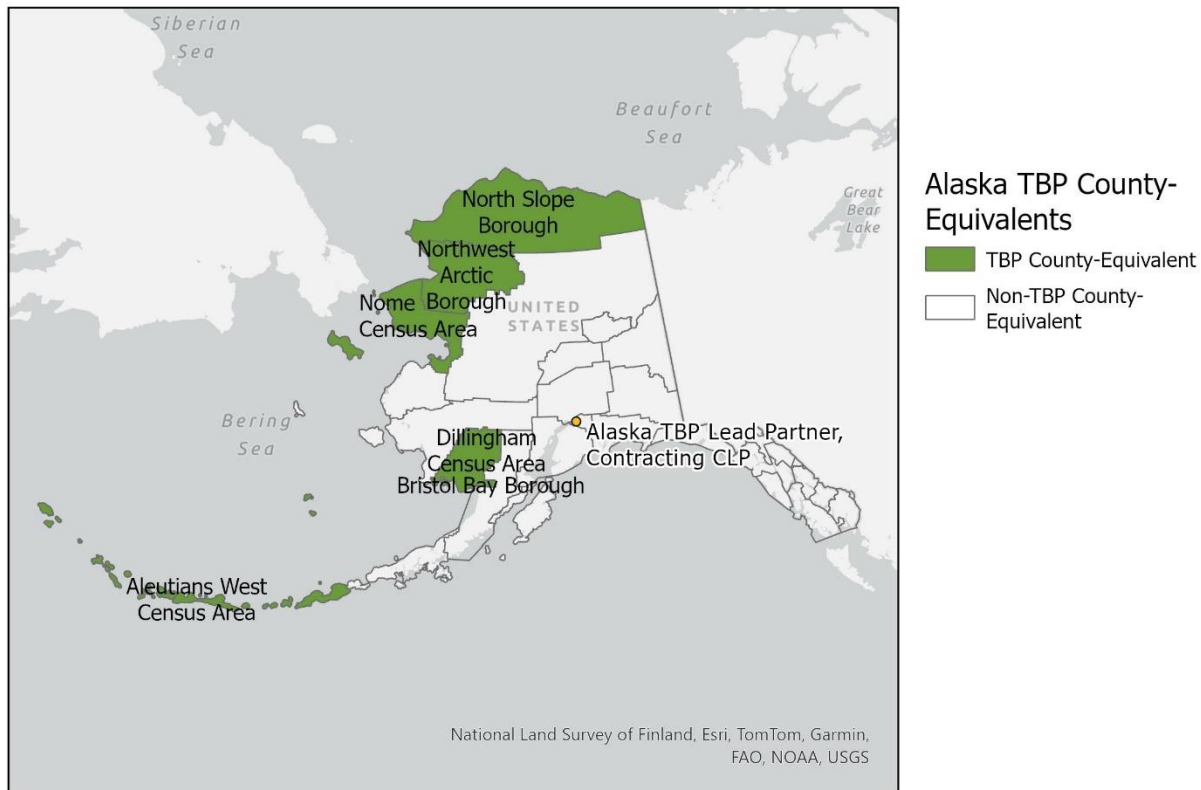
Figure 2. Map of 6 Alaska TBP target county-equivalents and the TBP Program lead organization that contracted the Alaska CLP team.

The Alaska Community Lead Partner (CLP) team was contracted through the lead TBP Program implementation organization TTAC, which is affiliated with Alaska Native Tribal Health Consortium (ANTHC), located in Anchorage, Alaska. TTAC, ANTHC, and the contracted Alaska CLP team all had existing relationships, networks, and partners located throughout the state and within the TBP target geographies. The Alaska CLP team had previously lived and worked in Alaska, including in some of the Alaska TBP target county-equivalents. Additionally, TTAC had strong existing relationships and networks in healthcare throughout Alaska, including some located in the TBP target county-equivalents.

For TBP Program implementation, the Alaska CLP team was not able to travel directly to the Alaska TBP Program target county-equivalents because of the high cost of travel required due to the geography and remoteness of the state (e.g., by plane), so they worked closely with TTAC to identify and recruit existing partner organizations and other potential Program participants. These efforts involved approximately 140 meetings, 4,400 phone calls, and more than 600 emails, resulting in contact with more than 350 businesses, 10 school districts, and 12 Tribal Health Organizations (THOs). An estimated 2,200 CLP person-hours were spent on TBP Program implementation.

TTAC also implemented several Program-wide strategies to facilitate recruitment, including in the 6 Alaska target county-equivalents (see the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*, for more detail).

Results from Alaska TBP Pods

The Alaska CLP team received data from 66 devices across 59 locations in the 6 TBP target county-equivalents; however, 7 locations had fewer than 100 speed tests or fewer than 14 unique days of data collection and were thus excluded from the analysis. A total of 52 locations across the 6 Alaska TBP target county-equivalents were included for analysis. See Table 9 for the total number of locations by county and by category.

Table 9. Total locations with pod deployments across the 6 Alaska TBP target county-equivalents, by category.

County-Equivalent	Healthcare	Non-healthcare CAI	Business	Consumer	Total
Aleutians West Census Area	6	1	0	1	**8**
Bristol Bay Borough	3	0	0	0	**3**
Dillingham Census Area	10	0	0	4	**14**
Nome Census Area	13	2	1	0	**16**
North Slope Borough	1	0	0	0	**1**
Northwest Arctic Borough	9	1	0	0	**10**
OVERALL	**42**	**4**	**1**	**5**	**52**

Across the included locations, 194,183 speed tests were conducted as of September 2024. The median download speed, upload speed, and latency was calculated for each location. Then, the median of these location medians was calculated by location category type, with results shown in Table 10. Medians were chosen to reduce the influence of locations with extremely high or low values.

Table 10. Total locations, speed tests, median download speed, median upload speed, and median latency for all locations in the 6 Alaska TBP target county-equivalents by category of location.

Category	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Business	1	2,242	4.3	3.9	37.1
Consumer	5	30,203	14.2	2.9	52.6
Healthcare	42	124,974	27.1	14.4	53.2
Non-healthcare CAI	4	36,764	77.6	67.3	68.1

*Medians reported are the medians of all median values calculated for each location.

The median download speed, upload speed, and latency were aggregated for all locations at the county-equivalent level for each of the 6 Alaska TBP target county-equivalents. Again, each location's median was first calculated, and the median of those medians by county is reported (see Table 11). Medians were chosen to reduce the influence of locations with extremely high or low values.

Table 11. Total locations, speed tests, median download speed, upload speed, and latency for each of the 6 Alaska TBP target county-equivalents.

County-Equivalent	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Aleutians West Census Area	8	60,873	36.3	8.1	68.5
Bristol Bay Borough	3	6,783	25.3	25.2	47.3
Dillingham Census Area	14	68,186	27.2	19.1	47.8
Nome Census Area	16	44,079	25.4	16.5	55.8
North Slope Borough	1	176	86.9	9.4	78.1
Northwest Arctic Borough	10	14,086	43.2	10.9	61.1

*Medians reported are the medians of all median values calculated for each location.

Excluding business locations (for which there was only 1 in Alaska), consumers had the lowest quality connections, with a median download speed of 14.2 Mbps, a median upload speed of 2.9 Mbps, and a median latency of 52.6 ms. These speeds fall below the 25/3/100 threshold. However, these observations are aggregated across only 5 consumer locations and may not be representative of all consumer homes in the 6 target county-equivalents. The median download speed, upload speed, and latency for healthcare and non-healthcare CAI locations fell between the 25/3/100 and 100/20/100 thresholds. Median download speeds of 27.1 Mbps (healthcare) and 77.6 (CAI), median upload speeds of 14.4 Mbps (healthcare) and 67.3 Mbps (CAIs), and median latencies of 53.2 ms (healthcare) and 68.1 ms (CAIs) were recorded. Again, observations of non-healthcare CAIs included only 4 unique locations across the 6 target county-equivalents and may not be representative of all non-healthcare CAIs in the region. Additionally, aggregating median measurements across many categories and locations does not show the complete experience of broadband for users at these locations.

The percentage of speed tests that fell below the 25/3/100 threshold, was between the 25/3/100 and 100/20/100 threshold, and met or exceeded the 100/20/100 threshold was calculated for each location category. In these calculations, each location was weighted equally, such that sites with

a greater number of speed tests had the same weight as locations with a smaller number of speed tests (although all included sites met the inclusion criteria of having at least 100 speed tests). The number of speed tests among included locations ranged from 103 to 17,516. The percentages of tests meeting these thresholds for locations in the 6 Alaska TBP target county-equivalents can be found in Figure 3.
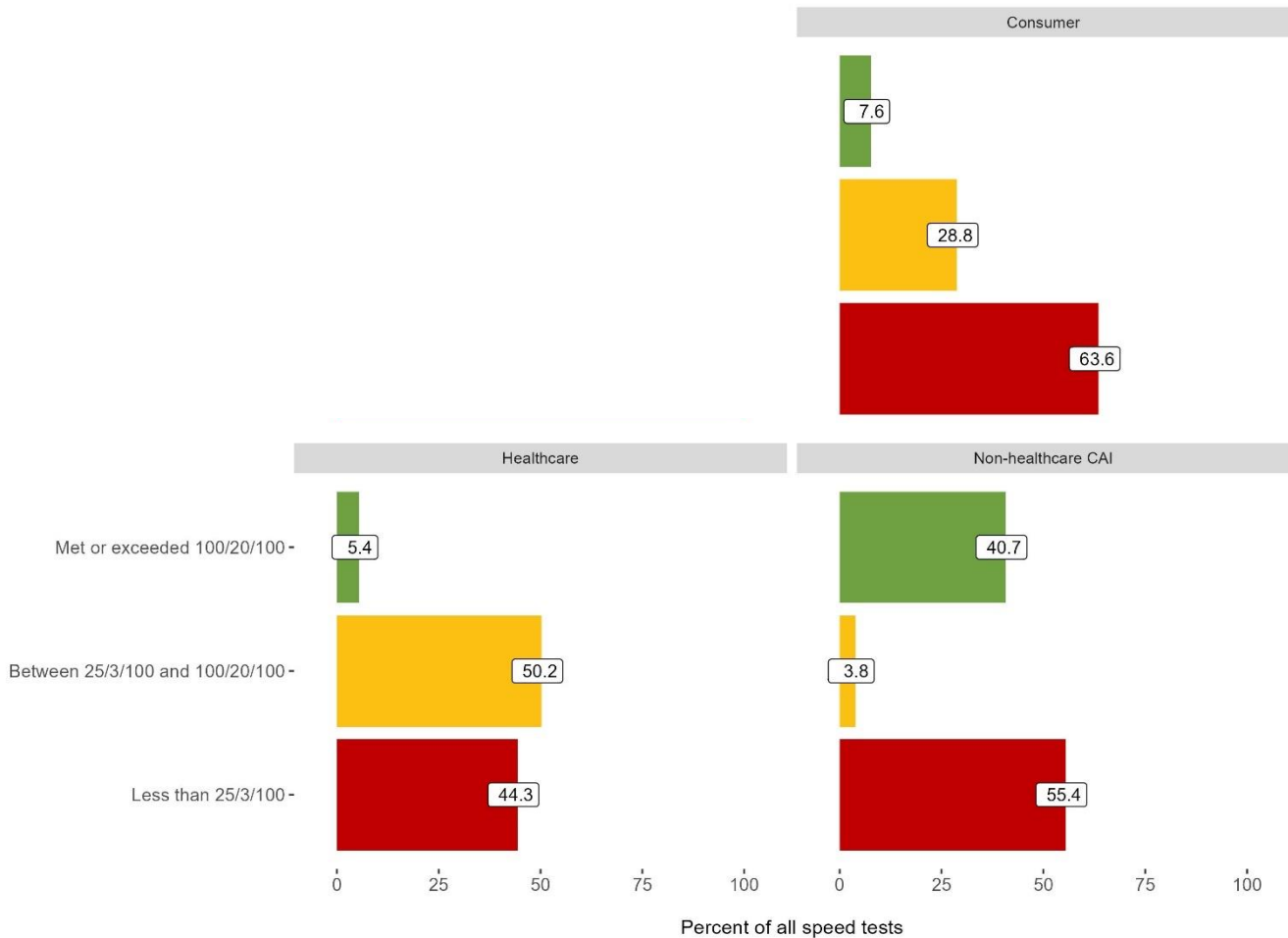
Figure 3. Percentage of speed tests recorded at less than 25/3/100, between 25/3/100 and 100/20/100, and met or exceeded 100/20/100 for sites in the 6 Alaska TBP target county-equivalents (each location equally weighted).

Among the 3 location categories, non-healthcare CAI locations had the highest percentage of speed tests meeting or exceeding the 100/20/100 threshold: 40.7%. However, most speed tests conducted at non-healthcare CAI locations fell below the 25/3/100 threshold, and only 3.8% of tests fell between the 25/3/100 and 100/20/100 thresholds, suggesting high variability in broadband speeds at these locations. Again, these tests include only 4 locations.

Healthcare sites showed the largest percentage of speed tests that fell between the 25/3/100 and 100/20/100 thresholds: 50.2%. Of the remaining tests, 44.3% fell below the 25/3/100 threshold,

and only 5.4% of speed tests at healthcare sites met or exceeded the 100/20/100 threshold (see the *Healthcare* section below for more detail).

Consumer locations demonstrated the highest percentage of speed tests falling below the 25/3/100 threshold: 63.6%. Additionally, 28.8% of all consumer speed tests fell between the 25/3/100 and 100/20/100 thresholds, and only 7.6% of consumer speed tests met or exceeded the 100/20/100 threshold. With only 5 consumer locations participating in the TBP Program throughout the 6 TBP Alaska county-equivalents, these measurements may not be representative of all consumer homes throughout the region.

Healthcare

Broadband needs for healthcare can vary depending on the size of a practice, the types of services delivered, the number of people served at one time, and other factors. However, many published recommendations of minimum healthcare broadband speeds are out of date,[17,18] particularly in light of the recent FCC threshold change.[2]

Of the 42 healthcare sites in the Alaska target county-equivalents, 27 had known advertised download and upload speeds. At all 27 of these healthcare sites, recorded download and upload speeds fell short of the advertised speeds (see Table 12).

Table 12. Overall characteristics of TBP healthcare locations with known advertised download and upload speeds in the 6 Alaska TBP target county-equivalents, as measured by pod deployments.

Location ID	Total tests	Unique days with tests	Advertised download speed (Mbps)	Advertised upload speed (Mbps)	Median download speed (Mbps)	Median upload speed (Mbps)	Median latency (in ms)
30-12	4,428	465	300	300	247.5	269.2	39.2
208-12	2,072	357	30	30	26.8	26.2	32.3
209-12	2,398	392	30	30	26.9	27.7	50.9
210-12	2,300	387	30	30	9.8	7.5	61.1
211-12	338	133	30	30	24.6	2.3	42.1
213-12	103	44	30	30	26.8	25.5	53.5
214-12	547	161	30	30	9.3	5.3	63.2
215-12	2,781	432	30	30	25.5	3.1	53.8
216-12	337	131	30	30	25.2	27.0	57.8
219-12	944	206	30	30	1.4	1.8	610.1
220-12	1,905	420	30	30	74.0	5.9	582.9
287-12	1,001	379	50	50	44.3	45.8	54.3
290-12	921	388	50	50	38.5	21.6	52.8
293-12	1,974	188	300	300	79.7	112.0	57.9
294-12	915	379	50	50	18.7	9.2	140.9
295-12	896	374	50	50	9.2	4.4	592.5
386-12	17,516	369	10	10	8.9	8.9	43.9
431-12	16,774	354	75	75	68.0	67.9	52.9
432-12	16,726	354	5	5	2.9	2.7	57.9
621-12	298	143	41.1	41.1	42.1	9.1	51.1
627-37	107	68	100	100	108.5	12.4	81.8
628-37	152	76	100	100	97.2	9.4	79.5
634-136	5,529	120	30	30	99.5	4.9	114.1
726-136	2,639	116	40	40	48.1	9.0	83.0
743-136	2,346	101	40	40	17.2	7.2	79.1
743-12	446	23	40	40	15.6	13.6	562.8
878-37	176	87	120	120	86.9	9.4	78.1

In Table 13, additional information regarding the speed tests at these healthcare locations with known advertised download and upload speeds is presented. Specifically, the table shows the number and percentage of tests falling below the 25/3/100 threshold, between the 25/3/100 and the 100/20/100 threshold, meeting or exceeding the 100/20/100 threshold, and meeting the advertised download and upload speed and latency.

Table 13. Number and percentage of speed tests observed by pods from TBP healthcare locations with known advertised download and upload speeds in Alaska TBP target county-equivalents meeting multiple standards (upload and download measurements in megabits per second; latency measurements in milliseconds; exp = expected; dl = download; ul = upload).

	Number of tests							Percentage of tests						
Location ID	< 25/3/100	25/3/100 to 100/20/100	≥ 100/20/100	Met advertised dl/ul	Did not meet advertised dl/ul	Latency ≤ 100	Latency > 100	< 25/3/100	25/3/100 to 100/20/100	≥ 100/20/100	Met advertised dl/ul	Did not meet advertised dl/ul	Latency ≤ 100	Latency > 100
30-12	36	340	4,052	211	4,217	24	4,404	0.8	7.7	91.5	4.8	95.2	99.5	0.5
208-12	734	1,338	0	0	2,072	4	2,068	35.4	64.6	0.0	0.0	100.0	99.8	0.2
209-12	143	2,255	0	0	2,398	7	2,391	6.0	94.0	0.0	0.0	100.0	99.7	0.3
210-12	2,300	0	0	634	1,666	1,142	1,158	100.0	0.0	0.0	27.6	72.4	50.4	49.7
211-12	304	33	1	1	337	2	336	89.9	9.8	0.3	0.3	99.7	99.4	0.6
213-12	7	96	0	0	103	1	102	6.8	93.2	0.0	0.0	100.0	99.0	1.0
214-12	547	0	0	32	515	265	282	100.0	0.0	0.0	5.9	94.2	51.6	48.5
215-12	2,479	302	0	0	2,781	1	2,780	89.1	10.9	0.0	0.0	100.0	100.0	0.0
216-12	163	174	0	0	337	1	336	48.4	51.6	0.0	0.0	100.0	99.7	0.3
219-12	944	0	0	0	944	944	0	100.0	0.0	0.0	0.0	100.0	0.0	100.0
220-12	1,905	0	0	0	1,905	1,434	471	100.0	0.0	0.0	0.0	100.0	24.7	75.3
287-12	92	909	0	0	1,001	66	935	9.2	90.8	0.0	0.0	100.0	93.4	6.6
290-12	91	830	0	0	921	73	848	9.9	90.1	0.0	0.0	100.0	92.1	7.9
293-12	560	848	566	0	1,974	523	1,451	28.4	43.0	28.7	0.0	100.0	73.5	26.5
294-12	525	390	0	0	915	487	428	57.4	42.6	0.0	0.0	100.0	46.8	53.2
295-12	896	0	0	0	896	877	19	100.0	0.0	0.0	0.0	100.0	2.1	97.9
386-12	17,516	0	0	621	16,895	152	17,364	100.0	0.0	0.0	3.6	96.5	99.1	0.9
431-12	161	16,613	0	0	16,774	42	16,732	1.0	99.0	0.0	0.0	100.0	99.8	0.3
432-12	16,726	0	0	0	16,726	289	16,437	100.0	0.0	0.0	0.0	100.0	98.3	1.7
621-12	36	262	0	0	298	33	265	12.1	87.9	0.0	0.0	100.0	88.9	11.1
627-37	28	69	10	0	107	23	84	26.2	64.5	9.4	0.0	100.0	78.5	21.5
628-37	38	113	1	0	152	35	117	25.0	74.3	0.7	0.0	100.0	77.0	23.0
634-136	4,199	1,330	0	0	5,529	4,044	1,485	76.0	24.1	0.0	0.0	100.0	26.9	73.1
726-136	1,479	1,160	0	0	2,639	837	1,802	56.0	44.0	0.0	0.0	100.0	68.3	31.7
743-136	1,368	978	0	0	2,346	606	1,740	58.3	41.7	0.0	0.0	100.0	74.2	25.8
743-12	446	0	0	0	446	392	54	100.0	0.0	0.0	0.0	100.0	12.1	87.9
878-37	30	140	6	0	176	27	149	17.1	79.6	3.4	0.0	100.0	84.7	15.3

The number of speed tests recorded at healthcare sites with a known advertised download and upload speed in the 6 Alaska TBP target county-equivalents ranged from 103 to 17,516, and the number of unique days where speed tests were recorded ranged from 23 to 465 days. For the healthcare locations with known advertised download and upload speeds, these advertised speeds were evaluated relative to the upload and download speeds in the 100/20/100 and 25/3/100 broadband thresholds (note that advertised latency was not recorded, making these 100/20 and 25/3 thresholds). Of the 27 healthcare locations with known advertised download and upload speeds, 5 had advertised speeds that met or exceeded the 100/20 threshold (18.5%), 20 fell between the 25/3 and 100/20 thresholds (74.1%), and 2 fell below the 25/3 threshold (7.4%). Among the 27 healthcare locations with known advertised speeds, 10 demonstrated an observed median download speed below 25 Mbps (37.0%), and 15 demonstrated an observed median download speed below 100 Mbps (55.6%). Thus, 25 of the 27 Alaskan healthcare locations with known advertised download speeds (92.6%) demonstrated median broadband download speeds below the current FCC broadband standard, and 10 healthcare locations with known advertised download speeds (37.0%) demonstrated low-quality broadband, falling below even outdated FCC thresholds for quality broadband.

Only 5 healthcare locations (18.5%) recorded median download speeds that met or exceeded their advertised speeds, and *none* of these healthcare locations recorded median upload speeds that met or exceeded their advertised upload speed. Only 2 healthcare locations (7.4%) with known advertised speeds met the 100 Mbps download speed threshold for the new FCC definition of broadband, and 9 (33.3%) met or exceeded the 20 Mbps upload speed threshold. Only *1* of the 27 healthcare locations (3.7%) met or exceeded *both* the 100 Mbps download speed threshold *and* the 20 Mbps upload speed threshold for broadband, although it still fell short of the advertised speeds.

When examining the individual speed tests for these healthcare locations, 21 locations (77.8%) recorded 0 speed tests meeting or exceeding the 100/20/100 threshold. Only 1 healthcare location recorded most of its speed tests as meeting or exceeding the 100/20/100 threshold. For 14 of the healthcare locations with known advertised speeds, most speed tests fell below the 25/3/100 threshold, and 8 of these locations (29.6%) recorded, all speed tests falling below that threshold.

Strikingly, all 27 locations reported that most speed tests that did not meet the known advertised download and upload speeds. The highest percentage of individual tests that met the advertised speed at 1 location was only 27.6%, even though the advertised download and upload speeds for this location were only 30 Mbps. For 6 of the 27 healthcare locations (22.2%) with known advertised speeds, most recorded speed tests demonstrated latencies greater than or equal to 100 ms. Median latency ranged from 32.3 ms to 610.1 ms.

Mobile

Although traveling to the Alaska TBP target county-equivalents was usually not feasible, the Alaska CLP team did conduct mobile speed tests using an Android app in 2 of the 6 target county-equivalents. By default, the mobile app ran a speed test every minute, but this testing interval could be modified by the user, especially in cases where mobile battery needed to be conserved. These mobile data were aggregated from tests conducted throughout the 2 county-equivalents, with the following results (see Table 14).

Table 14. Mobile app speed test results from CLP team mobile testing initiative across 2 of the 6 Alaska TBP target county-equivalents.

