

Broadband Connectivity and Telehealth Adoption: A Systematic Review of Digital Equity and Health Outcomes in Underserved Communities.

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Fakolade is a researcher whose work focuses on digital health equity, telehealth systems, and the role of broadband connectivity in shaping healthcare access and outcomes in underserved communities. This author's research applies equity-oriented frameworks, including the Digital Divide framework, to examine how infrastructure, digital capacity, and system design interact to influence telehealth adoption and effectiveness. Using systematic review methodologies aligned with PRISMA 2020 guidelines, their work synthesizes empirical evidence across public health, health informatics, and social science literature to inform equitable telehealth policy, broadband investment strategies, and inclusive digital health system design.

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BROADBAND CONNECTIVITY AND TELEHEALTH ADOPTION: A SYSTEMATIC REVIEW OF DIGITAL EQUITY AND HEALTH OUTCOMES IN UNDERSERVED COMMUNITIES.

Abstract

Telehealth has emerged as a critical strategy for expanding healthcare access, yet its effectiveness depends fundamentally on broadband connectivity. Persistent disparities in broadband access, quality, and affordability raise concerns that telehealth may reinforce existing inequities rather than mitigate them. This systematic review synthesizes empirical evidence on the relationship between broadband connectivity and telehealth adoption, equity, and health outcomes in underserved communities. Guided by the Digital Divide framework, the review examines how interactions among infrastructure access, digital capacity, and system implementation condition telehealth effectiveness across contexts. Following PRISMA 2020 guidelines, 42 empirical studies published between 2015 and 2025 were identified and analyzed. Findings reveal substantial geographic concentration of evidence in high-income settings, with limited representation from low- and middle-income regions. Across studies, telehealth adoption and positive health outcomes were consistently associated with reliable broadband connectivity, while low-connectivity environments were linked to disrupted care, reduced engagement, and mixed or negative outcomes. Evidence further indicates that broadband access alone is insufficient; digital literacy, device access, system usability, and institutional support interact with connectivity to shape meaningful telehealth engagement. The reviewed literature also demonstrates considerable heterogeneity in theoretical frameworks and methodological approaches, limiting cross-study comparability. Collectively, the findings indicate that telehealth functions as a socio-technical system in which benefits are realized only when adequate infrastructure and user capacity are jointly present. By positioning broadband connectivity as a foundational condition rather than a contextual variable, this review clarifies why telehealth reduces disparities in some settings while exacerbating them in others. The synthesis provides an evidence base to inform equitable telehealth design, broadband investment strategies, and future research on digital health equity.

Keywords: Policy, Telehealth, Digital health equity.

INTRODUCTION

Telehealth has become a core component of contemporary healthcare delivery, offering expanded access, improved continuity of care, and reduced geographic barriers. The rapid expansion of telehealth during the COVID-19 pandemic demonstrated its potential to support chronic disease management, behavioral health, and routine primary care. However, this expansion also revealed that the effectiveness of telehealth depends on the availability of adequate digital infrastructure, particularly broadband connectivity.

Broadband connectivity enables essential telehealth functions, including video-based visits, remote patient monitoring, secure communication, and sustained engagement with digital health tools. When broadband connectivity is weak, unreliable, or unaffordable, telehealth participation declines, engagement becomes inconsistent, and anticipated clinical benefits are diminished [1], [2]. Communities facing limited broadband access often experience compounding barriers such as reduced healthcare availability, lower digital literacy, and diminished trust in technology-mediated care, further restricting their ability to benefit from telehealth services [3].

Despite growing attention to digital inequities, research examining broadband connectivity and telehealth remains fragmented. Existing studies vary widely in scope, populations examined, methodological approaches, and conceptualizations of access, making it difficult to draw cohesive conclusions. This fragmentation underscores the need for a systematic review that integrates evidence across diverse contexts to clarify how broadband connectivity shapes telehealth adoption and outcomes [4].

Problem Statement

Persistent disparities in broadband connectivity significantly shape who benefits from telehealth and who remains underserved. These disparities disproportionately affect rural residents, low-income households, and racially or ethnically marginalized communities. Limited broadband connectivity constrains video-based care, increases missed appointments, disrupts patient-provider communication, and weakens the effectiveness of telehealth interventions intended to expand access [5]. In the absence of reliable broadband infrastructure, telehealth services cannot consistently reach or serve the populations they are often designed to support.