County	Median download speed (Mbps)	Median upload speed (Mbps)	Median latency (ms)	Overall number of speed tests
Aleutians West Census Area	42.9	10.3	85.5	116
Northwest Arctic Borough	2.1	0.6	89.0	229

Additionally, each mobile speed test was categorized according to the FCC mobile broadband thresholds: falling below the 7/1/100 threshold, falling between the 7/1/100 and 35/3/100 threshold, and meeting or exceeding the 35/3/100 threshold. The percentage of mobile tests that fell into each of these 3 categories can be found in Figure 4.
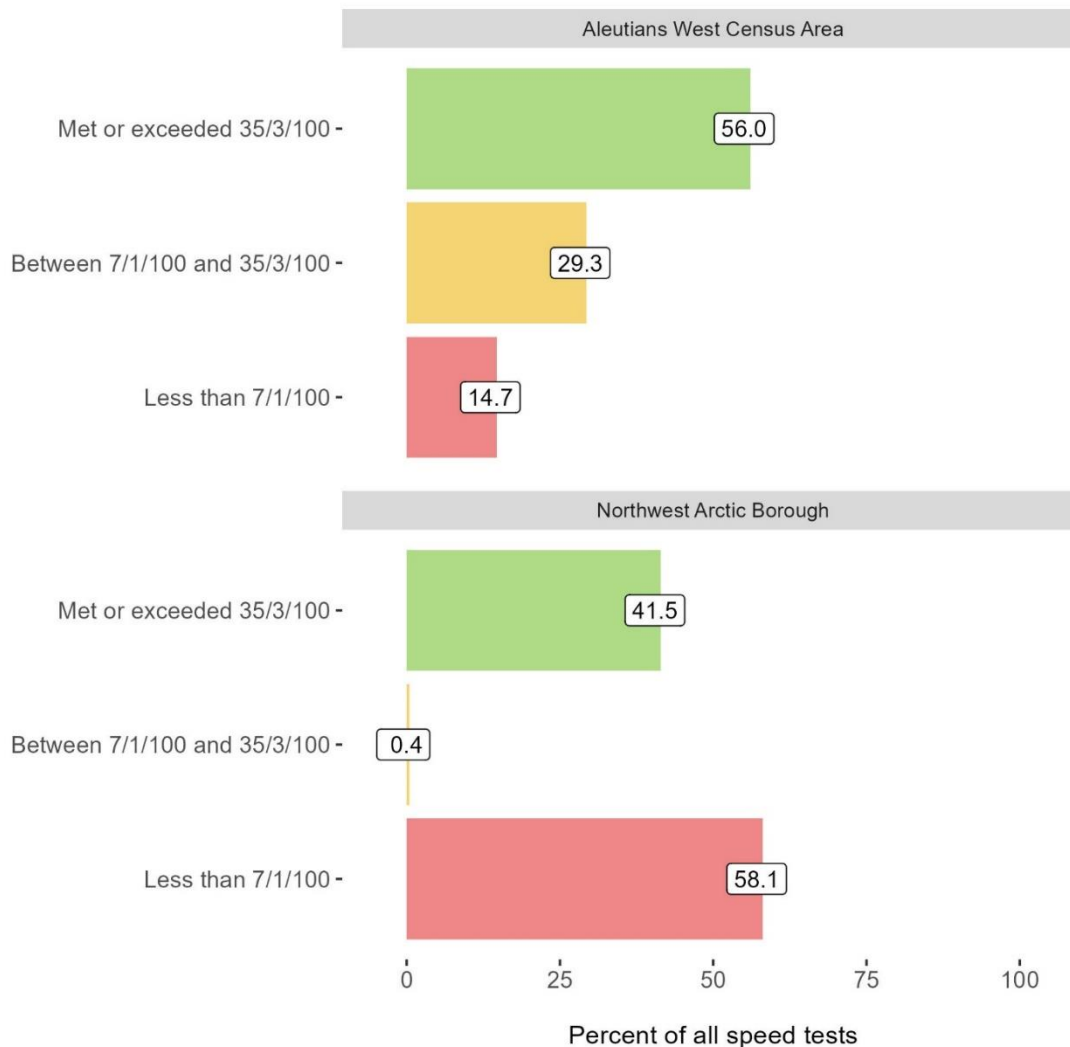

Figure 4. Percentage of mobile speed tests conducted in the 2 of the 6 Alaska TBP target county-equivalents by the Alaska CLP team falling below the 7/1/100 threshold, falling between the 7/1/100 and 35/3/100 threshold, and meeting or exceeding the 35/3/100 threshold.

Both county-equivalents with mobile speed test data showed variation in the quality of mobile broadband connections. Northwest Arctic Borough recorded the poorest quality mobile broadband connections, with 58.1% of all mobile speed tests falling below the 7/1/100 threshold. Mobile speed tests recorded in Aleutians West Census Area were of higher relative quality, with 56.0% meeting or exceeding the 35/3/100 threshold, but with 14.7% falling below the 7/1/100 threshold and 29.3% falling between the 2 thresholds.

Stories and Results from Alaska Technical Assistance Interventions

Technical assistance efforts were made by TBP Program leadership and staff to assist target county-equivalent sites with broadband-related issues. Beginning in July 2024, contracted TBP staff identified sites in need of technical assistance and tailored interventions based on the identified need and the organization being supported. The metrics reviewed to identify broadband-related issues were:

- Excessive outages
- High retransmission
- High speed test variance
- Slower than average latency
- Rate limiting
- Speeds too slow for telehealth
- Unexpectedly slow available speeds

Some interventions required significant time and collaboration with organizational IT teams in addition to the clinical teams to build sufficient trust to implement changes to the sites' broadband connections. Other interventions did not require involvement from an IT team and were thus faster and less resource-intensive.

Rural Alaska clinics relying on satellite internet experienced severe delays, making many applications unusable. A lack of local expertise and vendor support left these clinics unable to fully utilize essential healthcare services. In Alaska, TBP Program staff intervened with a healthcare location that had frequent reports of poor telehealth quality from users. Prior to the TBP Program intervention, the IT team had not observed, measured, or documented any issues at the location. Within days of the TBP pod installation, broadband measurement data revealed significantly less bandwidth available than had been advertised by the ISP. TBP staff then worked with the ISP to correct the connection configuration, and the experience of users at that location improved. Read more about TBP Program technical assistance interventions in Alaska on the [TBP Program website](#).

Telehealth, Broadband, and Program Implementation Challenges

The Alaska CLP team reviewed the telehealth adoption barriers identified through semi-structured, qualitative interviews with consumers across all TBP Program target counties. The Alaska CLP team ranked the following 3 barriers to telehealth adoption as the most impactful for consumers in the Alaska TBP target county-equivalents:

1. Lack of sufficient broadband connection
2. Low digital literacy
3. Perceived lack of telehealth service availability

From the semi-structured, qualitative interviews with consumers across all TBP Program target counties, the Alaska CLP team ranked the following 3 barriers to broadband access for consumers in the Alaska TBP target county-equivalents as the most impactful for Alaska:
1. Poor quality of broadband service
2. Poor quality of broadband connection
3. Low digital literacy

Finally, from the semi-structured, qualitative interviews with TBP staff, the Alaska CLP team was asked to select the barriers that most impacted their TBP Program implementation efforts. These barriers were:
1. Lack of a perceived benefit for participation among potential TBP Program participants
2. Ineffectiveness of some strategies across participants and communities
3. Concerns from potential participants about privacy and security

Discussion of Alaska TBP Results

The results from the TBP Program in Alaska demonstrate high levels of need to improve broadband in healthcare. No healthcare location in any of the 6 Alaska TBP target county-equivalents had a majority of recorded speeds that met their advertised broadband download and upload speeds, suggesting a need for higher-quality connections for all healthcare locations throughout the target county-equivalents. Even the single healthcare location (Location ID 30-12) with the highest quality broadband recorded still reported median download and upload speeds below their advertised speeds. Additionally, most healthcare locations (21 out of 27, or 77.8%) participating in the Alaska TBP Program reported 0 speed tests meeting or exceeding the new FCC benchmarks for broadband (100/20/100). Only 1 out of 27 healthcare locations (3.7%) with known advertised download and upload speeds even recorded a majority of speed tests that met or exceeded the 100/20/100 threshold.

When examining all included healthcare locations median broadband speeds, regardless of known advertised speeds, healthcare locations demonstrated the highest relative broadband connection quality. However, analyses still revealed significant issues in the experience of broadband at these locations. Only 5.4% of all speed tests conducted at healthcare locations met the 100/20/100 threshold. While 44.3% of healthcare location speed tests falling below the 25/3/100 threshold was the lowest for any category, more than half of all healthcare location speed tests (50.2%) fell between the 2 thresholds.

Across other location categories—non-healthcare CAIs, consumers, and businesses—few participated in the TBP Program but those that did saw poor-quality broadband. Non-healthcare CAIs had the highest quality broadband connections, with 40.7% of all speed tests meeting or exceeding the 100/20/100 threshold. However, more than half of conducted speed tests at non-healthcare CAIs fell below the 25/3/100 threshold, suggesting considerable variability in broadband connection quality for these locations. As only 4 non-healthcare CAIs participated in the TBP Program, these results may not be representative of all non-healthcare CAIs in the Alaska TBP target county-equivalents.

Consumer locations across the target county-equivalents demonstrated very poor connection quality, with 63.6% of consumer speed tests falling below the 25/3/100 threshold and 28.8% falling between the 25/3/100 and 100/20/100 thresholds. Only 7.6% of consumer speed tests met or exceeded the 100/20/100 threshold. Again, only 5 consumer locations were included in the TBP Program, thus, results may not be representative.

These results reinforce the unique challenges that Alaska faces when providing healthcare access, with many rural communities completely inaccessible without an expensive charter flight, and even then, only when weather permits.[19] Despite significant investment in Alaskan broadband through dedicated broadband subsidizing programs,[20] Alaska continues to face extreme challenges to broadband expansion. In fact, the FCC has proposed special rules specific to Alaska as part of BEAD funding to help address these issues.[21] The findings from the TBP Program support the great need for additional support and investment in Alaskan broadband infrastructure. Alaska has been a pioneer in telehealth, beginning in the 1960s over radio and continuing to innovate today through its Community Health Aide Program,[22,23] its Alaska Federal Health Care Access Network system,[19] and other programs, such as telehealth solutions for school-based hearing screenings[24] and telehealth smoking cessation programs.[25] However, data from the 6 Alaskan TBP county-equivalents suggest that many Alaskan healthcare locations still lack access to consistent, reliable broadband needed for certain types of telehealth, such as audio-video visits.[26]

The recent speed threshold change in the definition of broadband by the FCC demonstrates a recognition of the need for higher quality broadband for activities such as work, education, and telehealth.[2] The results observed from the 6 Alaskan TBP target county-equivalents raise even more concerns about the feasibility of innovative telehealth services in these communities. There are no specialty care hospitals located in any of the 6 Alaska TBP target county-equivalents. With most evaluated healthcare locations (96.3%) showing broadband speeds below the 100/20/100 threshold a majority of the time, the provision of specialty care such as tele-mental health services over an audio-video connection would not be consistent or reliable at these healthcare locations, let alone to consumers in their homes (where speeds of 100/20/100 were only available for 7.6% of speed tests).

It is beyond the scope of the TBP Program evaluation to determine the cause of every individual poorer quality speed test, which can be influenced by many factors within and outside of a location. Regardless of cause, these results highlight the need for higher quality broadband connections throughout rural Alaska, particularly at healthcare locations. If broadband is, in fact, a super determinant of health necessary for activities such as work, education, and healthcare, it is important and worth the investment to have uninterrupted access to those activities.

Recommendations

In light of results from the data collected in the 6 Alaska TBP target county-equivalents, this evaluation supports the following recommendations to improve the user experience of broadband for those communities:
   A. Provide support for consistent, high-quality broadband connections for healthcare, consumer, non-healthcare CAI, and business connections to facilitate broadband-dependent critical services, such as telehealth.
   B. Consider how frequently speeds meet broadband thresholds for high-quality experiences to ensure that services such as telehealth are reliably accessible to healthcare providers and patients.
   C. Further investigate the causes of the variability in the user experience of broadband.
   D. Create a centralized resource to help consumers, businesses, non-healthcare CAIs, and healthcare organizations provide broadband education, navigate locally available broadband options, and troubleshoot technical connectivity challenges

Appendix C: Michigan Telehealth Broadband Pilot Program Summary Report: Activations and Learnings from 6 Counties

Executive Summary

The Telehealth Broadband Pilot (TBP) Program measured broadband quality across 6 Michigan counties at 78 locations, including 64 consumer homes, 3 non-healthcare community anchor institutions (CAIs), and 11 business locations. Overall, observed median download speeds at non-healthcare CAIs, businesses, and consumer homes met the most recent Federal Communication Commission (FCC) threshold for quality broadband, but median upload speeds did not. Additionally, low percentages of individual broadband speed tests at these 3 location types met the quality broadband threshold. These results show a lack of reliable broadband sufficient for critical services such as telehealth. Although such services may generally be possible at some locations, practically these services may not be feasible at all times, in part because of variable broadband quality from the user perspective.

Median download speeds of 18.8 megabits per second (Mbps) at non-healthcare CAIs, 123.5 Mbps at business locations, and 107.1 Mbps at consumer homes were observed. Additionally, median upload speeds of 11.4 Mbps at non-healthcare CAIs, 11.1 Mbps at business locations, and 11.2 Mbps at consumer homes were also observed.

To assess the variability of these measurements, each speed test was sorted according to thresholds used by the FCC: 1) below 25 Mbps in download speed, *or* 3 Mbps in upload speed, *or* latency greater than 100 milliseconds (ms) (25/3/100); 2) meeting or exceeding 100 Mbps in download speed and 20 Mbps in upload speed with latency less than or equal to 100 ms (100/20/100); 3) falling between these 2 thresholds. Analysis of recorded tests at each location type revelated that 0.0% of tests at non-healthcare Community Anchor Institutions (CAIs), 0.9% of tests at business locations, and 17.6% of tests at consumer homes met or exceeded the 100/20/100 threshold. Indeed, 67.6% of tests at non-healthcare CAIs, 13.4% of tests at business locations, and 31.0% of tests at consumer homes fell below the 25/3/100 threshold.

Background

Michigan is the 22nd largest state in the US by area, and the 10th largest state by population, with more than 10 million people living across its 83 counties.[12,27] Approximately 1.04 million people live in the 53 rural counties of Michigan, or about 16.5% of its population.[28] According to its 5-year BEAD action plan, the state of Michigan has 4,027,591 Broadband Serviceable Locations (BSLs).[29] Of those, 368,388 meet the definition of unserved (9.1% of all BSLs) and 123,935 meet the definition of underserved (3.1%), or a total of 492,323 prioritized BSLs (12.2%).[29] In 2023, Michigan was allocated more than $1.559 billion in BEAD funding (the 4th largest amount of any state or territory)[13], or $3,167.36 in allocated funds per unserved or underserved BSL (see *A summary of Broadband Equity, Access, and Deployment [BEAD] Program plans for the 4 Telehealth Broadband Pilot Program states* for more detail).

The 6 Michigan counties selected for inclusion in the TBP Program were:[1]
- Gladwin County (2020 population: 25,386)
- Manistee County 2020 (population: 25,032)
- Missaukee County (2020 population: 15,052)
- Montmorency County (2020 population: 9,153)
- Osceola County (2020 population: 22,891)
- Oscoda County (2020 population: 8,219)

Healthcare and Telehealth in Michigan TBP Counties

Of the evaluated counties, 3 have acute care hospitals. Gladwin and Missaukee Counties both have a critical access hospital and Manistee County has a community hospital.[8] No specialty hospitals exist in any of the 6 TBP target counties in Michigan.[8] There are 3 Federally Qualified Health Center service delivery sites in Gladwin County, 5 in Manistee County, 1 in Missaukee County, 5 in Montmorency County, 3 in Osceola County, and 3 in Oscoda County.[15]

In a random sample of Medicare beneficiaries with Parts A and B coverage who aged into the Medicare program and lived in 1 of the Michigan TBP target counties throughout all months of 2018, 2019, 2020, and 2021, beneficiaries used the following types of healthcare services:
- In-person primary care: 94.4%
- Emergency department care: 64.8%
- Telehealth: 39.7%

Existing Broadband in Michigan TBP Counties

According to data from the FCC's Broadband Serviceable Location (BSL) Fabric, the percentage of locations in Michigan TBP target counties with access to advertised download speeds of at least 25 Mbps download speed and 3 Mbps upload speed for all wired and licensed fixed wireless connections ranged from 50.9% (Missaukee County) to 75.0% (Manistee County) for residential connections, and from 33.5% (Missaukee County) to 61.6% (Montmorency County) for business connections. The percentage of locations in the TBP target counties with access to advertised download speeds of at least 100 Mbps download speed and 20 Mbps upload speed for all wired and licensed fixed wireless connections ranged from 39.3% (Osceola County) to 68.2% (Gladwin County) for residential connections, and from 26.1% (Missaukee County) to 60.2% (Montmorency County) for business connections (see Table 15).

Table 15. Percentage of Broadband Serviceable Locations (BSLs) meeting download/upload speed thresholds for all wired and licensed fixed wireless residential and business connections in each of the 6 Michigan TBP target counties.

Michigan TBP Target County	Total BSLs	Location Type	Percentage of BSLs with speeds at or above __ download (in Mbps) and __ upload (in Mbps)					
			.02/ .02	10/ 1	25/ 3	100/ 20	250/ 25	1000/ 100
Gladwin	19,706	Residence	86.5	75.1	72.1	68.2	63.7	1.2
Manistee	18,014	Residence	89.5	78.6	75.0	61.3	60.2	11.8
Missaukee	10,063	Residence	74.9	66.4	50.9	43.5	42.4	19.0
Montmorency	10,144	Residence	89.5	81.4	69.3	59.7	59.0	39.3
Osceola	14,774	Residence	67.1	45.0	43.4	39.3	30.1	21.3
Oscoda	8,685	Residence	86.9	76.8	64.5	59.3	59.2	47.2
Gladwin	19,706	Business	77.0	47.2	38.2	27.6	18.5	9.4
Manistee	18,014	Business	83.4	53.8	45.2	33.1	29.2	24.9
Missaukee	10,063	Business	74.8	62.5	33.5	26.1	26.0	25.1
Montmorency	10,144	Business	88.3	65.0	61.6	60.2	59.7	42.7
Osceola	14,774	Business	73.0	52.0	40.5	35.4	27.6	26.3
Oscoda	8,685	Business	81.2	48.2	43.9	39.8	38.5	37.2

Mobile coverage in the 6 Michigan TBP target counties also varied (see Table 16). The FCC's BSL Fabric map reports that Fourth Generation Long-Term Evolution (4G LTE) in an outdoor stationary environment ranged from 42.8% (Manistee County) to 99.9% (Gladwin County). In-vehicle mobile coverage for 4G LTE was lower, ranging from 39.4% (Manistee County) to 93.2% (Osceola County). Fifth Generation New Radio (5G-NR) coverage also varied across the 6 Michigan TBP target counties at both FCC-reported speed thresholds. In an outdoor stationary environment, 5G-NR coverage at or above speeds of 7 Mbps download / 1 Mbps upload (7/1) ranged from 32.3% (Manistee County) to 83.1% (Osceola County). In-vehicle mobile 5G-NR coverage at or above the 7/1 speed threshold was lower, ranging from 12.3% (Manistee County) to 37.4% (Osceola County). 5G-NR coverage at or above the higher speed threshold (35 Mbps download / 3 Mbps upload; 35/3) ranged from 24.0% (Manistee County) to 67.4% (Osceola County) in an outdoor stationary environment and from 10.0% (Manistee County) to 29.8% (Osceola County) in an in-vehicle mobile environment.

Table 16. Percentage of total area of the 6 Michigan TBP target counties with 4G LTE, 5G-NR (at speeds of at least 7 download/1 upload, Mbps), and 5G-NR (at speeds of at least 35 download/3 upload, Mbps).

| Michigan TBP Target County | Total Area (in km²) | Percentage of area for which providers report mobile broadband service | | | | | |
| | | Outdoor stationary environment | | | In-vehicle mobile environment | | |
		4G LTE	5G-NR, (7/1 Mbps)	5G-NR, (35/3 Mbps)	4G LTE	5G-NR, (7/1 Mbps)	5G-NR, (35/3 Mbps)
Gladwin	1,264.2	99.9%	61.0%	32.2%	88.1%	16.3%	10.5%
Manistee	3,138.0	42.8%	32.3%	24.0%	39.4%	12.3%	10.0%
Missaukee	1,399.9	96.9%	66.6%	49.9%	85.4%	27.8%	23.8%
Montmorency	1,356.3	88.0%	45.4%	31.8%	70.5%	13.4%	10.5%
Osceola	1,407.1	98.7%	83.1%	67.4%	93.2%	37.4%	29.8%
Oscoda	1,383.8	89.5%	50.6%	37.9%	66.7%	14.9%	12.1%

Michigan Outreach Methods
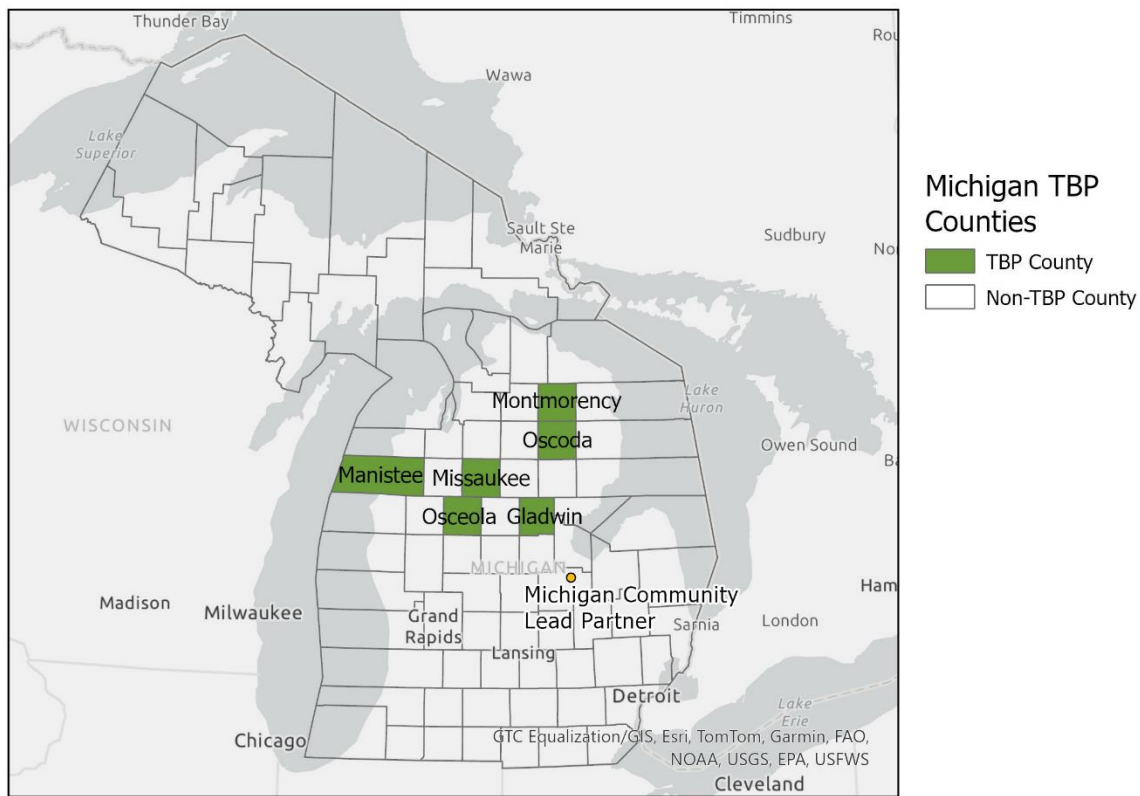
Figure 5. Map of 6 Michigan TBP target counties and the Michigan CLP organization.

The Michigan Community Lead Partner (CLP) team was established through a collaboration between the Office of Information Technology and the Rural Health Equity Institute at Central Michigan University, an academic institution located south of the Michigan TBP Program's target counties (see Figure 5). The Michigan CLP team had few existing relationships and networks with organizations located in the target counties. The nearest TBP community for the Michigan CLP team was Beaverton in Gladwin County (approximately 54 miles away, or a 49-minute drive). The farthest community was Manistee in Manistee County (approximately 154 miles away, or a 2-hour and 28-minute drive).

The Michigan CLP team relied on a variety of implementation strategies over the course of the TBP Program. Initially, the Michigan CLP team leveraged existing relationships and networks to recruit participants for the TBP Program. The team also contacted chambers of commerce and library associations to connect with members working in 1 of the 6 Michigan target counties. Later, the team conducted targeted outreach to 63 non-healthcare CAIs, including chambers of commerce, libraries, library associations, schools, and non-profit organizations. The team also attended 10 rural health and other health-related conferences, where 10 potential participants expressed interest. Despite these efforts, no healthcare organizations in the six TBP target counties in Michigan agreed to participate in the TBP Program (see the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*, for more detail).

Several strategies used by the Michigan CLP team took the form of direct or indirect outreach to participants. In total, the team conducted 6 outreach campaigns:

1. Direct outreach to targeted healthcare organizations located in TBP target counties, including 17 healthcare organizations, all of which were contacted multiple times.
2. Online outreach to consumers located in TBP target counties, yielding 16 users expressing interest in the Program from 1 social media post (Link to social media post 1).
3. Social media recruitment, which reached 7,378 users, generating 257 visits to the Michigan TBP Program website and 12 users expressing interest in Program participation.
4. Email outreach to a CLP organization alumni list with primary residence addresses located in TBP target counties, which included 1,776 individuals.
5. Two stories on local public radio stations (Link to story 1 in June 2023; Link to story 2 in February 2024), 1 of which was further covered by several local news outlets with coverage in Manistee County (Link to story 1 in June 2023; Link to story 2 in November 2023).
6. Promotion through a CLP organizational newsletter, yielding 11 individuals expressing interest in participating.

Additionally, the CLP team conducted a week-long, intensive in-person recruitment drive, first examining possible business locations within TBP communities using an online mapping application, and assessing recruitment potential by evaluating the number of business reviews. Once on site, the team spoke to staff and patrons to identify business locations that were frequented by residents, such as coffee shops and ice cream parlors. This approach helped identify the best locations to encounter locals as opposed to tourists, as only individuals with a primary residence in a TBP target county were eligible to participate in the Program. The Michigan CLP team then worked with those businesses to set up an outreach station to recruit potential participants. A one-week field visit implementing these

strategies in Manistee, Missaukee, Montmorency, and Oscoda Counties identified 44 consumer prospects who expressed interest in the Program. Thirty-nine of the 44 participants (89%) accepted and activated a pod. Throughout all in-person recruitment, the Michigan CLP team drove 1,601 miles.

An additional small business cold-calling campaign was conducted, targeting 332 small businesses located in Missaukee County that were identified using an online mapping application. TBP staff made 428 contact attempts to these businesses via phone, yielding 18 potential participants.

The lead TBP Program organization also implemented several Program-wide strategies to facilitate recruitment, including in the 6 Michigan TBP target counties (see the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*, for more detail).

Results from Michigan TBP Pods

The Michigan CLP team received data from 83 devices across 83 locations in the 6 TBP target counties; however, 5 locations had fewer than 100 speed tests or fewer than 14 unique days of data collection and were excluded from analysis. A total of 78 locations across the 6 Michigan TBP target counties were included for analysis. See Table 17 for the total number of locations by county and by category.

Table 17. Total locations with pod deployments across the 6 Michigan TBP target counties, by category.

County	Healthcare	Non-healthcare CAI	Business	Consumer	TOTAL
Gladwin County	0	1	0	8	**9**
Manistee County	0	0	0	20	**20**
Missaukee County	0	0	9	7	**16**
Montmorency County	0	1	0	12	**13**
Osceola County	0	1	2	4	**7**
Oscoda County	0	0	0	13	**13**
OVERALL	**0**	**3**	**11**	**64**	**78**

Across these locations, 340,218 speed tests were conducted as of September 2024. The median download speed, upload speed, and latency was calculated for each location. Then, the median of these location medians was calculated by location category, seen in Table 18. Medians were chosen to reduce the influence of locations with extremely high or low values.

Table 18. Total locations, speed tests, median download speed, median upload speed, and median latency for all locations in the 6 Michigan TBP target counties by category of location.

Category	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Business	11	79,932	123.5	11.1	12.2
Consumer	64	220,653	107.1	11.2	19.0
Non-healthcare CAI	3	39,633	18.8	11.4	25.0

*Medians reported are medians of all median values calculated for each location.

The median download speed, upload speed, and latency were aggregated for all locations for each of the 6 Michigan TBP target counties. Again, each location's median was first calculated, and the median of those medians by county is reported (see Table 19). Medians were chosen to reduce the influence of locations with extremely high or low values.

Table 19. Total locations, speed tests, median download speed, upload speed, and latency for each of the 6 Michigan TBP target counties.

County	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Gladwin County	9	35,990	20.6	2.8	31.3
Manistee County	20	70,046	339.5	11.3	11.0
Missaukee County	16	82,642	114.0	11.1	15.8
Montmorency County	13	50,786	18.8	1.5	21.7
Osceola County	7	48,755	341.6	11.1	23.3
Oscoda County	13	51,999	357.2	11.5	18.5

*Medians reported are medians of all median values calculated for each location.

In general, non-healthcare CAIs had the lowest quality connections, with a median download speed of 18.8 Mbps, a median upload speed of 11.4 Mbps, and a median latency of 25.0 ms across 3 locations. These median speeds would fall below the 25/3/100 threshold; however, these 3 locations may not be representative of all non-healthcare CAIs.

For the other 2 location categories (consumer and business), the median download speed, upload speed, and latency fell between the 25/3/100 and 100/20/100 thresholds. Median download speeds of 107.1 Mbps (consumer) and 123.5 Mbps (business) were recorded, as were median upload speeds of 11.2 Mbps (consumer) and 11.1 Mbps (business) and median latencies of 19.0 ms (consumer) and 12.2 ms (business). Consumer and business locations only fell below the 100/20/100 FCC threshold because of their median upload speeds. However, aggregating median measurements across many categories and locations does not show the complete experience of broadband for users at these locations.

The percentage of speed tests that fell below the 25/3/100 threshold, fell between the 25/3/100 and 100/20/100 threshold, and met or exceeded the 100/20/100 threshold for each location category (non-healthcare CAI, consumer, and business) was calculate. In these calculations, each location was equally weighted, such that sites with a greater number of speed tests had the same weight as sites with a smaller number of speed tests (although all included sites met the inclusion criteria of having at least 100 speed tests). In Michigan, the number of speed tests by site ranged from 942 to 20,533. The percentages of tests meeting these thresholds for locations in the 6 Michigan TBP target counties can be found in Figure 6.
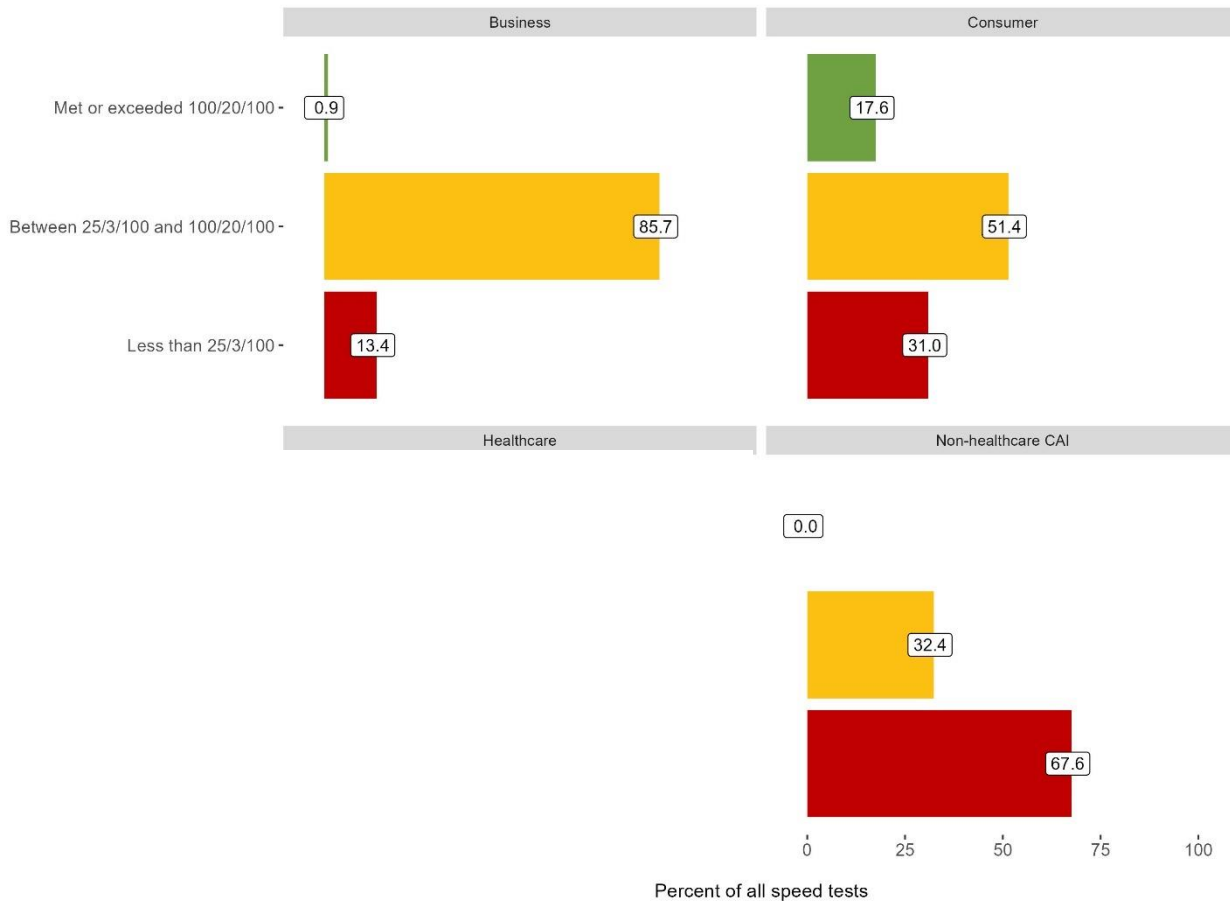
Figure 6. Percentage of speed tests recorded at less than 25/3/100, between 25/3/100 and 100/20/100, and met or exceeded 100/20/100 for sites in the 6 Michigan TBP target counties (each location equally weighted).

Non-healthcare CAI locations had the highest percentage of tests below the 100/20/100 threshold: 67.6%. Additionally, 32.4% of all speed tests conducted at non-healthcare CAI locations fell between the 25/3/100 and 100/20/100 thresholds. No CAI speed tests met or exceeded the 100/20/100 threshold. However, it should be noted that these tests represent only 3 non-healthcare CAI locations.

Speed tests conducted in consumer locations were more variable, with approximately a third (31.0%) falling below the 25/3/100 threshold, approximately half (51.4%) falling between the thresholds, and 17.6% meeting or exceeding the 100/20/100 threshold.

Most speed tests (85.7%) conducted at business locations fell between the 25/3/100 and 100/20/100 thresholds, and 13.4% fell below the 25/3/100 threshold. Only 0.9% of speed tests at business locations met or exceeded the 100/20/100 threshold.

Mobile

The Michigan CLP team also conducted mobile speed tests using an Android app while driving and visiting TBP target counties. By default, the mobile app ran a speed test every minute, but this testing interval could be modified by the user, especially in cases where mobile battery needed to be

conserved. These mobile data were aggregated from tests conducted throughout the 6 Michigan TBP target counties, with the following results (see Table 20).

Table 20. Mobile app speed test results from CLP team mobile testing initiative across 6 Michigan TBP target counties.

County	Median download speed (Mbps)	Median upload speed (Mbps)	Median latency (ms)	Overall number of speed tests
Gladwin County	26.1	4.4	38.8	947
Manistee County	20.5	1.8	45.9	1,309
Missaukee County	58.9	9.4	33.5	1,303
Montmorency County	42.7	0.9	39.7	901
Osceola County	29.2	5.3	47.6	990
Oscoda County	26.0	0.7	39.5	437

Each mobile speed test was categorized by the FCC's thresholds to assess mobile broadband coverage: falling below the 7/1/100 threshold, falling between the 7/1/100 and 35/3/100 threshold, and meeting or exceeding the 35/3/100 threshold. The percentage of mobile tests that fell into each of these categories are in Figure 7.
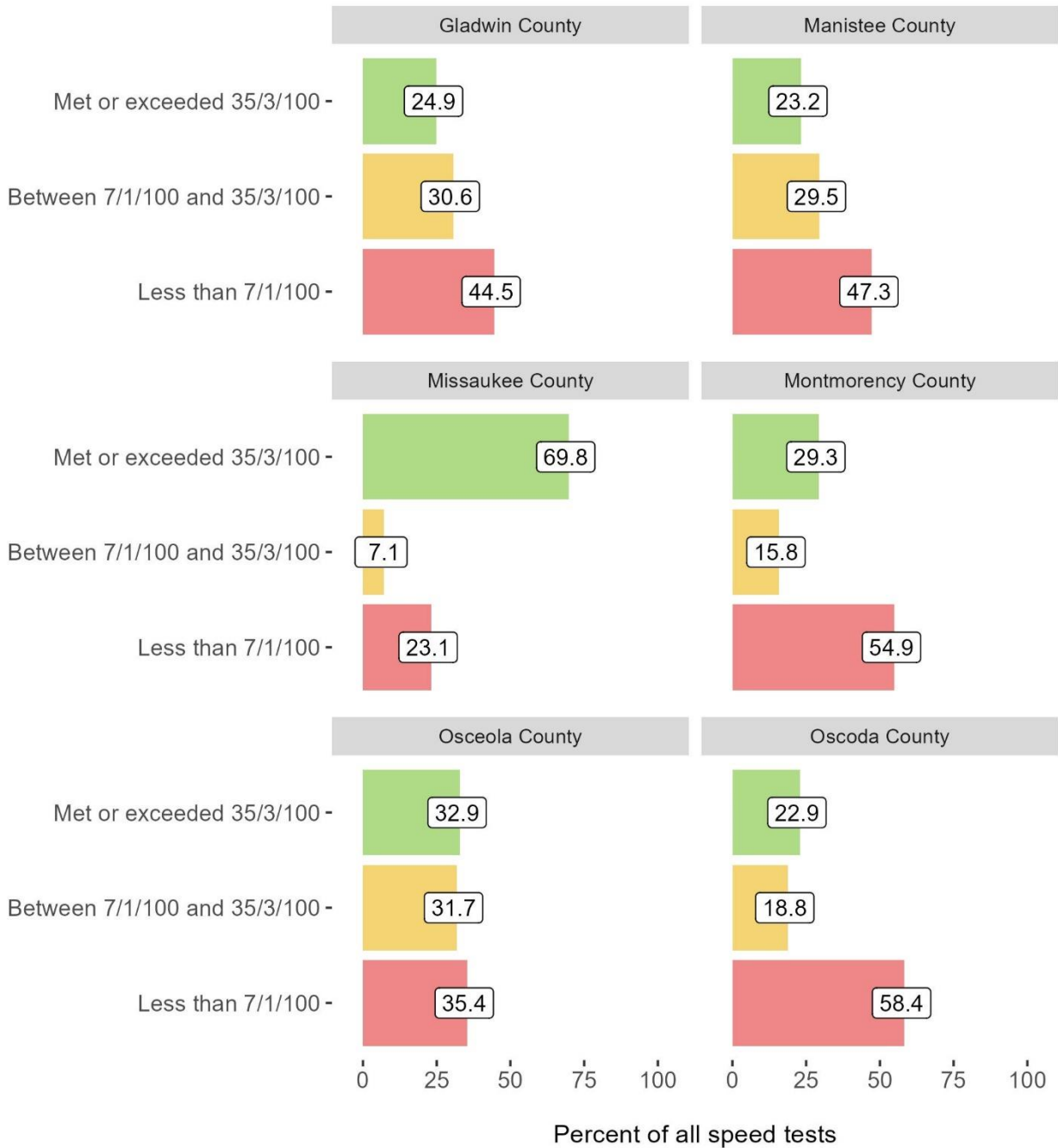
Figure 7. Percentage of mobile speed tests conducted in the 6 Michigan TBP target counties by the Michigan CLP team falling below the 7/1/100 threshold, falling between the 7/1/100 and 35/3/100 threshold, and meeting or exceeding the 35/3/100 threshold.

All 6 Michigan target counties showed variation in the quality of mobile broadband connections. Oscoda County recorded the poorest quality mobile broadband connections, with 58.4% of all mobile speed tests falling below the 7/1/100 threshold and 18.8% falling between the 7/1/100 threshold and the 35/3/100 threshold. Mobile speed tests recorded in Missaukee County were of the

highest relative quality, with 69.8% meeting or exceeding the 35/3/100 threshold and only 23.1% falling below the 7/1/100 threshold.

Stories and Results from Michigan Technical Assistance Interventions

Technical assistance efforts were made by TBP Program leadership and staff to assist target county sites with broadband-related issues. Beginning in July 2024, contracted TBP staff identified sites in need of technical assistance and tailored interventions based on the identified need and the organization being supported. The metrics reviewed to identify broadband-related issues were:

- Excessive outages
- High retransmission
- High speed test variance
- Slower than average latency
- Rate limiting
- Speeds too slow for telehealth
- Unexpectedly slow available speeds

One rural Michigan healthcare organization struggled with years of inconsistent and unreliable broadband, which part-time IT staff couldn't resolve. This impacted telehealth, delayed charting, and ultimately led to provider burnout and turnover. This healthcare organization reported multiple issues with broadband connectivity, including telehealth visit disruptions mid-call and abrupt system log-outs from electronical health records (EHR) during charting. This healthcare organization served refugee communities, which necessitates remote interpretation services. Disconnections not only disrupted healthcare service delivery because of the loss of the interpretation service, but also led to a significant time commitment for providers and patients because a different interpreter would be connected when service was restored, meaning any information relevant to the current discussion of the patient's health would need to be restated. TBP Program staff worked closely with a healthcare organization with 7 clinic locations, some of which were in TBP target counties. TBP Program staff deployed pods at these clinical sites and used the collected data to identify multiple issues, including:

- Wi-Fi access points that were delayed (longer than 5 seconds) when switching from one to another, causing broadband connections to drop
- Wi-Fi access points installed with incorrect orientation, prohibiting full bandwidth availability
- Too many installed Wi-Fi access points, which increased the likelihood of disconnections and reduced the available bandwidth leading to a lower quality wireless experience
- Incorrect internet routing configuration, which reduced full bandwidth availability to as low as only 10% of the advertised bandwidth

TBP staff improved the user experience of broadband at these locations by reducing the excessive and delayed Wi-Fi access point switching. TBP staff have also conducted further efforts to collaborate with the healthcare organizational leadership and the IT team to resolve issues, although improvements have already been reported. Read more about TBP Program technical assistance interventions in Michigan on the TBP Program website.

Telehealth, Broadband, and Program Implementation Challenges

The Michigan CLP team reviewed the telehealth adoption barriers identified through semi-structured, qualitative interviews with consumers across all TBP Program target counties. The Michigan CLP team ranked the following 3 barriers to telehealth adoption as the most impactful for consumers in the Michigan TBP target counties:
1. Perceived lack of value in telehealth
2. Lack of sufficient broadband connection
3. Low digital literacy

From the semi-structured, qualitative interviews with consumers across all TBP Program target counties, the Michigan CLP team ranked the following 3 barriers to broadband access for consumers in the Michigan TBP target counties as the most impactful for Michigan:
1. High cost
2. Lack of quality broadband service availability
3. Poor quality of broadband connection

Finally, from the semi-structured, qualitative interviews with TBP staff, the Michigan CLP team was asked to select the barriers that most impacted their TBP Program implementation efforts. These barriers were:
1. Staffing challenges
2. General resistance to Program participation
3. Resource intensiveness of Program recruitment and follow-up

Discussion of Michigan TBP Results

The results from the TBP Program demonstrated relatively poor-quality broadband connections for all participating location types, including consumers, businesses, and non-healthcare CAIs (although only 3 CAIs participated). Less than 1% of speed tests conducted at business locations and 0% of speed tests at non-healthcare CAIs met the new FCC threshold for broadband (100/20/100). The TBP Program in Michigan had its greatest participation with consumers, after a targeted in-person consumer outreach effort was conducted at local businesses within TBP target counties. However, consumer speed tests showed variable and relatively poor-quality broadband. Only 17.6% of consumer speed tests met the 100/20/100 threshold for high-quality broadband, and nearly a third of consumer speed tests fell below the outdated broadband threshold of 25/3/100. This is an important distinction, as a BSL may meet the FCC's served location criteria, but the experience of the broadband user at that location may not always be consistently high-quality.

In a healthcare context, broadband inconsistency could create a lag that disrupts a patient-provider connection or a delay in sending or receiving critical health information, as was seen in the technical assistance intervention in Michigan for a healthcare organization serving a large number of patients who required virtual interpretation services. Such inconsistency was observed among consumers in Michigan, who may experience poor broadband quality frequently enough to impact critical online services such as telehealth. However, as of September 2024 no broadband data were collected from healthcare locations in Michigan to examine telehealth consistency and reliability at the provider level despite repeated efforts to recruit healthcare organizations to participate in the TBP Program. However, results from the implementation study of TBP Program implementation suggest several ways healthcare organization participation could be increased in similar future broadband

program implementations (see the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*, for more detail). Some of the findings from the TBP Program implementation study were able to be put into action later in TBP Program implementation timeline. One barrier to TBP Program implementation identified by TBP staff was the lack of a perceived benefit for TBP Program participation. The offer to investigate and potentially resolve broadband issues for healthcare organizations was large enough perceived benefit to motivate at least 1 Michigan healthcare organization to install pods at multiple clinic locations in the last few months of TBP Program implementation. Thus, future efforts to measure the user experience of broadband over time in healthcare locations may be able to more quickly and successfully recruit healthcare organization participation based on these learnings.

When examining Michigan locations participating in the TBP Program, speed tests for businesses and consumer homes showed median download speeds exceeding the 100 Mbps threshold for the new FCC definition of broadband. The median download speed recorded for non-healthcare CAIs fell short, at 18.8 Mbps, but these observations came from only 3 locations and may not be representative of all non-healthcare CAIs in the region. The median upload speed for all 3 location categories (consumer, business, and non-healthcare CAI) fell below the 20 Mbps threshold for broadband.

Variability was also present across the 6 Michigan TBP target counties, with the poorest quality broadband speeds reported in Montmorency and Gladwin Counties. Higher quality broadband speeds were reported for the other 4 participating counties (Manistee, Missaukee, Osceola, and Oscoda Counties), with recorded median download speeds all exceeding 100 Mbps. However, the median upload speed across all 6 TBP target counties fell below the 20 Mbps threshold for broadband, ranging from 1.5 Mbps (Montmorency County) to 11.5 Mbps (Oscoda County). Sufficient upload speed is critical for telehealth services, which rely on fast transmission of information from the user back to another location.[30] Slow upload speeds may impair audio and video telehealth visits, creating a lag that could make a patient-provider connection difficult.

The recent speed threshold change in the FCC's definition of broadband demonstrates a recognition of the need for higher quality broadband for activities such as work, education, and telehealth.[2] In a report describing the rationale for this definition change, the FCC highlighted telehealth as an activity that may not be feasible with upload speeds of 3 Mbps or lower.[7] In light of these needs, the results observed from the 6 Michigan TBP target counties raise concerns about the feasibility of telehealth in these communities, particularly with regard to upload speed. Median upload speeds at all location types participating in the TBP Program fell below the 20 Mbps recommended by the FCC for a telehealth video conference. Moreover, only 17.6% of speed tests conducted at consumer locations met or exceeded the 100/20/100 broadband threshold. This finding suggests that consumers may need to travel long distances for specialty care and may struggle to receive consistently, high-quality telehealth.