Purpose of the Study

This systematic review synthesizes and evaluates empirical evidence on how broadband connectivity influences telehealth adoption, digital equity, and health outcomes in underserved communities. By integrating findings across diverse methodologies and geographic contexts, the review clarifies the infrastructural, social, and behavioral factors that shape telehealth participation [6]. Building on this synthesis, the review positions broadband connectivity as a foundational condition for meaningful telehealth engagement rather than a peripheral enabling factor. Guided by the Digital Divide framework, the review examines how broadband connectivity, digital literacy, and patterns of engagement interact to influence telehealth utilization and associated health outcomes. In doing so, the review moves beyond descriptive aggregation to provide a structured evidence base that can inform equitable telehealth program design, broadband investment decisions, and future research on digital health equity.

Research Questions and Contribution

This systematic review examines how broadband connectivity shapes telehealth adoption, equity, and health outcomes in underserved communities. Rather than treating broadband access as a contextual variable, the review positions broadband connectivity as a foundational condition that structures who can engage in telehealth and under what circumstances benefits are realized.

Guided by the Digital Divide framework, the review synthesizes fragmented empirical evidence to address four research questions:

1. What is the relationship between broadband connectivity and telehealth adoption in underserved populations?
2. How do disparities in broadband connectivity influence health outcomes associated with telehealth use?
3. What structural, socioeconomic, and digital capacity factors mediate the relationship between broadband connectivity and telehealth utilization?
4. What theoretical and methodological approaches are used to examine broadband connectivity and telehealth equity?

The contribution of this review lies in integrating evidence across diverse contexts to demonstrate that telehealth effectiveness is conditional on interactions among broadband infrastructure, user capacity, and system design. By organizing findings through a multi-layer digital divide lens, the review moves beyond descriptive aggregation to clarify why telehealth reduces disparities in some contexts while reinforcing them in others.

Significance of the Study

This review positions broadband connectivity as a foundational determinant of digital health equity. By synthesizing findings from diverse studies, it clarifies how gaps in digital infrastructure shape telehealth access, adoption patterns, and associated health outcomes. The insights generated can guide policymakers involved in broadband expansion initiatives, inform healthcare organizations seeking to design more equitable telehealth programs, and support community leaders advocating for digital inclusion [7]. By centering broadband connectivity, the review moves beyond general discussions of telehealth to focus on the infrastructural conditions that determine whether digital health innovations reach underserved populations.

Theoretical Framework: Digital Divide

This review is grounded in the Digital Divide framework, which conceptualizes digital inequity across three interconnected dimensions: access to technology, digital literacy, and meaningful engagement with digital tools. Applying this framework allows the review to examine how disparities in broadband connectivity influence patient readiness, provider capacity, and overall telehealth performance [1].

In this review, the Digital Divide framework functions as an analytic lens rather than a background concept. The synthesis is organized across three dimensions: access to broadband connectivity, capacity to use digital technologies through skills and available resources, and the

extent of meaningful engagement with telehealth services. Studies are examined not only in terms of whether telehealth is available, but also how broadband connectivity quality, digital literacy, and contextual factors shape participation and outcomes. Organizing the evidence in this way enables systematic comparison of how different layers of the digital divide influence telehealth adoption and health outcomes across underserved communities, while also revealing areas where existing research is concentrated and where gaps remain.

In this review, the Digital Divide framework is used not only to organize findings but to interpret how interactions among infrastructure access, digital capacity, and system implementation condition telehealth adoption and outcomes across studies.

Scope of study

This review synthesizes 42 empirical studies published between 2015 and 2025 that examine relationships among broadband connectivity, telehealth adoption, digital equity, and health outcomes [6]. By consolidating evidence drawn from rural, low-income, and other marginalized populations across multiple geographic contexts, the review provides a structured understanding of how broadband connectivity and related digital infrastructure constraints shape telehealth participation. The contributions of this review support the development of more equitable digital health systems, inform broadband investment strategies, and refine approaches to digital inclusion in healthcare.