Although TBP target communities may sometimes have sufficient download speeds for telehealth, upload speeds were much slower and may prove a limiting factor in patients participating in telehealth from their homes. The data also demonstrate that speed tests sometimes meet the 100/20/100 broadband threshold, but not often, meaning the user experience of broadband connections could vary considerably. It is beyond the scope of the TBP Program evaluation to determine the cause of every individual poorer quality speed test, which can be influenced by many factors within and outside of a location. However, these results do highlight the need to consider the experience of broadband as a user in addition to broadband connection access. If broadband is, in

fact, a super determinant of health necessary for activities such as work, education, and healthcare, it is important and worth the investment to have uninterrupted access to those activities.

Recommendations

In light of results from the data collected across the 6 Michigan TBP target counties, this evaluation supports the following recommendations to improve the user experience of broadband for those communities:

A. Provide support for consistent, high-quality broadband connections for healthcare, consumer, non-healthcare CAI, and business connections to facilitate broadband-dependent critical services, such as telehealth.
B. Consider how frequently speeds meet broadband thresholds for high-quality experiences to ensure that services such as telehealth are reliably accessible to healthcare providers and patients.
C. Further investigate the causes of the variability in the user experience of broadband.
D. Create a centralized resource to help consumers, businesses, non-healthcare CAIs, and healthcare organizations provide broadband education, navigate locally available broadband options, and troubleshoot technical connectivity challenges.

Appendix D: Texas Telehealth Broadband Pilot Program Summary Report: Activations and Learnings from 6 Counties

Executive Summary

The Telehealth Broadband Pilot (TBP) Program measured broadband quality across 6 Texas counties at 168 locations: 13 healthcare sites, 21 consumer homes, 78 non-healthcare community anchor institutions (CAIs), and 56 business locations. Overall, although observed median download and upload speeds at healthcare, non-healthcare CAI, and business locations all met or exceeded the Federal Communication Commission (FCC) threshold for quality broadband, the experience of broadband as assessed by individual speed tests over time was much more variable. Consumer home broadband was generally of lower quality, with median measurements of speed and latency falling below the FCC threshold for quality broadband. In this context, critical services such as telehealth may be possible, but may not be feasible at all times.

Median download speeds of 138.4 megabits per second (Mbps) at healthcare sites, 399.2 Mbps at non-healthcare CAIs, 152.1 Mbps at business locations, and 59.6 Mbps at consumer homes were observed. Additionally, observed median upload speeds were 69.0 Mbps at healthcare sites, 347.3 Mbps at non-healthcare CAIs, 102.5 Mbps at business locations, and 38.3 Mbps at consumer homes.

To further assess the variability of these measurements, each speed test was sorted according to thresholds used by the FCC: 1) below 25 Mbps in download speed, *or* 3 Mbps in upload speed, *or* latency greater than 100 milliseconds (ms) (25/3/100); 2) meeting or exceeding 100 Mbps in download speed and 20 Mbps in upload speed with latency less than or equal to 100 ms (100/20/100); 3) falling between these 2 thresholds. When examining individual speed test results, 69.7% of tests at non-healthcare CAIs, 35.7% of tests at business locations, 31.4% of tests at healthcare sites, and 9.7% of tests at consumer homes recorded speeds meeting or exceeding the 100/20/100 threshold. However, 9.4% of tests at non-healthcare CAIs, 11.1% of tests at healthcare sites, 25.9% of tests at business locations, and 63.8% of tests at consumer homes fell below the 25/3/100 threshold. Lastly, at 8 of the 10 healthcare sites with known advertised download and upload speeds, all measured speed tests fell below the advertised speeds.

Background

Texas is the second largest state in the US by land area and population, with more than 29 million people, roughly 9.9% of whom live in a rural county.[1,12,31] Across its 254 counties, Texas has identified 9,877,083 broadband serviceable locations (BSLs).[32] According to its 5-year BEAD action plan, the Texas State Broadband Office reports that 7.9% of these BSLs are unserved (779,378) and 3.7% of these BSLs are underserved (362,878).[32] In 2023, Texas was allocated over $3.3 billion in BEAD funding[13]—the most given to any state or territory. However, the allocated funds per unserved or underserved BSL was the lowest of any TBP target state: $2,900.06[33] (see *A summary of Broadband Equity, Access, and Deployment [BEAD] Program plans for the 4 Telehealth Broadband Pilot Program states* for more detail).

The 6 Texas counties selected for inclusion in the TBP Program were:[1]
- Crosby County (2020 population: 5,133)
- Fisher County (2020 population: 3,672)
- Haskell County (2020 population: 5,416)
- Jones County (2020 population: 19,663)
- Lamb County (2020 population: 13,045)
- Mitchell County (2020 population: 8,990)

Healthcare and Telehealth in Texas TBP Counties

Each of these 6 counties contain 1 acute care hospital: 4 have critical access hospitals (Crosby County, Fisher County, Haskell County, Mitchell County), 1 has a Sole Community Hospital (Lamb County), and 1 has a Medicare Dependent Hospital (Jones County).[8] None of the 6 counties have a specialty hospital.[8] There are no Federally Qualified Health Centers or Federally Qualified Health Center Look-Alikes in any of the 6 TBP target counties in Texas.[15]

In a random sample of Medicare beneficiaries with Parts A and B coverage who aged into the Medicare program and lived in 1 of 6 Texas TBP target counties throughout all months of 2018, 2019, 2020, and 2021, beneficiaries used the following types of healthcare services:
- In-person primary care: 89.4%
- Emergency department care: 63.0%
- Telehealth: 32.4%

Existing Broadband in Texas TBP Counties

According to data from the FCC's Broadband Serviceable Location (BSL) Fabric, the percentage of locations in target counties with access to advertised download speeds of at least 25 Mbps download speed and 3 Mbps upload speed for all wired and licensed fixed wireless connections ranged from 58.0% (Fisher County) to 95.5% (Crosby County) for residential connections, and from 49.7% (Fisher County) to 96.0% (Crosby County) for business connections. The percentage of locations in target counties with access to advertised download speeds of at least 100 Mbps download speed and 20 Mbps upload speed for all wired and licensed fixed wireless connections ranged from 52.7% (Fisher County) to 95.0% (Crosby County) for residential connections, and from 38.5% (Fisher County) to 95.2% (Crosby County) for business connections (see Table 21).

Table 21. Percentage of Broadband Serviceable Locations (BSLs) meeting download/upload speed thresholds for all wired and licensed fixed wireless residential and business connections in each of the 6 Texas TBP target counties.

Texas TBP Target County	Total BSLs	Location Type	Percentage of BSLs with speeds at or above __ download (in Mbps) and __ upload (in Mbps)					
			.02/ .02	10/ 1	25/ 3	100/ 20	250/ 25	1000/ 100
Crosby	3,806	Residence	97.2	96.2	95.5	95.0	89.0	74.3
Fisher	3,218	Residence	69.0	63.4	58.0	52.7	36.2	9.4
Haskell	4,706	Residence	90.8	89.5	88.0	79.3	78.6	78.6
Jones	9,796	Residence	85.7	77.7	58.3	55.4	53.4	25.8
Lamb	7,778	Residence	95.4	93.6	92.5	91.0	85.1	85.1
Mitchell	4,932	Residence	82.7	82.5	82.5	80.4	80.4	51.4
Crosby	3,806	Business	99.2	98.8	96.0	95.2	89.0	74.3
Fisher	3,218	Business	86.4	81.1	49.7	38.5	20.3	9.4
Haskell	4,706	Business	97.2	96.8	88.6	79.3	78.6	78.6
Jones	9,796	Business	94.4	87.3	55.2	40.2	36.8	23.7
Lamb	7,778	Business	98.3	97.4	92.8	91.1	85.1	85.1
Mitchell	4,932	Business	88.8	88.6	82.5	80.4	80.4	51.4

For mobile coverage, the BSL Fabric map reports that more than 94% of the total area for 5 of the 6 TBP target counties are covered by Fourth Generation Long-Term Evolution (4G LTE) in an outdoor stationary environment (see Table 22). However, only 81.9% of Mitchell County, Texas, is covered by 4G LTE. In an in-vehicle mobile environment, the target counties ranged from 54.6% of 4G LTE coverage (Mitchell County) to 96.8% (Lamb County). Fifth Generation New Radio (5G-NR) coverage in an outdoor stationary environment also varied considerably among the 6 TBP counties, ranging from 45.8% at or exceeding speeds of 7 Mbps download / 1 Mbps upload in Mitchell County to 75.0% in Lamb County. For 5G-NR coverage in an outdoor stationary environment at or exceeding speeds of 35 Mbps download / 3 Mbps upload, these ranges dropped to a low of 28.2% (Mitchell County) to a high of 60.0% (Lamb County). In-vehicle mobile environment 5G-NR coverage was even lower.

Table 22. Percentage of total area of the 6 Texas TBP target counties with 4G LTE, 5G-NR (at speeds of at least 7 download/1 upload, Mbps), and 5G-NR (at speeds of at least 35 download/3 upload, Mbps).

|		Percentage of area for which providers report mobile broadband service					
		Outdoor stationary environment			In-vehicle mobile environment		
Texas TBP Target County	Total Area (in km²)	4G LTE	5G-NR, (7/1 Mbps)	5G-NR, (35/3 Mbps)	4G LTE	5G-NR, (7/1 Mbps)	5G-NR, (35/3 Mbps)
Crosby	2,046.1	95.5%	58.9%	41.1%	85.3%	18.9%	15.1%
Fisher	2,042.2	94.8%	66.0%	48.8%	75.9%	19.5%	15.8%
Haskell	2,076.1	96.9%	60.4%	43.5%	68.5%	13.6%	8.6%
Jones	2,129.0	99.6%	60.9%	43.9%	90.8%	17.0%	11.1%
Lamb	2,307.1	99.6%	75.0%	60.0%	96.8%	23.6%	15.8%
Mitchell	2,062.1	81.9%	45.8%	28.2%	54.6%	11.6%	6.9%

Texas CLP Outreach Methods
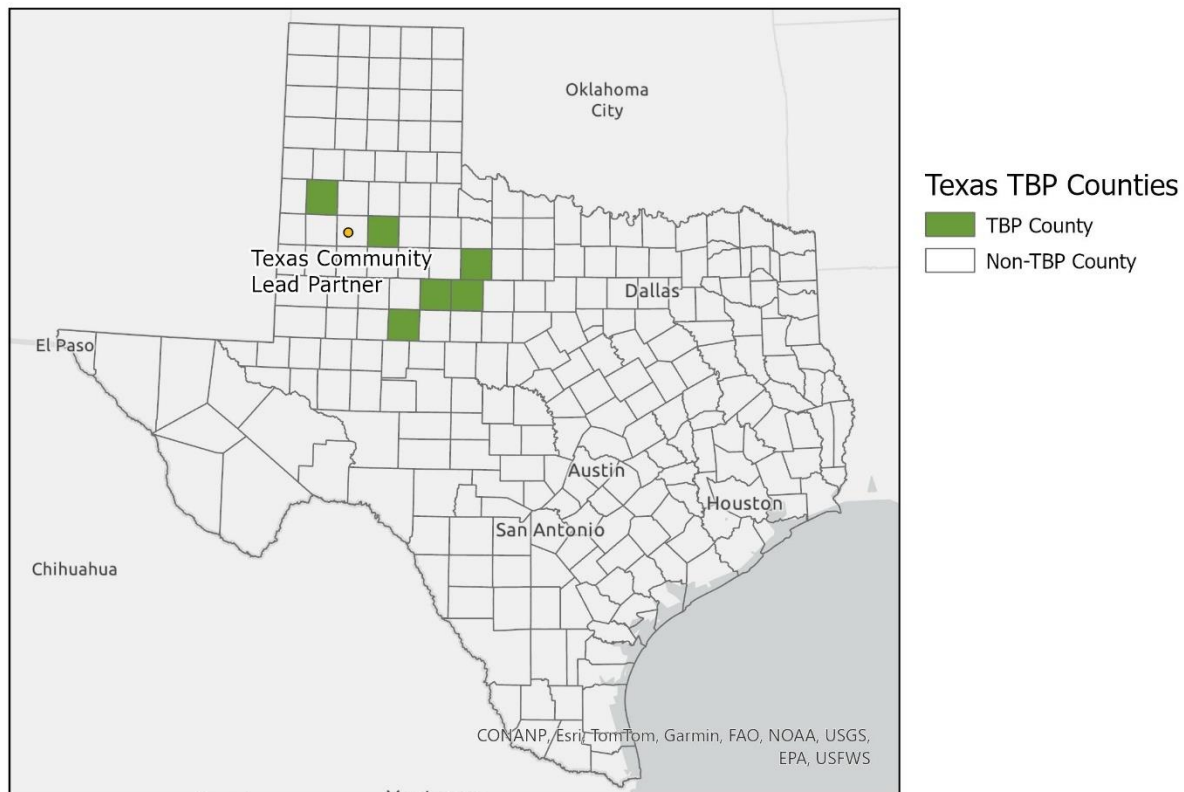
Figure 8. Map of 6 TBP target counties and the Texas CLP organization.

The Texas Community Lead Partner (CLP) was the Texas Tech University Health Sciences Center, an academic medical center located in Lubbock, Texas (see Figure 8). The CLP team did not have pre-existing close relationships with individuals or organizations located in the 6 target counties. The nearest TBP community for the Texas CLP team was Lorenzo, Texas, in Crosbyton County (approximately 23 miles away, or a 25-minute drive), and the farthest community was Lueders, Texas, in Jones County (approximately 168 miles away, or a 2 hour and 34 minute drive).

The Texas CLP team used an initial approach of identifying possible pod outreach sites using an online mapping application to identify potential sites for pod deployment outreach within specific communities, focusing on one of the six Texas TBP Program target counties at a time, including healthcare organizations, non-healthcare CAIs, and business locations. The Texas CLP team found that a snowball recruitment strategy was effective within the TBP Program communities, allowing them to leverage successful pod deployments to facilitate additional deployments. Focusing outreach efforts within one TBP Program target county at a time proved to be the most effective and efficient strategy to yield additional deployment sites. After reaching saturation, the Texas CLP team would move to another TBP Program community and restart this outreach strategy.

Through this process, the Texas CLP team identified the following potential locations for TBP Program recruitment (Reach):
- 24 healthcare sites
    - Such as hospitals, family medicine clinics, nursing homes, rehabilitation centers, home health organizations, pharmacies, and dental practices
- 105 non-healthcare CAIs
    - Such as schools, churches, community organizations, museums, radio stations, and government offices
- 201 businesses

All 330 of these locations were contacted about participating in the TBP Program using a variety of strategies including email, phone, and in-person outreach. Initially, the CLP team contacted identified sites via email or phone, then driving to the communities if a site committed to learn more about the TBP Program. However, the CLP team later modified this policy when they discovered that a boots-on-the-ground, door-to-door outreach approach worked well in these communities even without initial email or phone contact. These strategies proved effective in reaching healthcare sites, businesses, and non-healthcare CAIs in the six TBP target counties in Texas. In total, throughout all in-person, door-to-door recruitment, the Texas CLP team drove approximately 8,900 miles.

The lead TBP Program organization also implemented several Program-wide strategies to facilitate recruitment, including in the 6 Texas target counties (see the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*, for more detail).

Results from Texas TBP Pods

The Texas CLP team received data from 228 devices across 179 locations in the 6 target counties; however, 11 locations had fewer than 100 speed tests or fewer than 14 unique days of data collection and were excluded from the analysis. A total of 168 locations across the 6 Texas TBP target counties were included for analysis. See Table 23 for the total number of locations by county and by category.

Table 23. Total locations with pod deployments across the 6 Texas TBP target counties, by county and by category.

County	Healthcare	Non-healthcare CAI	Business	Consumer	Total
Crosby County	4	14	9	2	**29**
Fisher County	1	13	9	10	**33**
Haskell County	3	8	13	4	**28**
Jones County	3	17	10	1	**31**
Lamb County	0	19	7	0	**26**
Mitchell County	2	7	8	4	**21**
OVERALL	**13**	**78**	**56**	**21**	**168**

Across these locations, 2,484,674 speed tests were conducted as of September 2024. The median download speed, upload speed, and latency was calculated for each location. Then, the median of these location medians was calculated by location category type, as can be found in Table 24. Medians were chosen to reduce the influence of locations with extremely high or low values.

Table 24. Total locations, speed tests, median download speed, median upload speed, and median latency for all locations in the 6 Texas TBP target counties by category of location.

Category	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Business	56	649,495	52.1	24.6	15.4
Consumer	21	196,827	21.6	7.6	19.7
Healthcare	13	117,950	81.3	80.5	18.3
Non-healthcare CAI	78	1,519,575	372.5	210.9	12.8

*Medians reported are the medians of all median values calculated for each location.

The median download speed, upload speed, and latency were aggregated for all locations for each of the 6 Texas TBP target counties. Again, each location's median was first calculated, and the median of those medians by county is reported (see Table 25). Medians were chosen to reduce the influence of locations with extremely high or low values.

Table 25. Total locations, speed tests, median download speed, upload speed, and latency for each of the 6 Texas TBP target counties.

County	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Crosby County	29	495,198	91.2	42.1	19.7
Fisher County	33	452,143	30.1	7.6	20.0
Haskell County	28	362,445	91.8	91.5	7.1
Jones County	31	534,846	92.2	92.9	18.3
Lamb County	26	442,785	520.2	539.4	13.0
Mitchell County	21	196,430	245.1	101.3	12.8

*Medians reported are the medians of all median values calculated for each location.

In general, consumers had the lowest quality connections, with a median download speed of 58.3 Mbps, a median upload speed of 38.3 Mbps, and a median latency of 24.0 ms across 23 locations. These speeds fall between the FCC's 25/3/100 and 100/20/100 thresholds. Broadband speeds at the other 3 location categories (healthcare, non-healthcare CAI, and business) met or exceeded the 100/20/100 threshold. However, aggregating median measurements across many categories and locations does not show the complete experience of broadband for users at these locations.

The percentage of individual speed tests that fell below the 25/3/100 threshold, fell between the 25/3/100 and 100/20/100 threshold, and met or exceeded the 100/20/100 threshold for each location category was calculated. In these calculations, each location was equally weighted, such that sites with a greater number of speed tests had the same weight as sites with a smaller number of speed tests (although all sites met the inclusion criteria of having at least 100 speed tests). In Texas, the number of speed tests by site included for analysis ranged from 540 speed tests to 79,519. The percentages of tests meeting FCC thresholds by location can be found in Figure 9.
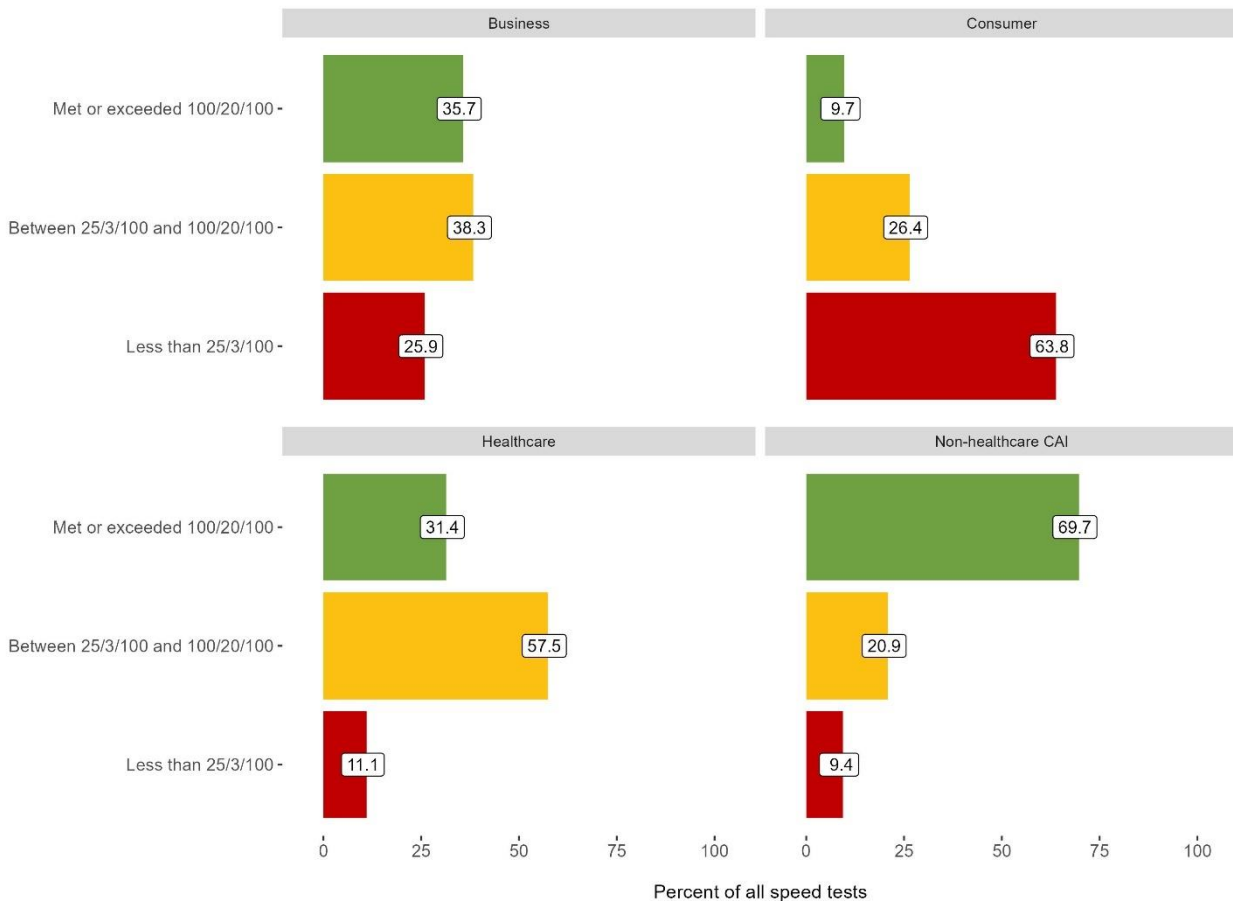
Figure 9. Percentage of speed tests recorded at less than 25/3/100 , between 25/3/100 and 100/20/100, and met or exceeded 100/20/100 for sites in the 6 Texas TBP target counties (each location equally weighted).

At healthcare sites, most speed tests fell between the between 25/3/100 and 100/20/100 thresholds: 57.5%. Only 11.1% of healthcare site speed tests in target counties fell below the 25/3/100 threshold, and 31.4% met or exceeded the 100/20/100 threshold (see the *Healthcare* section below for more detail).

Consumer locations demonstrated the poorest connection quality, with 63.8% of speed tests at consumer locations in target counties falling below the 25/3/100 threshold. An additional 26.4% of speed tests at consumer locations in Texas fell between the between 25/3/100 and 100/20/100 thresholds. Finally, 9.7% of consumer speed tests met or exceeded the 100/20/100 threshold.

The highest quality connections observed were in non-healthcare CAI locations in Texas, with 69.7% meeting or exceeding the 100/20/100 threshold. Only 20.9% of speed tests at non-healthcare CAI locations fell between the between 25/3/100 and 100/20/100 thresholds, and just 9.4% fell below the 25/3/100 threshold.

For speed tests recorded at business locations, 25.9% fell below the 25/3/100 threshold; 38.3% fell between the between 25/3/100 and 100/20/100 thresholds; and 35.7% met or exceeded the 100/20/100 threshold.

Healthcare

Broadband needs for healthcare can vary because of multiple factors, including the size of a healthcare practice, the types of services delivered, the number of people utilizing a connection at the same time, and other factors. However, many published recommendations of broadband speed minimums for healthcare are out of date,[17,18] particularly in light of the recent threshold change made by FCC.[2]

Of the 13 healthcare locations across the 6 target counties, 9 locations had known advertised broadband speeds, which were compared against the recorded speed test data. The total speed tests, total number of unique days with speed tests recorded, the advertised download speed, the advertised upload speed, median download speed, median upload speed, and median latency for those 13 healthcare locations are presented in Table 26.