METHODOLOGY

This study employed a systematic literature review to identify, evaluate, and synthesize empirical research examining the relationship between broadband connectivity and telehealth adoption in underserved populations. To ensure rigor, transparency, and reproducibility, the review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 guidelines. The methodology was designed to capture a broad yet targeted body of evidence across digital health, public health, and social science domains. Although this review includes studies conducted across multiple countries, findings are discussed with attention to their relevance for telehealth systems and broadband policy contexts commonly referenced in the United States.

Search Strategy

A comprehensive search strategy was developed to locate peer-reviewed and graduate-level empirical studies addressing broadband connectivity, telehealth utilization, digital inequities, or health outcomes associated with telehealth participation. Searches were conducted across three major scholarly databases, Scopus, PubMed, and ProQuest Dissertations and Theses Global. These databases were selected for their broad coverage of scientific, medical, engineering, and social science literature relevant to digital health research [8]. The strategy was designed to capture studies from both high-income and low-resource contexts.

Search strings combined core concepts related to broadband connectivity, telehealth, and equity, with Boolean operators used to ensure balanced retrieval of relevant literature. An example search string included broadband or internet access or connectivity, combined with telehealth or

telemedicine or virtual care or remote monitoring and digital divide or health equity or underserved or rural. These terms were iteratively refined through preliminary searches to improve both sensitivity and specificity.

Publication Window

The review included studies published between 2015 and 2025, with the database search conducted on 17 September 2025. This publication window captures the development of telehealth research before, during, and after the COVID 19 pandemic, a period marked by rapid expansion of digital care and increased attention to disparities associated with broadband connectivity.

Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were adapted from systematic review frameworks commonly used in digital health research [9]. Studies were included if they addressed broadband connectivity, internet infrastructure, or digital access; focused on telehealth adoption, virtual care use, or health outcomes associated with telehealth participation; examined underserved, rural, low income, minority, or otherwise marginalized populations; employed empirical methods, including qualitative, quantitative, or mixed methods approaches; were published in English between 2015 and 2025; and were available in full text. Studies were excluded if they did not examine broadband connectivity or digital infrastructure, discussed telehealth without relevance to connectivity-related factors, consisted of opinion pieces, commentaries, theoretical essays, or other non-empirical work, were published before 2015, or were not accessible in full text. Together, these criteria ensured the inclusion of methodologically rigorous studies with direct relevance to broadband connectivity and telehealth equity.

The database search and screening process yielded varying numbers of records across sources due to differences in disciplinary coverage, indexing practices, and applied filters. To provide transparency and support comparison across databases, Table 1 summarizes the search queries, filters applied, and records retained at each stage of the review process.

Table 1: Database and Boolean operators used.

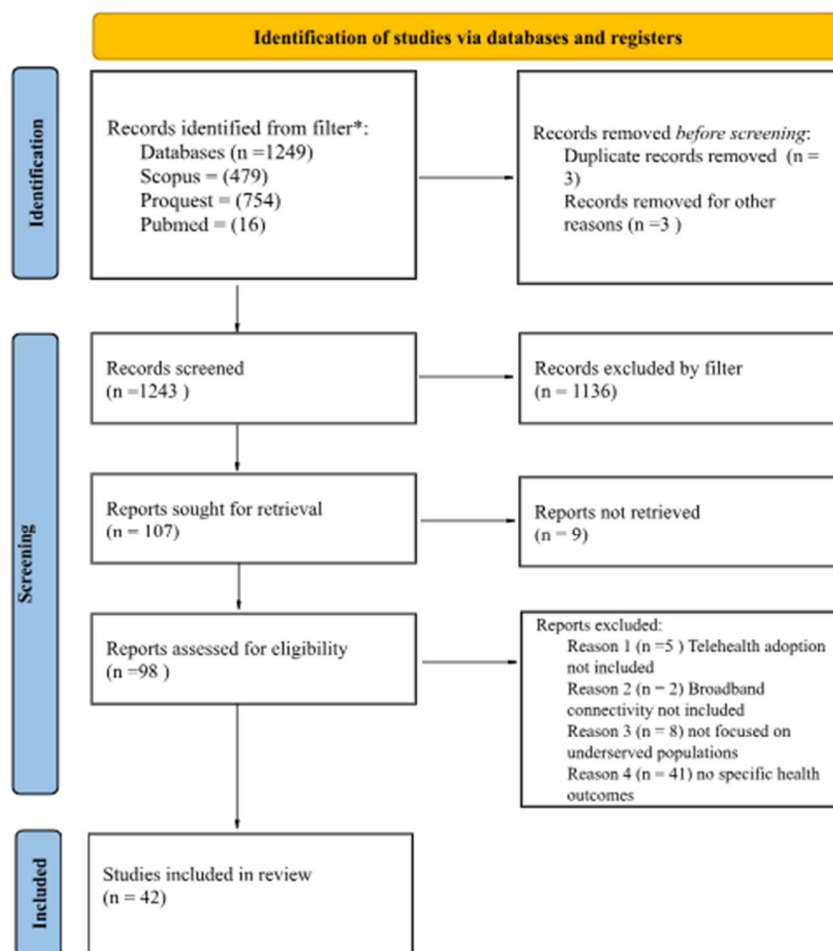
Database	Search Query Used	Date Search	Initial Records Identified	Filters	Records Identified after Filters	Duplicates Removed
SCOPUS	("broadband" OR "internet access" OR "digital infrastructure" OR "connectivity") AND ("telehealth" OR "telemedicine" OR "digital health" OR "e-health" OR "virtual care") AND ("digital equity" OR "digital divide" OR "digital inclusion" OR "technology access") AND ("health outcomes" OR "healthcare access" OR "health disparities" OR "health equity") AND ("underserved communities" OR "low-income populations" OR "marginalized groups" OR "rural communities" OR "disadvantaged populations")	17th September 2025	479	Year: 2015 - 2025 Subject Area: Social Science, Computer Science, Health Professions, and Engineering. Document type: Article, Review. Language: English Keywords: Health Service Accessibility, Telehealth, Telemedicine, Digital Divide, Rural Population, Health Care Access, Health Equity, Rural, Rural Area, Health. Country: United States. Source type: Journal. Open Access: All open access.	37	0
PROQUEST	("broadband" OR "internet access" OR "digital infrastructure" OR "connectivity") AND ("telehealth" OR "telemedicine" OR "digital health" OR "e-health" OR "virtual care") AND ("digital equity" OR "digital divide" OR "digital inclusion" OR "technology access") AND ("health outcomes" OR "healthcare access" OR "health disparities" OR "health equity") AND	17th September 2025	754	Year: 2015 - 2025 Subject Area: Health Care Management, Computer Science, and Sustainability. Language: English Keywords: Health Care Access, Telehealth, Telemedicine, Health Equity. Limit to: Full Text	57	0

	("underserved communities" OR "low-income populations" OR "marginalized groups" OR "rural communities" OR "disadvantaged populations")					
PUBMED	("broadband" OR "internet access" OR "digital infrastructure") AND ("telehealth" OR "telemedicine") AND ("digital equity" OR "digital divide" OR "digital inclusion") AND ("health outcomes" OR "healthcare access" OR "health disparities" OR "health equity") AND ("underserved communities" OR "rural" OR "low-income" OR "marginalized" OR "disadvantaged populations")	17th September 2025	16	Text Availability: Full Text Review	13	3

Screening Process

The study selection process was documented in accordance with PRISMA 2020 guidelines, and Figure 1 summarizes the identification, screening, eligibility, and inclusion of studies in this review. The screening followed the three-phase structure outlined by PRISMA:

PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).

**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

Figure 1: Prisma Flow Diagram

As shown in Figure 1, a total of 1,249 records were retrieved across all databases. After the removal of three duplicate records and three records not seen on the database, 1,243 studies remained for screening. Titles and abstracts were reviewed to exclude studies that were not related to broadband connectivity, telehealth, or digital equity, as well as studies that lacked an empirical focus or clear relevance to the review questions. Full-text articles were then retrieved and assessed against the established inclusion and exclusion criteria. Ultimately, 42 studies met all criteria and were included in the final synthesis. This selection process is summarized in the PRISMA flow diagram presented in Figure 1.