Table 26. Overall characteristics of TBP healthcare locations in 6 Texas TBP target counties as measured by pod deployments.

Location ID	Total tests	Unique days with tests	Advertised download speed (Mbps)	Advertised upload speed (Mbps)	Median download speed (Mbps)	Median upload speed (Mbps)	Median latency (in ms)
66-4	22,344	472	300	300	91.5	93.0	18.3
67-4	15,011	223	300	300	201.9	92.9	18.4
71-4	7,260	155	18	18	18.4	18.8	15.4
79-2	15,611	338	300	300	85.2	90.5	17.9
79-17	13,728	296	300	300	42.4	80.5	6.8
84-17	9,062	191	50	50	51.5	5.2	5.9
427-21	10,980	234	400	400	347.4	157.1	23.0
690-4	7,413	157	100	100	81.3	94.0	9.3
884-30	4,030	85	100	100	58.0	44.1	25.7
943-2	3,139	67	-	-	38.1	9.7	43.7
945-10	3,137	67	-	-	422.2	132.9	30.0
946-30	3,126	67	-	-	41.8	24.1	32.1
951-18	3,109	66	-	-	319.0	53.6	9.9

For the 9 healthcare sites with known advertised download and upload speeds, additional information regarding the speed tests is presented, specifically the number and percentage of tests that fall below the 25/3/100 threshold, between the 25/3/100 and the 100/20/100 threshold, and meet or exceed the 100/20/100 threshold, as well as meeting the advertised download and upload speeds and latency (see Table 27).

Table 27. Number and percentage of speed tests observed by pods from TBP healthcare locations with known advertised download and upload speeds in Texas TBP target counties meeting multiple standards (upload and download measurements in megabits per second; latency measurements in milliseconds; exp = expected; dl = download; ul = upload).

	Number of tests							Percentage of tests						
Location ID	< 25/3/100	25/3/100 to 100/20/100	≥ 100/20/100	Met advertised dl/ul	Did not meet advertised dl/ul	Latency ≤ 100	Latency > 100	< 25/3/100	25/3/100 to 100/20/100	≥ 100/20/100	Met advertised dl/ul	Did not meet advertised dl/ul	Latency ≤ 100	Latency > 100
66-4	188	21,258	898	0	22,344	17	22,327	0.8	95.1	4.0	0.0	100.0	99.9	0.1
67-4	96	6,551	8,364	0	15,011	7	15,004	0.6	43.6	55.7	0.0	100.0	100.0	0.1
71-4	7,260	0	0	6,528	732	9	7,251	100.0	0.0	0.0	89.9	10.1	99.9	0.1
79-2	260	15,044	307	0	15,611	4	15,607	1.7	96.4	2.0	0.0	100.0	100.0	0.0
79-17	96	6,876	6,756	6,295	7,433	8	13,720	0.7	50.1	49.2	45.9	54.1	99.9	0.1
84-17	37	9,025	0	0	9,062	13	9,049	0.4	99.6	0.0	0.0	100.0	99.9	0.1
427-21	22	75	10,883	0	10,980	2	10,978	0.2	0.7	99.1	0.0	100.0	100.0	0.0
690-4	24	7,389	0	0	7,413	2	7,411	0.3	99.7	0.0	0.0	100.0	100.0	0.0
884-30	519	3,511	0	0	4,030	11	4,019	12.9	87.1	0.0	0.0	100.0	99.7	0.3

Among the 13 healthcare sites, the number of recorded speed tests ranged from 3,109 to 22,344, and the number of unique days with recorded speed tests ranged from 66 to 472. The median download speed exceeded the 25 Mbps threshold at all but 1 healthcare location. However, 8 healthcare sites (61.5%) recorded median download speeds between 25 Mbps and 100 Mbps thresholds, with 5 of those sites receiving connections with advertised download speeds above the 100 Mbps threshold. No healthcare sites fell below the 3 Mbps upload speed threshold for median upload speed, and only 3 (23.1%) fell below the 20 Mbps threshold.

Few healthcare locations showed consistently strong broadband quality, with only 3 (23.1%) recording more than 95% of speed tests as meeting or exceeding the 100/20/100 threshold. Another 2 sites had high-quality broadband about half of the time, with 49.2% and 55.7% of observed speed tests meeting the 100/20/100 threshold. At 5 healthcare sites (38.5%), no speed tests met the 100/20/100 threshold. For 8 healthcare sites (61.5%), most speed tests fell between 25/3/100 and 100/20/100 thresholds.

For the healthcare locations with known advertised download and upload speeds, these advertised speeds were evaluated relative to the upload and download speeds in the 100/20/100 and 25/3/100 broadband thresholds (note that advertised latency was not recorded, making these 100/20 and 25/3 thresholds). Of the 9 healthcare locations with known advertised download and upload speeds, 7 had advertised speeds that met or exceeded the 100/20 threshold (77.8%), 1 fell between the 25/3 and 100/20 thresholds (11.1%), and 1 fell below the 25/3 threshold (11.1%). Across these 9 healthcare sites with known advertised download and upload speeds, only 1 location (11.1%) reported median download and upload speeds that met their advertised download and upload speeds. This location also recorded most of their speed tests above the advertised speeds; however, the advertised speeds were very low, just 18 Mbps for download and upload. In fact, all the speed tests measured at this site fell below the 25/3/100 threshold. An additional location (11.1%) met its advertised upload speed, but did not meet the advertised download speed.

Latency was not a persistent issue for any of the 13 healthcare sites. Almost all healthcare site speed tests in Texas recorded latencies at or below 100 ms (92.8% or greater at all healthcare locations). Median latency ranged from 5.9 ms to 43.7 ms.

Mobile

The Texas CLP team also conducted mobile speed tests using an Android app on a mobile device while driving and visiting TBP target counties. By default, the mobile app ran a speed test every minute, but this testing interval could be modified by the user, especially in cases where mobile battery needed to be conserved. These mobile data were aggregated from tests conducted throughout the 6 Texas TBP target counties, with the following results (see Table 28).

Table 28. Mobile app speed test results from CLP team mobile testing initiative across 6 Texas TBP target counties.

County	Median download speed (Mbps)	Median upload speed (Mbps)	Median latency (ms)	Overall number of speed tests
Crosby County	51.5	17.9	21.3	127
Fisher County	52.6	7.2	19.7	365
Haskell County	37.0	7.7	41.6	223
Jones County	40.4	4.0	27.8	372
Lamb County	60.5	10.5	35.1	357
Mitchell County	56.9	9.6	34.0	253

Each mobile speed test was sorted according to the FCC thresholds to assess mobile broadband coverage: falling below the 7/1/100 threshold, falling between the 7/1/100 and 35/3/100 threshold, and meeting or exceeding the 35/3/100 threshold. The percentage of mobile tests that fell into each of these 3 categories can be found in Figure 10.

Figure 10. Percentage of mobile speed tests conducted in the 6 Texas TBP target counties by the Texas CLP team falling below the 7/1/100 threshold, falling between the 7/1/100 and 35/3/100 threshold, and meeting or exceeding the 35/3/100 threshold.

All 6 Texas target counties demonstrated variation in mobile broadband connection quality. Jones County recorded the poorest quality mobile broadband connections, with 29.3% of all mobile speed tests falling below the 7/1/100 threshold, and 30.9% of all mobile speed tests falling between the 7/1/100 threshold and the 35/3/100 threshold. Mobile speed tests recorded in Lamb County were

of the highest relative quality, with 70.0% meeting or exceeding the 35/3/100 threshold and only 11.2% falling below the 7/1/100 threshold.

Stories and Results from Texas Technical Assistance Interventions

Technical assistance efforts were made by TBP Program leadership and staff to assist target county sites with broadband-related issues. Beginning in July 2024, contracted TBP staff identified sites in need of technical assistance and tailored interventions based on the identified need and the organization being supported. The metrics reviewed to identify broadband-related issues were:

- Excessive outages
- High retransmission
- High speed test variance
- Slower than average latency
- Rate limiting
- Speeds too slow for telehealth
- Unexpectedly slow available speeds

In Texas, TBP staff used pod data to identify potential candidates for technical assistance interventions. TBP staff identified data from 3 non-healthcare CAIs, 4 consumers, and 5 businesses that indicated broadband issues. In each case, TBP staff have provided a list of possible solutions to resolve the broadband issues. Four people have expressed interest in working with TBP staff to receive technical assistance. At most identified locations, broadband connectivity was insufficient or other significant ISP issues were found. Read more about TBP Program technical assistance interventions in Texas on the [TBP Program website](#).

Telehealth, Broadband, and Program Implementation Challenges

The Texas CLP team reviewed the telehealth adoption barriers identified through semi-structured, qualitative interviews with consumers across all TBP Program target counties. The Texas CLP team ranked the following 3 barriers to telehealth adoption as the most impactful for consumers in the Texas TBP target counties:

1. High cost or lack of reimbursement
2. Perceived lack of value in telehealth
3. Perceived lack of telehealth service availability

From the semi-structured, qualitative interviews with consumers across all TBP Program target counties, the Texas CLP team ranked the following 4 barriers to broadband access for consumers in the Texas TBP target counties as the most impactful for Texas:

1. High cost
2. Lack of quality broadband service availability
3. Poor quality of broadband service
4. Poor quality of broadband connection

Finally, from the semi-structured, qualitative interviews with TBP staff, the Texas CLP team was asked to select the barriers that most impacted their TBP Program implementation efforts. These barriers were:

1. Lack of a perceived benefit for participation among potential TBP Program participants
2. Ineffectiveness of some strategies across participants and communities
3. Perceived lack of clarity in Program goals
4. Lack of centrally developed and tested language and materials for outreach and marketing

Discussion of Texas TBP Results

The TBP Program implementation in Texas found that although many of the locations in target communities may sometimes have a high-quality broadband connection, the user experience of those connections is not always good. When examining median download speeds, upload speeds, and latencies for participating Texas locations, healthcare sites, non-healthcare CAIs, and business locations all appeared to have relatively high-quality connections meeting or exceeding the FCC's 100/20/100 threshold or falling between the 25/3/100 and 100/20/100 thresholds. The consumer connections—even in aggregate—demonstrated poorer quality, with download speeds, upload speeds, and latencies falling between the 25/3/100 and 100/20/100 thresholds. However, when examining individual speed tests conducted at TBP locations, a different experience of broadband emerged.

Although the aggregated measures of broadband connections at a healthcare, non-healthcare CAI, and business sites may meet the new threshold of broadband, users at these locations do not always experience high-quality connections. In fact, 57.5% of all speed tests conducted at TBP healthcare locations fell between the 25/3/100 and 100/20/100 thresholds, and 11.1% fell below the 25/3/100 threshold. This is an important distinction, as a BSL may meet the FCC's served location criteria, but the experience of the broadband user at that location may not always be consistently high-quality. In a healthcare context, this variability may mean a lag that disrupts a provider-patient telehealth connection or a delay in sending or receiving critical health information.

Businesses and non-healthcare CAIs had similarly mixed connections. At business locations, speed tests were almost evenly spread between tests falling below the 25/3/100 threshold, between the 25/3/100 and 100/20/100 thresholds, and meeting or exceeding the 100/20/100 threshold. Although non-healthcare CAIs generally had the highest quality connections with 69.7% of speed tests meeting or exceeding the 100/20/100 threshold, nearly a third of speed tests still fell below the threshold for highest quality broadband. This finding supports the BEAD funding priority to invest in CAI broadband after other unserved and underserved locations have been addressed. Not having broadband for some of the time at these locations will likely delay activities such as work, education, and community services.

The recent FCC speed threshold change in the definition of broadband demonstrates a recognition of the need for higher quality broadband for activities such as work, education, and telehealth.[2] In a report describing the rationale for this definition change, the FCC highlighted telehealth as an activity that may not be feasible with upload speeds of 3 Mbps or lower.[7] The results observed from the 6 Texas target counties raise concerns about the feasibility of telehealth for these communities. There are no specialty care hospitals located in any of the 6 counties, and only 3 of the 13 in-county healthcare locations demonstrated speeds meeting or exceeding the 100/20/100 threshold more than 95% of the time. Further, only 9.7% of speed tests conducted at consumer locations met or exceeded the 100/20/100 broadband threshold. These findings suggest that

consumers living in 1 of the Texas target counties would likely have to travel long distances for specialty care and would struggle to receive high-quality telehealth at home.

It is beyond the scope of the TBP Program evaluation to determine the cause of every individual poor quality speed test, which can be influenced by many factors within and outside of a location. However, these results do highlight the need to consider the experience of broadband as a user in addition to broadband connection access. If broadband is, in fact, a super determinant of health necessary for activities such as work, education, and healthcare, it is important and worth the investment to have uninterrupted access to those activities.

Recommendations

In light of results from the data collected across the 6 Texas TBP target counties, this evaluation supports the following recommendations to improve the user experience of broadband for those communities:
   A. Provide support for *consistent*, high-quality broadband connections for healthcare, consumer, non-healthcare CAI, and business connections to facilitate broadband-dependent critical services, such as telehealth.
   B. Consider how frequently speeds meet broadband thresholds for high-quality experiences to ensure that services such as telehealth are reliably accessible to healthcare providers and patients.
   C. Further investigate the causes of the variability in the user experience of broadband.
   D. Create a centralized resource to help consumers, businesses, non-healthcare CAIs, and healthcare organizations provide broadband education, navigate locally available broadband options, and troubleshoot technical connectivity challenges.

Appendix E: West Virginia Telehealth Broadband Pilot Program Summary Report: Activations and Learnings from 7 Counties

Executive Summary

The Telehealth Broadband Pilot (TBP) Program measured broadband quality across 7 West Virginia counties at 80 locations: 21 healthcare sites, 42 consumer homes, 4 non-healthcare community anchor institutions (CAIs), and 13 business locations. Overall, median download and upload speeds for consumer, business, and non-healthcare CAI locations fell below the Federal Communication Commission (FCC) threshold for high-quality broadband. Although the median download and upload speeds at healthcare locations exceeded this threshold, additional analysis revealed that broadband speeds were not consistently meeting these benchmarks. Speed tests conducted at business, consumer, and non-healthcare CAI locations were also variable, and even less likely to meet the high-quality threshold. Thus, services such as telehealth may be generally possible at healthcare, non-healthcare CAI, business, and consumer locations, but may not be feasible at all times.

Median download speeds of 101.0 Megabits per second (Mbps) at healthcare sites, 17.7 Mbps at non-healthcare CAIs, 30.8 Mbps at business locations, and 71.0 Mbps at consumer homes were recorded. Additionally, median upload speeds of 50.8 Mbps at healthcare sites, 8.7 Mbps at non-healthcare CAIs, 3.6 Mbps at business locations, and 5.3 Mbps at consumer homes were also recorded.

To assess the variability of these measurements, each speed test was according to thresholds set by the FCC: 1) below 25 Mbps in download speed, *or* 3 Mbps in upload speed, *or* latency greater than 100 milliseconds (ms) (25/3/100); 2) meeting or exceeding 100 Mbps in download speed and 20 Mbps in upload speed with latency less than or equal to 100 milliseconds (100/20/100); 3) falling between these 2 thresholds. When examining individual speed test results by location category, 29.8% of non-healthcare CAIs, 27.2% of business locations, 40.8% of healthcare sites, and 36.9% of consumer homes recorded speeds meeting or exceeding the 100/20/100 threshold. However, 42.3% of tests at non-healthcare CAIs, 21.3% of tests at healthcare sites, 53.5% of tests at business locations, and 42.4% of tests at consumer homes fell below the 25/3/100 threshold. Additionally, only 8 of the 15 healthcare locations (53.3%) with known advertised download and upload speeds had a majority of speed tests meet or exceed these speeds.

Background

West Virginia is the 41st largest state by area and 39th largest state by population, with approximately 1.79 million people, of whom about 39.2% live in rural counties.[1,12,34] In 2023, West Virginia was allocated more than $1.21 billion in Broadband Equity, Access, and Deployment (BEAD) funding—the 11th largest amount allocated to any US state or territory.[13] According to West Virginia's 5-year BEAD action plan, the state has a total of 900,407 Broadband Serviceable Locations (BSLs).[35] However, it boasts a high relatively percentage of unserved BSLs: 15.6%, or 140,334 BSLs. An additional 27,631 BSLs were identified as underserved, yielding a total number of unserved or underserved BSLs across the state of 167,965 or 18.7% of all statewide BSLs. Thus, West Virginia received $7,208.65 in allocated BEAD funding per unserved or underserved BSL (see *A summary of Broadband Equity, Access, and Deployment [BEAD] Program plans for the 4 Telehealth Broadband Pilot Program states* for more detail).

The 7 West Virginia target counties selected for inclusion in the TBP Program were:[1]
- Calhoun County (2020 population: 6,229)
- Clay County (2020 population: 8,051)
- Jackson County (2020 population: 27,791)
- Kanawha County (2020 population: 180,745)
- Nicholas County (2020 population: 24,604)
- Ritchie County (2020 population: 8,444)
- Roane County (2020 population: 14,028)

Healthcare and Telehealth in West Virginia TBP Counties

Of the 7 target counties, 5 contain at least 1 acute care hospital: Calhoun, Jackson, Nicholas, and Roane Counties all have 1 critical access hospital, and Kanawha has 4 acute care hospitals.[8] Six of the 7 counties lack any specialty hospitals, with Kanawha County housing 2 specialty hospitals: a long term care hospital and a psychiatric hospital.[8] There are 8 Federally Qualified Health Center service delivery sites in Calhoun County, 8 in Clay County, 3 in Jackson County, 36 in Kanawha County, 15 in Nicholas County, 5 in Ritchie County, and 1 in Roane County.[15]

In a random sample of Medicare beneficiaries with Parts A and B coverage who aged into the Medicare program and lived in 1 of the West Virginia TBP counties throughout all months of 2018, 2019, 2020, and 2021, beneficiaries used the following types of healthcare services:
- In-person primary care: 94.0%
- Emergency department care: 58.2%
- Telehealth: 45.8%

Existing Broadband in West Virginia TBP Counties

According to data from the FCC's Broadband Serviceable Location (BSL) Fabric, the percentage of locations in West Virginia TBP target counties with access to advertised download speeds of at least 25 Mbps download speed and 3 Mbps upload speed for all wired and licensed fixed wireless connections ranged from 24.3% (Calhoun County) to 89.9% (Kanawha County) for residential connections, and from 8.7% (Clay County) to 83.8% (Ritchie County) for business connections. The percentage of locations in West Virginia TBP target counties with access to advertised download speeds of at least 100 Mbps download speed and 20 Mbps upload speed for all wired and licensed fixed wireless connections ranged from 16.9% (Clay County) to 88.0% (Kanawha County) for residential connections, and from 5.2% (Clay County) to 83.0% (Ritchie County) for business connections (see Table 29).

Table 29. Percentage of Broadband Serviceable Locations (BSLs) meeting download/upload speed thresholds for all wired and licensed fixed wireless residential and business connections in each of the 7 West Virginia TBP target counties.

| West Virginia TBP Target County | Total BSLs | Location Type | Percentage of BSLs with speeds at or above __ download (in Mbps) and __ upload (in Mbps) | | | | | |
			.02/ .02	10/ 1	25/ 3	100/ 20	250/ 25	1000/ 100
Calhoun	4,367	Residence	44.5	35.2	24.3	20.8	1.2	1.2
Clay	5,129	Residence	65.4	53.5	27.7	16.9	15.6	3.7
Jackson	15,958	Residence	77.0	66.1	63.7	56.7	55.2	47.7
Kanawha	103,585	Residence	92.1	90.8	89.9	88.0	79.5	18.0
Nicholas	15,596	Residence	79.7	77.9	57.4	48.3	46.9	3.3
Ritchie	6,529	Residence	88.4	86.9	83.8	83.0	69.6	69.6
Roane	9,204	Residence	62.8	54.0	40.4	27.1	26.0	2.7
Calhoun	4,367	Business	35.3	22.6	22.1	20.9	1.2	1.2
Clay	5,129	Business	39.4	13.0	8.7	5.2	3.8	0.0
Jackson	15,958	Business	79.3	38.4	25.9	12.4	7.8	3.9
Kanawha	103,585	Business	84.7	45.9	44.8	22.4	15.3	1.4
Nicholas	15,596	Business	63.8	56.8	50.6	45.9	44.4	0.5
Ritchie	6,529	Business	89.6	86.2	83.8	83.0	69.6	69.6
Roane	9,204	Business	58.5	28.7	19.1	9.2	7.8	0.3

Mobile coverage also varied across the 7 West Virginia TBP target counties (see Table 30). The BSL Fabric map reports that Fourth Generation Long-Term Evolution (4G LTE) in an outdoor stationary environment ranged from 53.9% (Ritchie County) to 92.0% (Jackson County). In-vehicle mobile coverage for 4G LTE was lower, ranging from 18.7% (Calhoun County) to 52.5% (Jackson County). Fifth Generation New Radio (5G-NR) coverage also varied across the 7 target counties at both FCC speed thresholds. In an outdoor stationary environment, 5G-NR coverage at or above speeds of 7 Mbps download / 1 Mbps upload (7/1) ranged from 14.9% (Calhoun County) to 59.5% (Jackson County). In-vehicle mobile 5G-NR coverage at or above the 7/1 speed threshold was lower, ranging from 3.2% (Calhoun County) to 26.9% (Kanawha County). 5G-NR coverage at or above the higher speed threshold (35 Mbps download / 3 Mbps upload; 35/3) ranged from 9.1% (Calhoun County) to 41.5% (Jackson County) in an outdoor stationary environment, and from 1.7% (Calhoun County) to 19.9% (Kanawha County) in an in-vehicle mobile environment.

Table 30. Percentage of total area of the 7 West Virginia TBP target counties with 4G LTE, 5G-NR (at speeds of at least 7 download/1 upload, Mbps), and 5G-NR (at speeds of at least 35 download/3 upload, Mbps).

| West Virginia TBP Target County | Total Area (in km²) | Percentage of area for which providers report mobile broadband service | | | | | |
| | | Outdoor stationary environment | | | In-vehicle mobile environment | | |
		4G LTE	5G-NR, (7/1 Mbps)	5G-NR, (35/3 Mbps)	4G LTE	5G-NR, (7/1 Mbps)	5G-NR, (35/3 Mbps)
Calhoun	750.4	56.9%	14.9%	9.1%	18.7%	3.2%	1.7%
Clay	927.2	61.1%	25.3%	14.7%	30.0%	6.9%	3.9%
Jackson	1,263.5	92.0%	59.5%	41.5%	52.5%	21.3%	12.2%
Kanawha	2,465.8	76.3%	51.0%	37.7%	44.9%	26.9%	19.9%
Nicholas	1,771.5	67.2%	41.7%	27.5%	34.7%	12.4%	6.7%
Ritchie	1,206.1	53.9%	24.2%	15.2%	19.0%	5.9%	3.6%
Roane	1,298.7	77.7%	38.7%	23.1%	33.7%	10.4%	5.3%

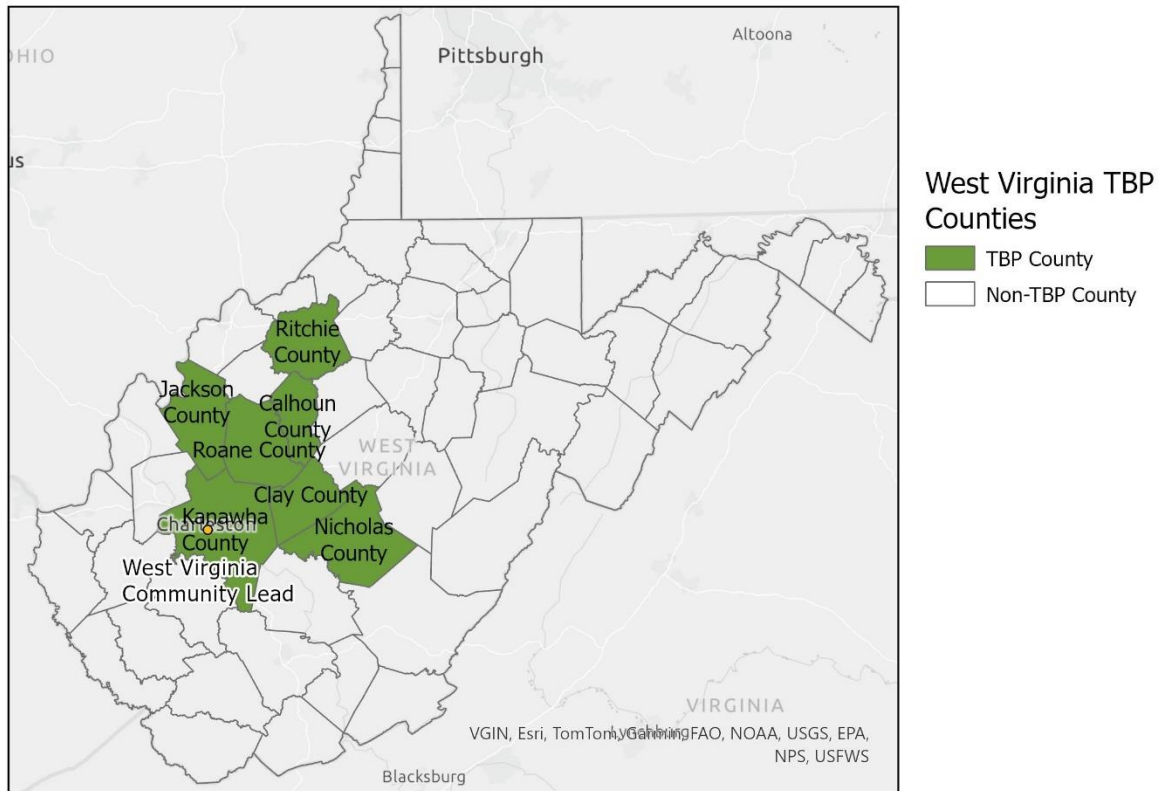*West Virginia CLP Outreach Methods*

Figure 11. Map of 7 West Virginia TBP target counties and the West Virginia CLP organization.