Data Extraction and Synthesis

A structured data extraction matrix was developed in Microsoft Excel following established best practices for systematic literature reviews in digital health research [10]. For each included study, key variables were extracted, including publication year and geographic context; population characteristics such as rural, minority, or low income status; indicators of broadband connectivity including availability, affordability, speed, and infrastructure characteristics; telehealth outcomes such as adoption, modality, and engagement; health outcomes including clinical indicators, access related measures, and patient satisfaction; reported barriers and facilitators; theoretical frameworks employed; and methodological approach. Given the heterogeneity of study designs, populations, and outcome measures, a narrative synthesis approach was used. Where appropriate, descriptive quantitative patterns, including frequencies of reported barriers and geographic distributions of studies, were integrated to support the synthesis.

Quality Appraisal

The methodological quality of each included study was assessed using the Mixed Methods Appraisal Tool 2018 [11], which supports consistent evaluation across qualitative, quantitative, and mixed methods research designs. The appraisal examined the appropriateness of the selected methodology, the clarity of research questions, the reliability and validity of measurements, and, for studies using multiple methods, the adequacy of data integration. Quality appraisal informed the interpretation of findings but was not used as a criterion for study exclusion.

Risk of Bias

Several strategies were employed to reduce the risk of bias throughout the review process. These strategies included searching multiple databases to limit publication bias, applying consistent screening and coding procedures, extracting data using predefined categories, cross-checking included studies for accuracy, and using an established appraisal framework to assess methodological quality. Together, these procedures align with best practices in digital health systematic reviews and strengthen the credibility and reliability of the findings.

RESULT

The results are organized to align directly with the research questions guiding this review. Sections 3.1 through 3.4 address the geographic distribution of evidence and the populations examined in studies of broadband connectivity and telehealth adoption, responding primarily to the first research question. Sections 3.5 through 3.7 synthesize evidence on telehealth interventions and patterns of adoption across populations, addressing both adoption dynamics and mediating structural and socioeconomic factors. Section 3.8 examines health outcomes associated with broadband connectivity-enabled telehealth, responding to the second research question. Sections 3.9 and 3.10 synthesize strategies for advancing telehealth equity and summarize the theoretical and methodological approaches used across the reviewed studies, addressing the third and fourth research questions.

Geographic Distribution of the Evidence

Across the 42 included studies, the geographic distribution of evidence reveals a pronounced imbalance. As shown in Figure 2, research examining broadband connectivity and telehealth adoption is heavily concentrated in North America, with minimal representation from Africa and Asia. This uneven distribution indicates a substantial gap in empirical evidence from low- and middle-income regions, despite the heightened relevance of broadband limitations in these contexts [12]. Prior reviews of digital health equity similarly note that telehealth evidence disproportionately reflects high-income country infrastructure and policy environments [13].

Across studies, this geographic concentration suggests that existing evidence on broadband connectivity and telehealth adoption is shaped primarily by high-income contexts, limiting insight into how infrastructure constraints influence telehealth in regions where broadband access is most limited [12].

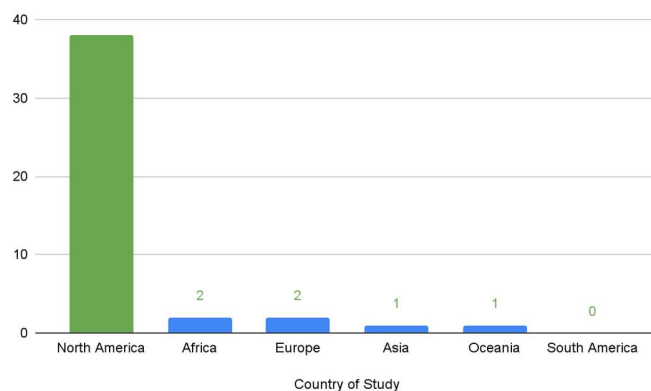


Figure 2: Distribution of the study across continents.

Country-Level Representation

Country-level analysis further reinforces this imbalance. Figure 3 illustrates a randomized bubble network of telehealth studies by country, showing that the United States is the most frequently represented country in the dataset. Several African countries, including Uganda, Kenya, Ghana, Malawi, Ethiopia, Tanzania, Zambia, Rwanda, Nigeria, Botswana, Sierra Leone, Lesotho, and South Africa, each appear only once. Canada is also represented by a single study, and Cambodia is the only Asian country included. Although digital inequity is widely recognized as a global challenge, empirical literature linking broadband connectivity to telehealth adoption remains largely centered on the United States [13], [14].

Taken together, this country-level distribution indicates that telehealth equity research remains disproportionately U.S.-focused, despite evidence that broadband-related constraints may play an even more consequential role in low- and middle-income settings [12], [13].

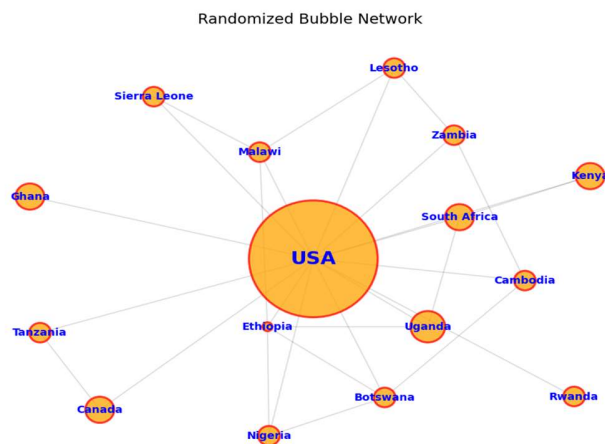


Figure 3: Randomized Bubble Network of Telehealth studies by Country.

U.S. State Distribution

Within the United States, the reviewed studies span a wide geographic range. Figure 4 presents the distribution of studies across more than 25 states, demonstrating that broadband connectivity–related telehealth challenges are not confined to a single region. States such as California, New York, Pennsylvania, Massachusetts, Ohio, Florida, and Georgia appear frequently, reflecting diverse populations and persistent healthcare access gaps [5], [15]. Rural and frontier states, including Montana, Idaho, Wyoming, Washington, and Colorado, are also represented, where broadband connectivity limitations remain a structural barrier to telehealth participation [14], [16]. Southern states such as Alabama, Mississippi, Tennessee, Arkansas, and Texas further highlight the intersection of poverty, racial inequities, and constrained digital infrastructure [14], [17].

This distribution suggests that broadband-driven telehealth disparities emerge across diverse policy, economic, and infrastructural contexts within the United States rather than being geographically isolated [5], [14].

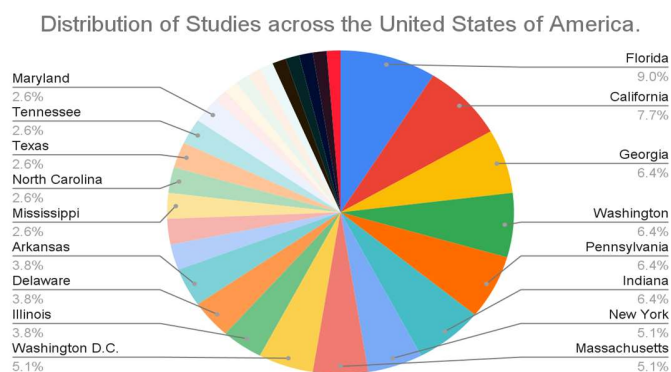


Figure 4: Distribution of studies across the United States of America.

Underserved Populations and Study Settings

Across all geographic contexts, the reviewed studies consistently focused on underserved populations. Studies conducted in the United States frequently examined rural residents, Medicaid recipients, safety-net patients, individuals with chronic conditions, children with complex health needs, and racially or ethnically marginalized groups [5], [15]. Common study settings included Federally Qualified Health Centers, rural hospitals, and community clinics, where limitations in broadband connectivity directly constrained telehealth participation [7], [16].

Outside the United States, studies examined First Nations communities in Northern Ontario and remote regions in Uganda, Kenya, Malawi, Ghana, Cambodia, and other African countries, documenting compounded challenges related to limited digital infrastructure, socioeconomic hardship, linguistic barriers, and low digital literacy [1], [12], [13]. Across settings, broadband connectivity consistently emerged as a foundational determinant of telehealth access and engagement [12], [15].

Telehealth Interventions Examined

The telehealth interventions examined across the reviewed studies varied widely. Synchronous modalities, particularly video and audio consultations, were the most frequently reported across studies [15], [17]. Asynchronous approaches, including secure messaging, email communication, and patient portals, were reported in 9 studies [16], [18]. Mobile health applications and remote patient monitoring systems were more commonly implemented in higher-resource settings [15], [17]. Advanced technologies, such as artificial intelligence tools, wearable devices, and digital coaching programs, appeared less frequently and were typically deployed where stable broadband infrastructure existed [19].