In West Virginia, TTAC contracted the West Virginia Primary Care Association, a provider-focused, non-profit healthcare organization, as the CLP team. This team had existing relationships and networks with many healthcare organizations throughout the state, including:

- Calhoun County: 4 health centers or clinics, 4 School-Based Health Centers
- Clay County: 1 health center or clinic, 5 School-Based Health Centers
- Jackson County: 2 health centers or clinics, 1 School-Based Health Center
- Kanawha County: 25 health centers or clinics, 10 School-Based Health Centers
- Nicholas County: 6 health centers or clinics, 6 School-Based Health Centers
- Roane County: 1 health center or clinic, 0 School-Based Health Centers
- Ritchie County: 1 health center or clinic, 4 School-Based Health Centers

The West Virginia CLP team leveraged existing relationships and networks with these and other known healthcare locations to recruit organizations to participate in the TBP Program as their primary recruitment strategy.

The lead TBP Program organization also implemented several Program-wide strategies to facilitate recruitment, including in the 7 West Virginia TBP target counties (see the white paper, *An examination of the implementation and effectiveness of the Telehealth Broadband Pilot Program in the United States*, for more detail).

Results from West Virginia TBP Pods

The West Virginia CLP team received data from 228 devices across 104 locations in the 7 target counties; however, 24 locations had fewer than 100 speed tests or fewer than 14 unique days of data collection and were excluded from analysis. A total of 80 locations across the 7 West Virginia target counties were included for analysis. See Table 31 for the total number of locations by county and by category.

Table 31. Total locations with pod deployments across the 7 West Virginia TBP target counties, by category.

County	Healthcare	Non-healthcare CAI	Business	Consumer	TOTAL
Calhoun County	2	0	0	2	**4**
Clay County	5	0	2	10	**17**
Jackson County	2	0	0	0	**2**
Kanawha County	5	2	6	16	**29**
Nicholas County	1	1	0	2	**4**
Ritchie County	4	0	0	0	**4**
Roane County	2	1	5	12	**20**
OVERALL	**21**	**4**	**13**	**42**	**80**

Across these locations, 591,346 speed tests were conducted as of September 2024. The median download speed, upload speed, and latency was calculated for each location. Then, the median of these location medians was calculated by category, as seen in Table 32. Medians were chosen to reduce the influence of locations with extremely high or low values.

Table 32. Total locations, speed tests, median download speed, median upload speed, and median latency for all locations in the 7 West Virginia TBP target counties by category of location.

Category	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Business	13	49,449	30.8	3.6	27.7
Consumer	42	264,839	71.0	5.3	27.3
Healthcare	21	258,417	101.0	50.8	22.5
Non-healthcare CAI	4	18,641	17.7	8.7	24.1

*Medians reported are medians of all median values calculated for each location.

The median download speed, upload speed, and latency were recorded for all locations by county. Again, each location's median was first calculated, and the median of those medians by county is reported (see Table 33). Medians were chosen to reduce the influence of locations with extremely high or low values.

Table 33. Total locations, speed tests, median download speed, upload speed, and latency for each of the 7 West Virginia TBP target counties.

County	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Calhoun County	4	51,030	387.3	329.7	20.7
Clay County	17	82,968	21.4	1.7	27.7
Jackson County	2	44,991	528.9	51.5	26.9
Kanawha County	29	216,463	304.3	36.7	20.6
Nicholas County	4	13,508	19.5	6.9	30.2
Ritchie County	4	70,514	89.5	91.4	19.2
Roane County	20	111,872	15.3	2.6	29.6

*Medians reported are medians of all median values calculated for each location.

In general, businesses and non-healthcare CAIs had the lowest quality connections as measured by download speed, upload speed, and latency. Across 13 business locations, the median download speed was 30.8 Mbps, the median upload speed was 3.6 Mbps, and median latency was 27.7 ms. Across 4 non-healthcare CAIs, the median download speed was 17.7 Mbps, the median upload speed was 8.7 Mbps, and the median latency was 24.1 ms. Median measurements for business and non-healthcare CAI locations fell between 25/3/100 and 100/20/100 thresholds.

For the 42 consumer locations, the median download speed was 71.0 Mbps, the median upload speed was 5.3 Mbps, and the median latency was 27.3 ms, falling between the 25/3/100 and 100/20/100 thresholds. The 21 healthcare locations recorded median download speeds of 101.0 Mbps, median upload speeds of 50.8 Mbps, and median latencies of 22.5 ms. These aggregated measurements exceed the 100/20/100 threshold for high-quality broadband. However, aggregating median measurements across many categories and locations does not show the complete experience of broadband for users at these locations.

The percentage of individual speed tests that fell below the 25/3/100 threshold, fell between the 25/3/100 and 100/20/100 threshold, and met or exceeded the 100/20/100 threshold were

calculated for each location category. In these calculations, each location was equally weighted, such that sites with a greater number of speed tests had the same weight as sites with a smaller number of speed tests (although all sites met the inclusion criteria of having at least 100 speed tests). In West Virginia, the number of speed tests conducted at individual locations ranged from 636 to 25,193 tests. The percentages of tests meeting the FCC thresholds by location category in West Virginia target counties can be found in Figure 12.
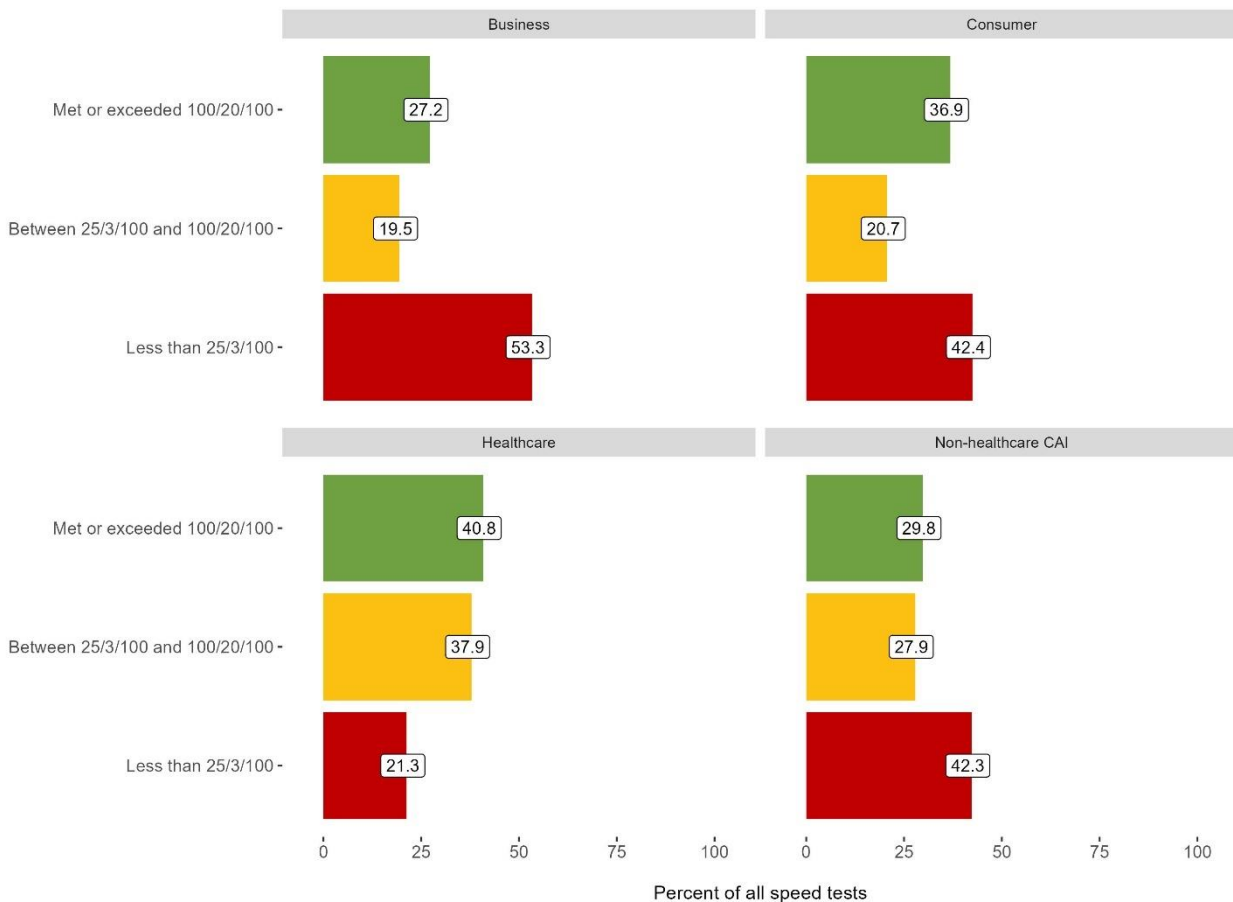
Figure 12. Percentage of speed tests recorded at less than 25/3/100, between 25/3/100 and 100/20/100, and met or exceeded 100/20/100 for sites in the 7 West Virginia TBP target counties (each location equally weighted).

Speed tests conducted at healthcare locations in the target counties varied, with 40.8% of all tests meeting or exceeding the 100/20/100 threshold, 37.9% falling between the 25/3/100 and 100/20/100 thresholds, and 21.3% falling below the 25/3/100 threshold (see the *Healthcare* section below for more detail).

Consumer location speed tests demonstrated similar variability, with 36.9% meeting or exceeding the 100/20/100 threshold, 20.7% falling between the 25/3/100 and 100/20/100 thresholds, and 42.4% falling below the 25/3/100 threshold.

Speed tests conducted at non-healthcare CAI locations were also inconsistent: 29.8% met or exceeded the 100/20/100 threshold, 27.9% fell between the 25/3/100 and 100/20/100 thresholds, and

42.3% fell below the 25/3/100 threshold. However, these tests represent only 4 non-healthcare CAI locations and may not be representative of all non-healthcare CAI locations in the 7 target counties.

Business location speed tests had the highest percentage of tests falling below the 25/3/100 threshold of any location category (53.3%). An additional 19.5% of business location speed tests fell between the 25/3/100 and 100/20/100 thresholds, and the remaining 27.2% met or exceeded the 100/20/100 threshold.

Healthcare

Broadband needs for healthcare can vary due to multiple factors, including the size of a healthcare practice, the types of services delivered, the number of people working at the same time, and other factors. However, many published recommendations of broadband speed minimums for healthcare are out of date,[17,18] particularly in light of the recent FCC broadband quality threshold change.[2]

Of the 21 healthcare sites located in the 7 target counties, 15 had known advertised download and upload speeds, which were compared against the recorded speeds. The total speed tests, total number of unique days with speed tests recorded, the advertised download speed, the advertised upload speed, median download speed, median upload speed, and median latency are presented in Table 34.

Table 34. Overall characteristics of 21 TBP healthcare locations in the 7 West Virginia TBP target counties, as measured by pod deployments.

Location ID	Total tests	Unique days with tests	Advertised download speed (Mbps)	Advertised upload speed (Mbps)	Median download speed (Mbps)	Median upload speed (Mbps)	Median latency (in ms)
196-26	25,099	534	-	-	80.6	62.1	29.3
198-37	16,977	379	50	50	131.4	8.1	30.7
198-25	2,518	266	50	50	31.4	7.6	20.2
199-37	3,082	73	20	20	152.2	43.0	26.9
199-25	22,669	504	20	20	46.2	42.8	22.5
203-36	23,511	501	-	-	189.3	194.6	12.0
225-18	21,719	466	50	50	528.7	50.6	26.6
226-18	23,272	520	50	50	529.1	52.5	27.2
231-40	25,193	532	-	-	92.0	95.2	19.1
232-40	21,456	453	-	-	27.8	28.6	19.2
233-40	3,376	73	-	-	86.9	87.5	25.8
233-49	20,489	433	-	-	101.0	102.8	15.0
312-25	21,927	464	500	500	723.4	506.2	21.8
358-33	1,882	41	1000	1000	26.8	9.0	49.9
358-18	821	20	1000	1000	667.0	50.8	20.8
358-25	699	17	1000	1000	5.2	0.5	28.6
387-25	11,843	254	500	500	768.1	658.7	3.3
389-25	1,336	29	500	500	824.2	846.2	12.7
809-18	5,054	107	200	200	508.6	51.0	20.8
913-25	3,294	71	25	25	6.4	0.6	27.8
2017-12872	2,200	47	500	500	29.7	4.3	59.0

For the 15 healthcare sites with known advertised broadband speeds, additional information is presented in Table 35, specifically tests falling below the 25/3/100 threshold, between the 25/3/100 and the 100/20/100 threshold, meeting or exceeding the 100/20/100 threshold, and meeting the advertised download and upload speed and latency.

Table 35. Number and percentage of speed tests observed by pods from TBP healthcare locations with known advertised download and upload speeds in West Virginia TBP target counties meeting multiple standards (upload and download measurements in megabits per second; latency measurements in milliseconds; exp = expected; dl = download; ul = upload).

Location ID	Number of tests							Percentage of tests						
	< 25/3/100	25/3/100 to 100/20/100	≥ 100/20/100	Met advertised dl/ul	Did not meet advertised dl/ul	Latency ≤ 100	Latency > 100	< 25/3/100	25/3/100 to 100/20/100	≥ 100/20/100	Met advertised dl/ul	Did not meet advertised dl/ul	Latency ≤ 100	Latency > 100
198-37	4,787	11,786	404	117	16,860	40	16,937	28.2	69.4	2.4	0.7	99.3	99.8	0.2
198-25	2,107	378	33	9	2,509	2	2,516	83.7	15.0	1.3	0.4	99.6	99.9	0.1
199-37	33	1,157	1,892	2,153	929	1	3,081	1.1	37.5	61.4	69.9	30.1	100.0	0.0
199-25	16	22,631	22	22,490	179	2	22,667	0.1	99.8	0.1	99.2	0.8	100.0	0.0
225-18	2,214	294	19,211	11,405	10,314	997	20,721	10.2	1.4	88.5	52.5	47.5	95.4	4.6
226-18	4,375	565	18,332	16,367	6,905	1,888	21,384	18.8	2.4	78.8	70.3	29.7	91.9	8.1
312-25	2	6	21,919	11,214	10,713	0	21,927	0.0	0.0	100.0	51.1	48.9	100.0	0.0
358-33	873	1,009	0	0	1,882	10	1,872	46.4	53.6	0.0	0.0	100.0	99.5	0.5
358-18	0	18	803	0	821	0	821	0.0	2.2	97.8	0.0	100.0	100.0	0.0
358-25	699	0	0	0	699	9	690	100.0	0.0	0.0	0.0	100.0	98.7	1.3
387-25	8	4	11,831	8,835	3,008	0	11,843	0.1	0.0	99.9	74.6	25.4	100.0	0.0
389-25	0	332	1,004	895	441	0	1,336	0.0	24.9	75.2	67.0	33.0	100.0	0.0
809-18	20	318	4,716	0	5,054	0	5,054	0.4	6.3	93.3	0.0	100.0	100.0	0.0
913-25	3,294	0	0	0	3,294	10	3,284	100.0	0.0	0.0	0.0	100.0	99.7	0.3
2017-12872	117	2,083	0	0	2,200	4	2,196	5.3	94.7	0.0	0.0	100.0	99.8	0.2

The number of speed tests recorded at healthcare sites with a known advertised download and upload speeds ranged from 699 to 25,193, and the number of unique days where speed tests were recorded ranged from 17 to 534 days. For the healthcare locations with known advertised download and upload speeds, these advertised speeds were evaluated relative to the upload and download speeds in the 100/20/100 and 25/3/100 broadband thresholds (note that advertised latency was not recorded, making these 100/20 and 25/3 thresholds). Of the 15 healthcare locations with known advertised download and upload speeds, 8 had advertised speeds that met or exceeded the 100/20 threshold (53.3%), 5 fell between the 25/3 and 100/20 thresholds (33.3%), and 2 fell below the 25/3 threshold (13.3%).

For 2 of the 21 healthcare locations (9.5%), the median download speed fell below 25 Mbps and the median upload speed fell below 3 Mbps, demonstrating low-quality broadband below even the outdated FCC-defined thresholds. When comparing against the new FCC definition for quality broadband, 11 of the 21 healthcare locations (52.3%) met the 100 Mbps download speed threshold and 15 (71.4%) met or exceeded the 20 Mbps upload speed threshold. Only 10 locations met or exceeded *both* the 100 Mbps download speed *and* the 20 Mbps upload speed thresholds.

When looking at individual speed tests instead of aggregated measures, 6 of the 21 healthcare locations (28.6%) recorded 0 speed tests meeting or exceeding the 100/20/100 threshold. Only 10 healthcare locations (47.6%) reported that most speed tests met or exceeded the 100/20/100 threshold. In fact, 3 healthcare locations (14.3%) reported that most of their speed tests fell below the 25/3/100 threshold.

Latency was not a persistent issue for any of the 21 healthcare sites. Almost all speed tests recorded latencies at or below 100 ms (91.9% or greater at all healthcare locations). Median latency ranged from 3.3 ms to 59.0 ms.

For the 15 healthcare locations with known advertised download and upload speeds, 9 demonstrated median download speeds recorded that met or exceeded their advertised download speeds (60.0%) and 7 (46.7%) recorded median upload speeds that met or exceeded advertised upload speeds. For 8 locations with known advertised speeds, most speed tests fell below the advertised download or upload speeds, and only 1 location (6.7%) with known advertised speeds demonstrated less than 10% of all speed tests falling below the advertised speeds.

Mobile

The West Virginia CLP team also conducted mobile speed tests using an Android app on a mobile device while driving and visiting TBP target counties. By default, the mobile app ran a speed test every minute, but this testing interval could be modified by the user, especially in cases where mobile battery needed to be conserved. These mobile data were aggregated from tests conducted throughout 6 of the 7 West Virginia target counties, with the following results (see Table 36).

Table 36. Mobile app speed test results from CLP team mobile testing initiative across 6 of the 7 West Virginia TBP target counties.

County	Median download speed (Mbps)	Median upload speed (Mbps)	Median latency (ms)	Overall number of speed tests
Calhoun County	7.6	3.0	5.1	6
Clay County	64.6	3.9	28.8	376
Jackson County	63.4	6.2	27.4	53
Kanawha County	47.4	40.3	28.0	21,014
Nicholas County	67.4	11.8	28.2	165
Roane County	67.5	7.2	32.1	367

Each mobile speed test was sorted according to the FCC thresholds to assess mobile broadband coverage: falling below the 7/1/100 threshold, falling between the 7/1/100 and 35/3/100 threshold, and meeting or exceeding the 35/3/100 threshold. Because a low number of mobile speed tests were conducted in Calhoun County (n = 6), the speed tests from Calhoun County were excluded from analysis. The percentage of mobile tests that fell into each of these categories for 5 of the 7 West Virginia TBP target counties can be found in Figure 13.
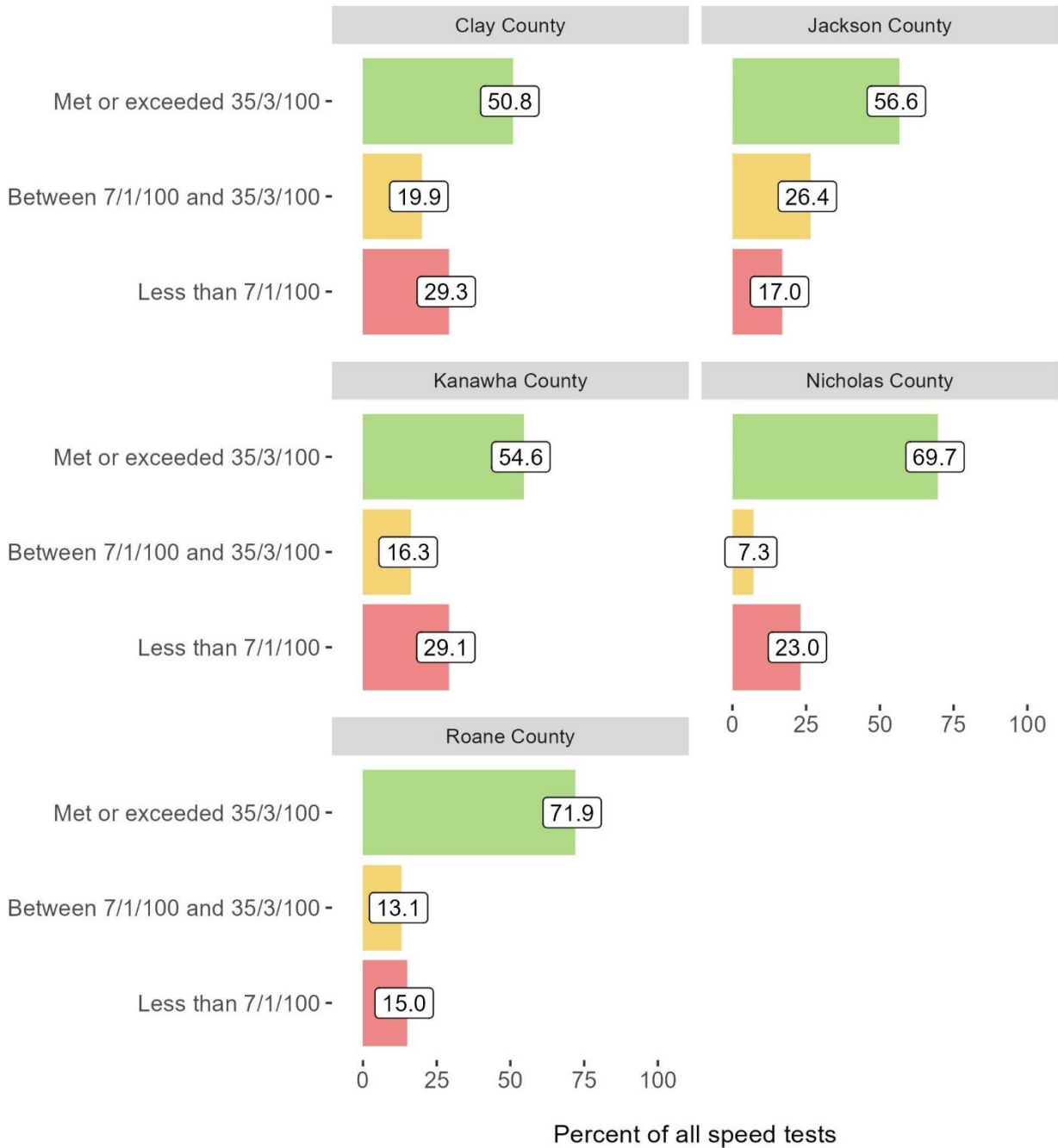
Figure 13. Percentage of mobile speed tests conducted in 5 of the 7 West Virginia TBP target counties by the West Virginia CLP team falling below the 7/1/100 threshold, falling between the 7/1/100 and 35/3/100 threshold, and meeting or exceeding the 35/3/100 threshold

All 5 of the 7 West Virginia target counties with recorded mobile speed test data show variation in mobile broadband connection quality. Clay County recorded the poorest quality mobile broadband connections, with 29.3% of all mobile speed tests falling below the 7/1/100 threshold and 19.9% falling between the 7/1/100 threshold and the 35/3/100 threshold. Mobile speed tests recorded in

Roane County were of the highest relative quality, with 71.9% meeting or exceeding the 35/3/100 threshold and only 15.0% falling below the 7/1/100 threshold.

Stories and Results from West Virginia Technical Assistance Interventions

Technical assistance efforts were made by TBP Program leadership and staff to assist target county sites with broadband-related issues. Beginning in July 2024, contracted TBP staff identified sites in need of technical assistance and tailored interventions based on the identified need and the organization being supported. The metrics reviewed to identify broadband-related issues were:

- Excessive outages
- High retransmission
- High speed test variance
- Slower than average latency
- Rate limiting
- Speeds too slow for telehealth
- Unexpectedly slow available speeds

In West Virginia, a mental health clinic providing frequent telehealth services to pediatric patients reported broadband connectivity issues to TBP staff. Specifically, clinic staff reported frequent audio and video telehealth calls disrupted because of poor broadband connectivity, resulting in providers needing to take telehealth calls outside to ensure better call quality. TBP staff worked with clinic staff to install a pod, which did not initially reveal broadband connectivity issues. However, additional wireless analysis demonstrated poor signal quality within the building, which was constructed of dense materials. TBP staff suggested higher-quality Wi-Fi equipment and a more optimized placement of network devices to resolve this issue, which increased the quality of the user experience and reduced audio and video telehealth call disruptions. This intervention highlighted a need for skilled IT support in many TBP communities to address relatively simple technical challenges. Read more about TBP Program technical assistance interventions in West Virginia on the TBP Program website.

Discussion of West Virginia TBP Results

The TBP Program implementation in West Virginia found that many locations in the target communities may occasionally have a high-quality broadband connection, but the user experience of those connections is not always high-quality. Median download speeds, upload speeds, and latencies for participating healthcare locations appeared to demonstrate high-quality broadband connections, although broadband measurements in aggregate can obscure important variability. However, consumer, business, and non-healthcare CAI connections—even in aggregate—demonstrated poorer quality, with median download speeds below 100 Mbps and median upload speeds below 20 Mbps. Only non-healthcare CAIs demonstrated median speeds below the outdated broadband threshold, although these data should be interpreted with caution, as they are based on a small number of locations. Median measurements from consumer and business locations fell between the 25/3/100 and 100/20/100 thresholds, but when examining individual speed test data, a slightly different experience of broadband emerged.

Less than half (40.8%) of speed tests conducted at healthcare locations individually met the 100/20/100 benchmark for high-quality broadband, meaning that the broadband experience for users was likely not consistent or reliable more than half of the time at participating healthcare locations. In

fact, 21.3% of healthcare location speed tests fell below the outdated broadband threshold of 25/3/100, and about a third of healthcare locations had 0 speed tests meeting or exceeding the 100/20/100 threshold. These results suggest that the experience of broadband connections fall well below recommended benchmarks to ensure quality delivery of healthcare services at some healthcare locations in the TBP target counties.

The experience of broadband for consumers residing in the 7 West Virginia target counties was of even poorer quality: only 36.9% of all speed tests conducted at consumer homes met the 100/20/100 benchmark and 42.4% fell below the 25/3/100 benchmark. These results raise concerns about the consistency and reliability of broadband connections throughout the target counties to support critical services such as telehealth. This is an important distinction, as a BSL may meet the served location criteria, but the experience of the broadband user may not always be consistently high-quality. In a healthcare context, this variability may mean a lag that disrupts a provider-patient connection or a delay in sending or receiving critical health information from another location.

The recent FCC speed threshold change in the definition of broadband demonstrates a recognition of the need for higher quality broadband for activities such as work, education, and telehealth.[2] In a report describing the rationale for this definition change, the FCC highlighted telehealth as an activity that may not be feasible with upload speeds of 3 Mbps or lower.[7] The results observed from the 7 West Virginia target counties raise concerns about the feasibility of telehealth for these communities. There are no specialty care hospitals in 6 of the 7 target counties, and 2 counties lack an acute care hospital. Data collected through the TBP Program showing inconsistent broadband quality suggest that consumers living in West Virginia target counties without a specialty care hospital would likely have to travel long distances for specialty care or would struggle to receive consistently high-quality telehealth.

It is beyond the scope of the TBP Program evaluation to determine the cause of every individual poorer quality speed test, which can be influenced by many factors within and outside of a location. However, these results do highlight the need to consider the experience of broadband as a user in addition to broadband connection access. If broadband is, in fact, a super determinant of health necessary for activities such as work, education, and healthcare, it is important and worth the investment to have uninterrupted access to those activities.

Recommendations

In light of results from the data collected across the 7 West Virginia TBP target counties, this evaluation supports the following recommendations to improve the user experience of broadband for those communities:

A. Provide support for consistent, high-quality broadband connections for healthcare, consumer, non-healthcare CAI, and business connections to facilitate broadband-dependent critical services, such as telehealth.
B. Consider how frequently speeds meet broadband thresholds for high-quality experiences to ensure that services such as telehealth are reliably accessible to healthcare providers and patients.
C. Further investigate the causes of the variability in the user experience of broadband.
D. Create a centralized resource to help consumers, businesses, non-healthcare CAIs, and healthcare organizations provide broadband education, navigate locally available broadband options, and troubleshoot technical connectivity challenges.

Appendix F: Alaska Telehealth Broadband Pilot Program Summary Report: Activations and Learnings from Expansion Areas

Although the Telehealth Broadband Pilot (TBP) Program targeted 6 county-equivalents in Alaska, additional data were collected throughout other places designated as rural by the Health Resources and Services Administration that the Program and funds allowed for.[36] Here, the results of the measurements recorded throughout these additional expansion areas are reported.

Results from Alaska TBP Expansion Area Pods

The Alaska Community Lead Partner (CLP) received data from a total of 26 devices across 25 locations in the TBP expansion areas of Alaska; however, 2 locations had fewer than 100 speed tests or fewer than 14 unique days of data collection and were excluded from analysis. In total, the analysis included 23 additional locations across TBP areas of Alaska that the Program and funds allowed for. These 23 locations were in the following county-equivalents:

- Bethel Census Area, 5 locations
- Kenai Peninsula Borough, 1 location
- Ketchikan Gateway Borough, 1 location
- Lake and Peninsula Borough, 12 locations
- Matanuska-Susitna Borough, 1 location
- Yukon-Koyukuk Census Area, 3 locations

Across these locations, 109,651 speed tests were conducted as of September 2024. The number of speed tests by individual site ranged from 1,058 speed tests to 8,635. The median download speed, upload speed, and latency was calculated for each location category, but all locations included in the Alaska TBP expansion areas were either healthcare locations or uncategorized. The median of these location medians was calculated by location category type, as can be found in Table 37. Medians were chosen to reduce the influence of locations with extremely high or low values.

Table 37. Total locations, speed tests, median download speed, median upload speed, and median latency for all locations the TBP expansion areas of Alaska by category of location.

Category	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Healthcare	19	99,041	26.7	20.4	52.0
(Uncategorized)	4	10,610	78.8	59.8	54.5

*Medians reported are medians of all median values calculated for each location.

In general, healthcare locations in expansion areas had relatively poor-quality broadband connections. Across these 19 healthcare locations, the median download speed was 26.7 Megabits per second (Mbps), the median upload speed was 20.4 Mbps, and the median latency was 52.0 milliseconds (ms). Across uncategorized locations, the median download speed was 78.8 Mbps, the median upload speed was 59.8 Mbps, and the median latency was 54.5 ms. Measurements for both

location types fell between the 25/3/100 and 100/20/100 FCC thresholds. However, aggregating median measurements across many categories and locations does not show the complete picture or the experience of broadband for users at these locations.

Broadband quality of individual speed tests was also examined, and the percentage of speed tests that fell below the 25/3/100 threshold, fell between the 25/3/100 and 100/20/100 threshold, and met or exceeded the 100/20/100 for each location category are reported. In these calculations, each location was equally weighted, such that sites with a greater number of speed tests had the same weight as sites with a smaller number of speed tests (although all sites met the inclusion criteria of having at least 100 speed tests). The percentages of tests meeting these thresholds for locations in TBP target county-equivalents can be found in Figure 14.
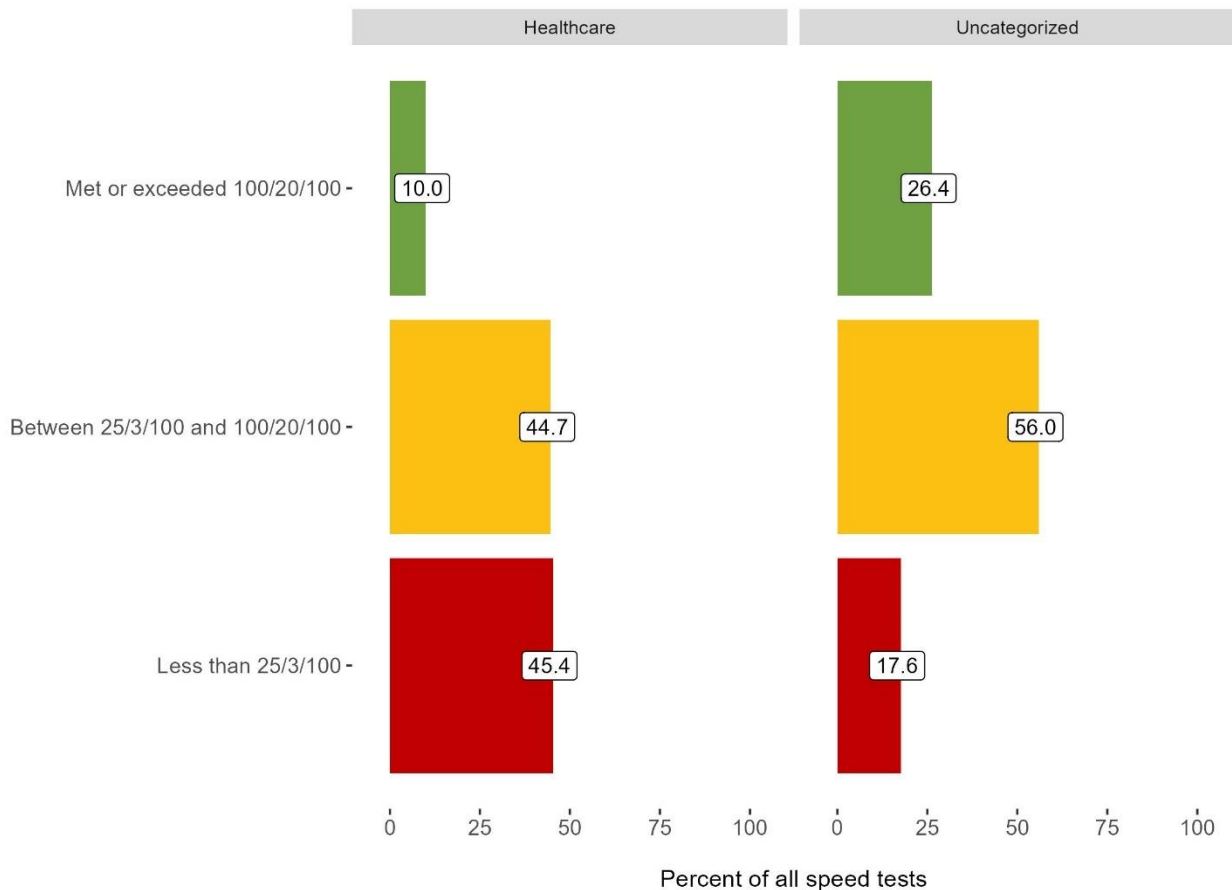
Figure 14. Percentage of speed tests recorded at less than 25/3/100, between 25/3/100 and 100/20/100, and met or exceeded 100/20/100 for healthcare and uncategorized locations across the TBP expansion areas of Alaska (each location equally weighted).

Speed tests conducted at healthcare locations throughout the TBP expansion areas of Alaska were of variable quality, but most speed tests either fell below the outdated 25/3/100 threshold (45.4%) or between the 25/3/100 and 100/20/100 thresholds (44.7%). Only 10.0% of all speed tests conducted across the 19 healthcare locations met or exceeded the new broadband benchmarks of 100/20/100.

Broadband needs for healthcare can vary due to multiple factors, including the size of a healthcare practice, the types of services delivered, the number of people working at the same time, and other factors. However, many published recommendations of broadband speed minimums for healthcare are out of date,[17,18] particularly in light of the recent FCC broadband quality threshold change.[2]

Of the 19 healthcare sites located across the TBP expansion areas of Alaska, 12 had known advertised download and upload speeds, which were compared against recorded speed test data. The total speed tests, total number of unique days with speed tests recorded, the advertised download speed, the advertised upload speed, median download speed, median upload speed, and median latency are presented in Table 38.

Table 38. Overall characteristics of 19 healthcare locations across the TBP expansion areas of Alaska, as measured by pod deployments.

Location ID	Total tests	Unique days with tests	Advertised download speed (Mbps)	Advertised upload speed (Mbps)	Median download speed (Mbps)	Median upload speed (Mbps)	Median latency (in ms)
54-12	1,483	32	10	10	300.0	61.5	42.0
629-136	8,393	177	10	10	26.4	26.7	52.0
630-136	8,635	183	40	40	36.1	36.6	41.0
632-136	6,215	139	10	10	9.3	3.7	537.4
633-136	8,108	171	30	30	26.7	19.5	40.0
635-136	8,156	175	10	10	25.6	24.6	52.0
636-136	7,644	163	10	10	9.4	9.4	52.0
637-136	4,958	105	30	30	27.2	26.8	58.0
638-136	8,098	171	10	10	9.4	6.3	118.9
639-136	6,096	130	30	30	13.8	3.7	584.7
640-136	8,052	170	30	30	27.1	26.9	53.0
641-136	8,475	179	50	50	46.3	46.2	51.0
1971-12	1,215	30	-	-	6.9	3.6	625.6
1976-12	1,163	27	-	-	27.5	28.1	41.4
1979-12	4,419	59	-	-	26.7	20.4	48.6
1980-12	2,438	57	-	-	4.3	2.3	631.6
1982-12	2,179	59	-	-	49.3	3.9	65.6
2029-12	1,608	37	-	-	6.8	3.6	626.6
2032-12	1,706	37	-	-	194.9	226.4	44.6

For the 12 healthcare sites with known advertised download and upload speeds, additional information is presented in Table 39, specifically the number and percentage of tests falling below the 25/3/100 threshold, between the 25/3/100 and the 100/20/100 threshold, meeting or exceeding the 100/20/100 threshold, and meeting the advertised download and upload speed and latency.

Table 39. Number and percentage of speed tests observed by pods from TBP healthcare locations with known advertised download and upload speeds across the TBP expansion areas of Alaska meeting multiple standards (upload and download measurements in megabits per second; latency measurements in milliseconds; exp = expected; dl = download; ul = upload).

	Number of tests							Percentage of tests						
Location ID	< 25/3/100	25/3/100 to 100/20/100	≥ 100/20/100	Met advertised dl/ul	Did not meet advertised dl/ul	Latency ≤ 100	Latency > 100	< 25/3/100	25/3/100 to 100/20/100	≥ 100/20/100	Met advertised dl/ul	Did not meet advertised dl/ul	Latency ≤ 100	Latency > 100
198-37	14	82	1,387	1,466	17	7	1,476	0.9	5.5	93.5	98.9	1.2	99.5	0.5
198-25	4,043	4,350	0	4,434	3,959	29	8,364	48.2	51.8	0.0	52.8	47.2	99.7	0.4
199-37	98	8,537	0	0	8,635	8	8,627	1.1	98.9	0.0	0.0	100.0	99.9	0.1
199-25	5,961	254	0	91	6,124	5,892	323	95.9	4.1	0.0	1.5	98.5	5.2	94.8
225-18	928	7,180	0	0	8,108	12	8,096	11.5	88.6	0.0	0.0	100.0	99.9	0.2
226-18	4,012	4,144	0	4,305	3,851	44	8,112	49.2	50.8	0.0	52.8	47.2	99.5	0.5
312-25	7,644	0	0	3,642	4,002	27	7,617	100.0	0.0	0.0	47.7	52.4	99.7	0.4
358-33	241	4,717	0	0	4,958	21	4,937	4.9	95.1	0.0	0.0	100.0	99.6	0.4
358-18	7,693	405	0	141	7,957	5,299	2,799	95.0	5.0	0.0	1.7	98.3	34.6	65.4
358-25	5,681	415	0	0	6,096	5,578	518	93.2	6.8	0.0	0.0	100.0	8.5	91.5
387-25	263	7,789	0	0	8,052	29	8,023	3.3	96.7	0.0	0.0	100.0	99.6	0.4
2017-12872	68	8,407	0	0	8,475	29	8,446	0.8	99.2	0.0	0.0	100.0	99.7	0.3

The number of speed tests recorded at healthcare sites with a known advertised download and upload speed across the expansion areas of Alaska ranged from 1,163 to 8,635, and the number of unique days where speed tests were recorded ranged from 27 to 183. For the healthcare locations with known advertised download and upload speeds, these advertised speeds were evaluated relative to the upload and download speeds in the 100/20/100 and 25/3/100 broadband thresholds (note that advertised latency was not recorded, making these 100/20 and 25/3 thresholds). Of the 12 healthcare locations with known advertised download and upload speeds, 0 had advertised speeds that met or exceeded the 100/20 threshold (0.0%), 6 fell between the 25/3 and 100/20 thresholds (50.0%), and 6 fell below the 25/3 threshold (50.0%).

For 7 of the 19 healthcare locations (36.8%), the median download speed fell below 25 Mbps, and for 1 location, the median upload speed fell below 3 Mbps (5.3%). These aggregated measures demonstrate low-quality broadband, falling below even the older FCC-defined thresholds. Only 2 of the 19 healthcare locations (10.5%) across the TBP expansion areas of Alaska met the 100 Mbps download speed threshold for the new FCC definition of broadband, and 10 (52.6%) met or exceeded the 20 Mbps upload speed threshold. Only 2 healthcare locations (10.5%) met or exceeded *both* speed thresholds for broadband.

Additionally, 17 healthcare locations (89.5%) recorded 0 speed tests meeting or exceeding the 100/20/100 threshold. Most speed tests at the other 2 healthcare locations (10.5%) met or exceeded the 100/20/100 threshold. For 7 healthcare locations (36.8%), most speed tests fell below the 25/3/100 threshold.

The latency measurements in the expansion areas of Alaska also demonstrated poor quality broadband, with 6 healthcare locations (31.6%) recording median latency values and a majority of speed tests with latencies slower than 100 ms.

For the 12 healthcare locations with known advertised download and upload speeds, 3 (25.0%) demonstrated median download and upload speeds that met or exceeded their advertised speeds. Only these 3 locations had most of their recorded broadband speed tests meeting or exceeding the advertised download and upload speeds. Among the other 9 locations, 8 reported less than 2% of all speed tests meeting the advertised download and upload speeds, and 6 reported 0 speed tests meeting the advertised download and upload speeds.

Appendix G: Michigan Telehealth Broadband Pilot Program Summary Report: Activations and Learnings from Expansion Areas

Although the Telehealth Broadband Pilot (TBP) Program targeted 6 Michigan counties, additional data were collected throughout additional places designated rural by the Health Resources and Services Administration that the Program and funds allowed for.[36] Here, the results of the measurements recorded throughout these additional expansion areas are reported.

Results from Michigan TBP Expansion Area Pods

The Michigan Community Lead Partner (CLP) received data from 55 devices across 54 locations in the TBP expansion areas of Michigan; however, 5 locations had fewer than 100 speed tests or fewer than 14 unique days of data collection and were excluded from analysis. In total, 49 locations across 18 additional counties that the Program and funds allowed for were included:

- Alpena County, 1 location
- Barry County, 1 location
- Benzie County, 2 locations
- Clare County, 3 locations
- Crawford County, 1 location
- Grand Traverse County, 3 locations
- Gratiot County, 2 locations
- Huron County, 4 locations
- Iosco County, 1 location
- Isabella County, 9 locations
- Kalkaska County, 1 location
- Leelanau County, 1 location
- Montcalm County, 1 location
- Newaygo County, 1 location
- Oceana County, 1 location
- Presque Isle County, 10 locations
- Tuscola County, 4 locations
- Wexford County, 3 locations

Across these locations, 461,830 speed tests were conducted as of September 2024. The number of individual speed tests by site ranged from 848 speed tests to 29,318. The median download speed, upload speed, and latency was calculated for each location category. The median of these location medians was calculated by location category type, as can be found in Table 40. Medians were chosen to reduce the influence of locations with extremely high or low values.

Table 40. Total locations, speed tests, median download speed, median upload speed, and median latency for all locations the TBP expansion areas of Michigan by category of location.

Category	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Business	2	14,279	329.0	31.1	19.3
Consumer	31	256,638	71.9	11.1	19.7
Healthcare	1	15,877	354.5	11.2	18.1
Non-healthcare CAI	11	138,582	512.0	54.0	25.7
(Uncategorized)	4	36,454	932.3	906.2	11.1

*Medians reported are medians of all median values calculated for each location.

In general, consumers had the lowest quality broadband in expansion areas as measured by median download speed, upload speed, and latency. Across 31 consumer locations, the median download speed was 71.9 Megabit per second (Mbps), the median upload speed was 11.1 Mbps, and the median latency was 19.7 milliseconds (ms). These aggregated measurements would fall between the Federal Communication Commission's (FCC's) 25/3/100 and 100/20/100 thresholds. Non-healthcare community anchor institutions (CAIs) demonstrated relatively high-quality broadband connections, with median download speeds of 512.0 Mbps, upload speeds of 54.0 Mbps, and latency of 25.7 ms, which exceed the 100/20/100 threshold.

The percentage of individual speed tests that fell below the 25/3/100 threshold, between the 25/3/100 and 100/20/100 threshold, and met or exceeded the 100/20/100 threshold for each location category were recorded. In these calculations, each location was equally weighted, such that sites with a greater number of speed tests had the same weight as sites with a smaller number of speed tests (although all sites met the inclusion criteria of having at least 100 speed tests). The percentages of tests meeting these thresholds for locations in TBP target counties can be found in Figure 15.
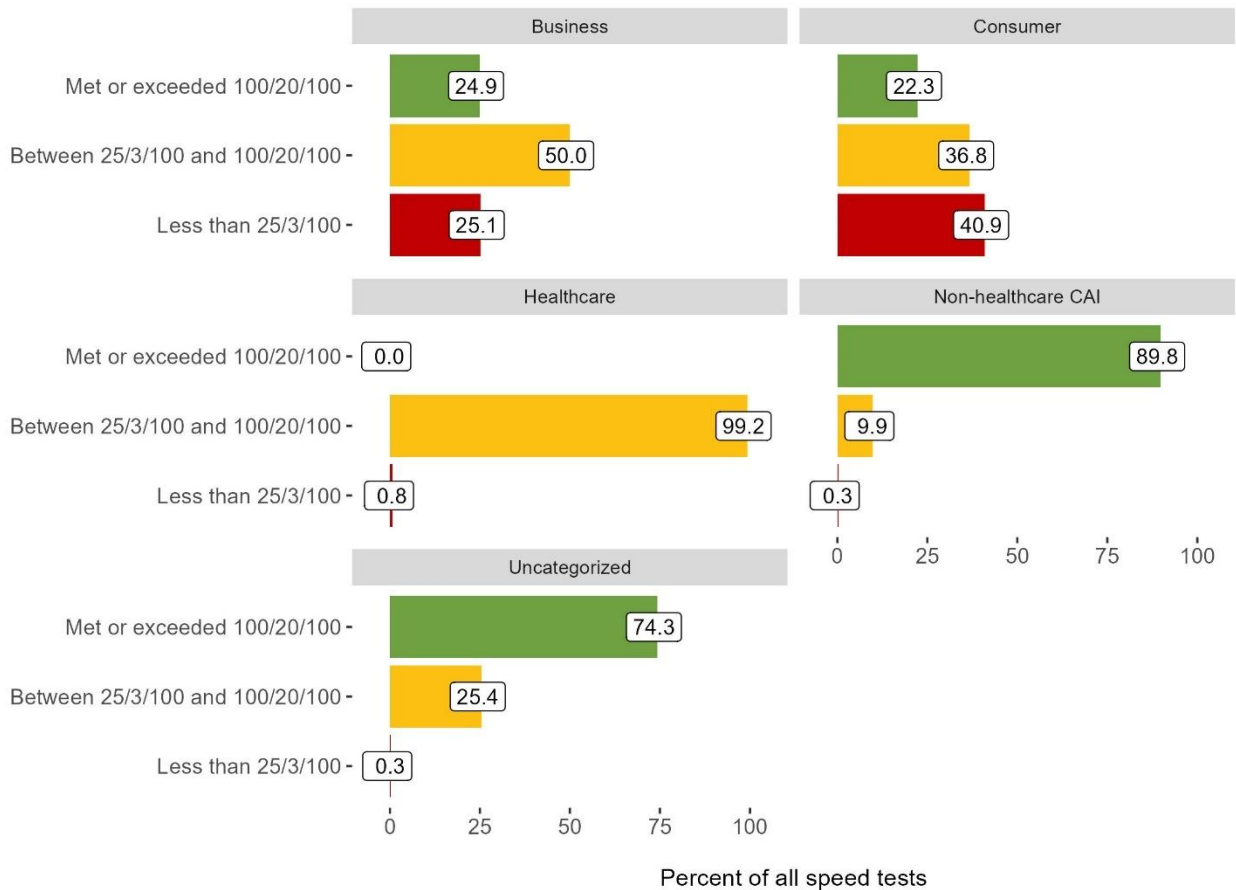
Figure 15. Percentage of speed tests recorded at less than 25/3/100, between 25/3/100 and 100/20/100, and met or exceeded 100/20/100 for healthcare and uncategorized locations across the TBP expansion areas of Michigan (each location equally weighted).

Despite the aggregated measurements at consumer sites falling between the 25/3/100 and 100/20/100 thresholds, 40.9% of speed tests conducted at consumer locations fell *below* the 25/3/100 threshold. Speed tests conducted at non-healthcare CAIs showed much higher quality and relatively reliable connections, with most speed tests (89.8%) meeting or exceeding the 100/20/100 threshold. Finally, 99.2% of all speed tests conducted at the 1 healthcare location in Michigan expansion areas fell between the 25/3/100 and 100/20/100 thresholds.

Appendix H: West Virginia Telehealth Broadband Pilot Program Summary Report: Activations and Learnings from Expansion Areas

Although the Telehealth Broadband Pilot (TBP) Program targeted 7 West Virginia counties, additional data were recorded throughout additional places designated rural by the Health Resources and Services Administration that the Program and funds allowed for.[36] Here, the results of the measurements recorded throughout these additional expansion areas are reported.

Results from West Virginia TBP Expansion Area Pods

The West Virginia Community Lead Partner (CLP) received data from 151 devices across 142 locations in the TBP expansion areas of West Virginia; however, 54 locations had fewer than 100 speed tests or fewer than 14 unique days of data collection and were excluded from the analysis. In total, the data from 88 locations across 26 additional counties of West Virginia were analyzed:

- Barbour County, 3 locations
- Boone County, 1 location
- Greenbrier County, 5 locations
- Hancock County, 2 locations
- Hardy County, 1 location
- Harrison County, 1 location
- Lewis County, 1 location
- Lincoln County, 5 locations
- Logan County, 6 locations
- Marion County, 3 locations
- McDowell County, 7 locations
- Mercer County, 2 locations
- Mineral County, 1 location
- Mingo County, 14 locations
- Monroe County, 9 locations
- Morgan County, 1 location
- Pendleton County, 5 locations
- Pocahontas County, 2 locations
- Preston County, 2 locations
- Randolph County, 3 locations
- Summers County, 1 location
- Taylor County, 1 location
- Tucker County, 5 locations
- Upshur County, 2 locations
- Wetzel County, 2 locations
- Wyoming County, 3 locations

Across these locations, 1,022,447 speed tests were conducted as of September 2024. The number of speed tests by individual site ranged from 326 speed tests to 26,020. The median download speed, upload speed, and latency was calculated for each location category in West Virginia. The median of these location medians was calculated by location category type, as can be found in Table 41. Medians were chosen to reduce the influence of locations with extremely high or low values.

Table 41. Total locations, speed tests, median download speed, median upload speed, and median latency for all locations the TBP expansion areas of West Virginia by category of location.

Category	Total Locations with Pod Deployments	Total Speed Tests	Median Download Speed (Mbps)*	Median Upload Speed (Mbps)*	Median Latency (ms)*
Consumer	24	234,963	60.4	7.6	28.3
Healthcare	54	659,879	98.1	39.8	21.4
Non-healthcare CAI	7	100,905	169.2	168.5	26.0
(Uncategorized)	3	26,700	89.6	147.8	13.0

*Medians reported are the medians of all median values calculated for each location.

In general, consumer locations had the poorest quality connections, as shown by median download speeds of 60.4 Megabits per second (Mbps), upload speeds of 7.6 Mbps, and latency of 28.3 milliseconds (ms). Although these aggregated values exceeded the Federal Communication Commission's (FCC's) former 25/3/100 threshold, they fell below the updated 100/20/100 threshold for highest broadband quality. Healthcare locations had faster speeds than consumer homes, but the median download speed (98.1 Mbps) still fell short of the 100 Mbps download speed benchmark. Non-healthcare CAI locations had the highest relative broadband quality across the expansion areas of West Virginia, with a median download speed of 169.2 Mbps, a median upload speed of 168.5 Mbps, and a median latency of 26.0 ms. However, aggregating median measurements across many categories and locations does not show the complete experience of broadband for users at these locations.

The percentage of individual speed tests that fell below the 25/3/100 threshold, fell between the 25/3/100 and 100/20/100 threshold, and met or exceeded the 100/20/100 threshold for each location category were examined. In these calculations, each location was equally weighted, such that sites with a greater number of speed tests had the same weight as sites with a smaller number of speed tests (although all sites met the inclusion criteria of having at least 100 speed tests). The percentages of tests meeting these thresholds for locations in TBP target counties can be found in Figure 16.
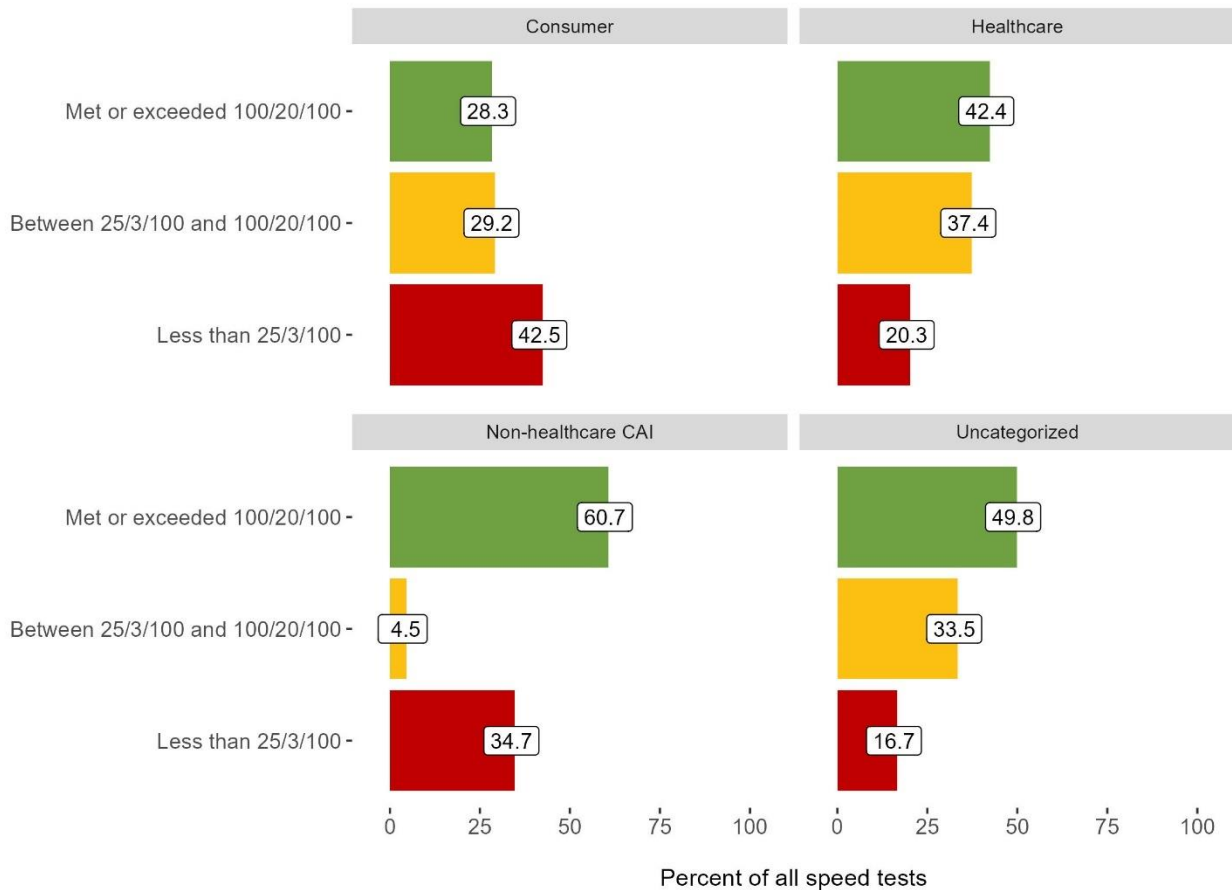
Figure 16. Percentage of speed tests recorded at less than 25/3/100, between 25/3/100 and 100/20/100, and met or exceeded 100/20/100 for healthcare and uncategorized locations across the TBP expansion areas of West Virginia (each location equally weighted).

Speed tests conducted at healthcare locations throughout the expansion areas of West Virginia varied in quality, with 42.4% meeting or exceeding the 100/20/100 threshold, 37.4% falling between the 25/3/100 and 100/20/100 thresholds, and 20.3% falling below the outdated 25/3/100 broadband threshold. Consumer speed tests also varied in quality. Although the median speeds for consumer locations fell between the 25/3/100 and 100/20/100 thresholds, 42.5% of all consumer speed tests fell below the 25/3/100 threshold. Finally, even though non-healthcare CAIs demonstrated the highest quality median broadband connections, more than a third (34.7%) fell below the 25/3/100 threshold.

Healthcare

Broadband needs for healthcare can vary due to multiple factors, including the size of a healthcare practice, the types of services delivered, the number of people working at the same time, and other factors. However, many published recommendations of broadband speed minimums for healthcare are out of date,[17,18] particularly in light of the recent FCC threshold change for high-quality broadband speeds.[2]

Of the 54 healthcare sites located across the TBP expansion areas of West Virginia, 46 had known advertised download and upload speeds. The total speed tests, total number of unique days with speed tests recorded, the advertised download speed, the advertised upload speed, median download speed, median upload speed, and median latency are presented for these 46 locations in Table 42.

Table 42. Overall characteristics of 46 healthcare locations across the TBP expansion areas of West Virginia, as measured by pod deployments.

Location ID	Total tests	Unique days with tests	Advertised download speed (Mbps)	Advertised upload speed (Mbps)	Median download speed (Mbps)	Median upload speed (Mbps)	Median latency (in ms)
146-18	8,203	202	1000	1000	625.1	48.5	23.0
146-25	16,956	373	1000	1000	705.4	782.8	16.0
147-25	6,407	142	1000	1000	704.0	726.8	6.6
147-26	1,704	21	1000	1000	274.0	284.8	13.8
148-25	1,850	39	1000	1000	607.4	611.5	7.1
149-25	19,445	414	200	200	18.7	19.9	26.4
160-38	19,446	452	200	200	90.8	7.5	25.9
165-31	24,207	516	200	200	101.3	18.8	24.7
167-31	13,610	290	200	200	57.0	18.9	26.8
168-31	13,078	540	200	200	51.6	2.2	23.9
182-32	14,408	308	500	500	223.7	218.3	28.0
183-32	16,772	357	200	200	86.3	86.2	50.7
184-32	3,449	76	200	200	16.5	16.5	109.1
200-18	1,032	45	20	20	49.6	24.9	24.8
200-25	3,206	91	20	20	44.7	23.9	15.5
202-25	9,523	203	10	10	9.2	5.7	17.3
206-32	21,669	476	50	50	89.2	44.9	29.0
206-41	326	18	50	50	63.6	4.3	622.5
241-26	24,455	521	200	200	668.3	454.1	20.0
243-26	6,576	142	500	500	559.9	548.5	19.0
244-26	24,740	524	200	200	567.4	457.0	23.0
257-25	21,252	508	100	100	94.6	94.6	6.5
259-40	23,749	501	250	250	230.6	238.4	1.9
260-31	22,739	486	250	250	234.5	280.1	1.9
265-46	10,396	222	500	500	281.4	695.6	10.7
267-46	23,252	491	500	500	92.0	101.4	8.5
268-46	12,594	267	200	200	9.3	34.3	16.2
275-31	23,743	500	300	300	284.2	321.9	5.0
305-18	5,540	120	1000	1000	314.2	22.8	15.4
305-25	18,254	384	1000	1000	10.8	10.8	23.0
305-49	12,030	258	1000	1000	312.4	24.5	23.9
306-49	8,001	187	500	500	322.4	25.4	23.6

310-18	19,856	423	500	500	318.3	31.1	14.2
316-18	2,078	46	500	500	318.5	31.6	20.9
577-22	9,321	196	200	200	743.3	40.3	21.9
661-18	7,675	164	500	500	286.2	23.9	15.8
662-18	7,683	164	500	500	318.1	30.8	14.5
663-18	7,370	159	500	500	520.9	48.3	14.6
692-25	3,534	77	500	500	43.4	76.0	24.7
695-25	1,525	38	200	200	764.3	129.9	9.0
695-37	1,554	68	200	200	111.4	19.2	26.2
697-22	6,489	138	200	200	91.1	40.2	26.2
698-22	6,716	142	200	200	29.1	39.8	28.0
700-22	6,988	148	200	200	29.2	39.8	28.0
702-22	2,298	50	200	200	29.1	39.5	28.1
728-26	6,847	148	200	200	338.7	121.2	38.3

Additional information for these 46 healthcare sites with known advertised speeds, specifically the number and percentage of tests that fell below the 25/3/100 threshold, between the 25/3/100 and the 100/20/100 threshold, met or exceeded the 100/20/100 threshold, and met the advertised download and upload speed and latency was also recorded (Table 43).

Table 43. Number and percentage of speed tests observed by pods from TBP healthcare locations with known advertised download and upload speeds across the TBP expansion areas of West Virginia meeting multiple standards (upload and download measurements in megabits per second; latency measurements in milliseconds; exp = expected; dl = download; ul = upload).

Location ID	Number of tests							Percentage of tests						
	< 25/3/100	25/3/100 to 100/20/100	≥ 100/20/100	Met advertised dl/ul	Did not meet advertised dl/ul	Latency ≤ 100	Latency > 100	< 25/3/100	25/3/100 to 100/20/100	≥ 100/20/100	Met advertised dl/ul	Did not meet advertised dl/ul	Latency ≤ 100	Latency > 100
146-18	53	546	7,604	0	8,203	2	8,201	0.65	6.66	92.7	0	100	99.98	0.02
146-25	83	165	16,708	0	16,956	0	16,956	0.49	0.97	98.54	0	100	100	0
147-25	0	4	6,403	0	6,407	0	6,407	0	0.06	99.94	0	100	100	0
147-26	0	10	1,694	0	1,704	0	1,704	0	0.59	99.41	0	100	100	0
148-25	3	0	1,847	0	1,850	1	1,849	0.16	0	99.84	0	100	99.95	0.05
149-25	19,445	0	0	0	19,445	29	19,416	100	0	0	0	100	99.85	0.15
160-38	195	19,251	0	0	19,446	5	19,441	1	99	0	0	100	99.97	0.03
165-31	886	18,242	5,078	0	24,206	642	23,564	3.66	75.36	20.98	0	100	97.34	2.65
167-31	139	13,471	0	0	13,610	0	13,610	1.02	98.98	0	0	100	100	0
168-31	7,010	6,068	0	0	13,078	3	13,075	53.6	46.4	0	0	100	99.98	0.02
182-32	33	3,026	11,349	623	13,785	8	14,400	0.23	21	78.77	4.32	95.68	99.94	0.06
183-32	269	16,503	0	0	16,772	191	16,581	1.6	98.4	0	0	100	98.86	1.14
184-32	3,449	0	0	0	3,449	3,448	1	100	0	0	0	100	0.03	99.97
200-18	5	1,027	0	993	39	0	1,032	0.48	99.52	0	96.22	3.78	100	0
200-25	49	3,157	0	2,109	1,097	1	3,205	1.53	98.47	0	65.78	34.22	99.97	0.03
202-25	9,523	0	0	0	9,523	19	9,504	100	0	0	0	100	99.8	0.2
206-32	625	21,044	0	3,643	18,026	123	21,546	2.88	97.12	0	16.81	83.19	99.43	0.57
206-41	253	73	0	0	326	185	141	77.61	22.39	0	0	100	43.25	56.75
241-26	29	354	24,072	16,745	7,710	8	24,447	0.12	1.45	98.43	68.47	31.53	99.97	0.03
243-26	3	35	6,538	2,515	4,061	1	6,575	0.05	0.53	99.42	38.25	61.75	99.98	0.02
244-26	30	288	24,422	19,156	5,584	2	24,738	0.12	1.16	98.71	77.43	22.57	99.99	0.01
257-25	3	21,249	0	0	21,252	1	21,251	0.01	99.99	0	0	100	100	0
259-40	9,766	2	13,981	2,363	21,386	0	23,749	41.12	0.01	58.87	9.95	90.05	100	0
260-31	8,253	1	14,485	10,609	12,130	0	22,739	36.29	0	63.7	46.66	53.34	100	0
265-46	2,757	7	7,632	676	9,720	1	10,395	26.52	0.07	73.41	6.5	93.5	99.99	0.01

267-46	5,825	17,426	0	0	23,251	2	23,249	25.05	74.94	0	0	100	99.99	0.01
268-46	12,594	0	0	0	12,594	1	12,593	100	0	0	0	100	99.99	0.01
275-31	3	1,571	22,169	0	23,743	1	23,742	0.01	6.62	93.37	0	100	100	0
305-18	193	2,096	3,250	0	5,539	2	5,537	3.48	37.83	58.66	0	99.98	99.95	0.04
305-25	18,254	0	0	0	18,254	2	18,252	100	0	0	0	100	99.99	0.01
305-49	9	1,346	10,675	0	12,030	4	12,026	0.07	11.19	88.74	0	100	99.97	0.03
306-49	3	64	7,934	0	8,001	3	7,998	0.04	0.8	99.16	0	100	99.96	0.04
310-18	40	857	18,959	0	19,856	2	19,854	0.2	4.32	95.48	0	100	99.99	0.01
316-18	0	114	1,964	0	2,078	0	2,078	0	5.49	94.51	0	100	100	0
577-22	24	58	9,239	0	9,321	0	9,321	0.26	0.62	99.12	0	100	100	0
661-18	15	3,878	3,782	0	7,675	1	7,674	0.2	50.53	49.28	0	100	99.99	0.01
662-18	6	400	7,277	0	7,683	0	7,683	0.08	5.21	94.72	0	100	100	0
663-18	7	146	7,217	0	7,370	2	7,368	0.09	1.98	97.92	0	100	99.97	0.03
692-25	0	1,770	1,764	0	3,534	0	3,534	0	50.08	49.92	0	100	100	0
695-25	1	680	844	390	1,135	1	1,524	0.07	44.59	55.34	25.57	74.43	99.93	0.07
695-37	12	1,040	502	0	1,554	2	1,552	0.77	66.92	32.3	0	100	99.87	0.13
697-22	4	6,485	0	0	6,489	3	6,486	0.06	99.94	0	0	100	99.95	0.05
698-22	946	5,770	0	0	6,716	10	6,706	14.09	85.91	0	0	100	99.85	0.15
700-22	907	6,081	0	0	6,988	14	6,974	12.98	87.02	0	0	100	99.8	0.2
702-22	374	1,924	0	0	2,298	5	2,293	16.28	83.72	0	0	100	99.78	0.22
728-26	21	64	6,762	1,025	5,822	7	6,840	0.31	0.93	98.76	14.97	85.03	99.9	0.1

The number of speed tests recorded at healthcare locations with a known advertised download and upload speed across the expansion areas of West Virginia ranged from 326 to 24,740, and the number of unique days where speed tests were recorded ranged from 18 to 540. For the healthcare locations with known advertised download and upload speeds, these advertised speeds were evaluated relative to the upload and download speeds in the 100/20/100 and 25/3/100 broadband thresholds (note that advertised latency was not recorded, making these 100/20 and 25/3 thresholds). Of the 46 healthcare locations with known advertised download and upload speeds, 41 had advertised speeds that met or exceeded the 100/20 threshold (89.1%), 2 fell between the 25/3 and 100/20 thresholds (4.3%), and 3 fell below the 25/3 threshold (6.5%).

For 5 of the 46 healthcare locations (10.9%) with known advertised download and upload speeds, the median download speed fell below 25 Mbps, and 1 healthcare location (2.1%) had the median upload speed fall below 3 Mbps. In 6 locations (13.0%), the median download and upload speeds demonstrate low-quality broadband, with measures falling below even the older FCC-defined thresholds for broadband. More than half (56.5%) of the 46 locations met the new FCC download speed threshold of 100 Mbps, and 36 (78.3%) met or exceeded the 20 Mbps upload speed threshold. Twenty-four healthcare locations (52.2%) across the TBP met or exceeded *both*.

Additionally, 23 of the 46 healthcare locations (50.0%) had most speed tests meet or exceed the 100/20/100 threshold, while 19 (41.3%) recorded 0 speed tests meeting or exceeding the 100/20/100 threshold. Further, 7 healthcare locations (15.2 %) recorded most speed tests falling below the 25/3/100 threshold.

Only 2 healthcare locations (4.3%) with known advertised download and upload speeds recorded median latency values slower than 100 ms and both reported that most speed tests had latencies slower than 100 ms.

In total, only 11 healthcare locations with known advertised download speeds (23.9%) met or exceeded the advertised speeds, and 8 (17.4%) met or exceeded advertised upload speeds. In fact, 33 healthcare locations (71.7%) with known advertised download and upload speeds had 0 speed tests met or exceed the advertised speeds. Only 4 healthcare locations (8.7%) with known advertised speeds reported that most speed tests met or exceeded the advertised download and upload speeds.

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