Comparison across studies suggests that more technologically intensive telehealth interventions are concentrated in contexts supported by reliable broadband connectivity, while lower-bandwidth modalities are more common in resource-constrained environments [14].

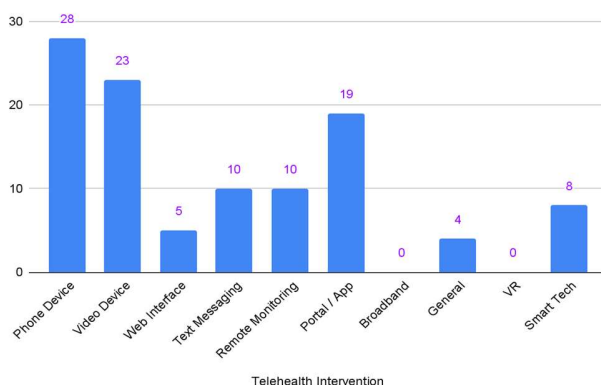


Figure 5: Telehealth Intervention used across the study.

Factors Facilitating Telehealth Adoption

Across the reviewed studies, several recurring factors facilitated telehealth adoption. As shown in Figure 6, perceived usefulness emerged as a central driver, with patients and providers more likely to adopt telehealth when it reduced travel burdens or improved access to care [13], [20]. The COVID-19 pandemic functioned as a major accelerator by temporarily reducing regulatory and reimbursement barriers [9], [21]. Provider readiness, supported by training, workflow adaptation, and technical assistance, further contributed to uptake [19].

Across studies, these facilitating factors were most effective when broadband infrastructure and institutional support were already in place, suggesting that adoption drivers operate within broader structural constraints rather than independently of connectivity conditions [5], [16].

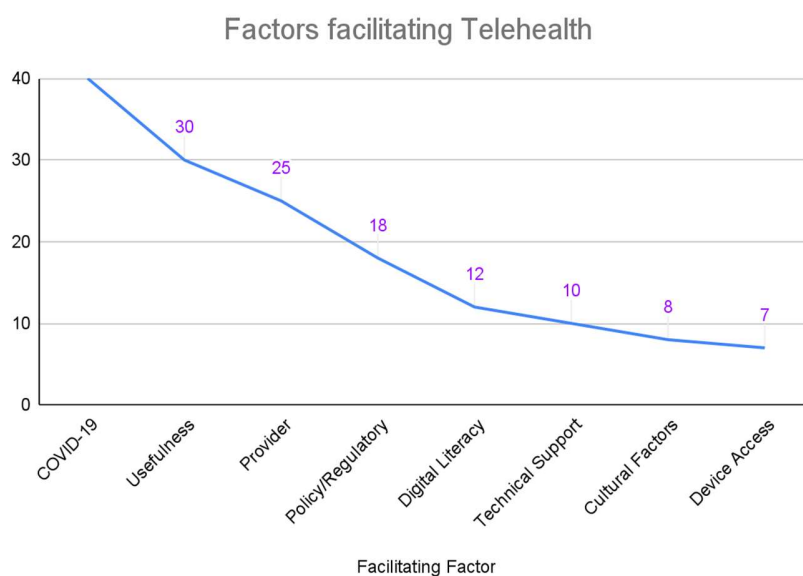


Figure 6: Factors Facilitating Telehealth Intervention

Patterns of Telehealth Adoption Across Populations

Although telehealth adoption increased across many settings, the pace and extent of uptake varied across populations. As shown in Figure 7, rural vs urban residence was the most frequently reported source of variation, identified in more than 30 studies, with rural communities facing persistent barriers related to broadband connectivity, device access, and technical support [5], [14], [16].

Race and ethnicity also emerged as prominent sources of variation. Black, Hispanic or Latina, Indigenous, and immigrant populations experienced lower broadband connectivity, reduced patient portal use, and language-related barriers limiting equitable participation in telehealth [8], [16], [17], [18]. Age, socioeconomic status, and digital literacy further shaped adoption patterns, particularly among older adults and low-income households [18].

Together, these patterns suggest that variation in telehealth adoption is influenced by interactions among broadband connectivity, population characteristics, and available support, rather than differences in individual willingness alone [17].

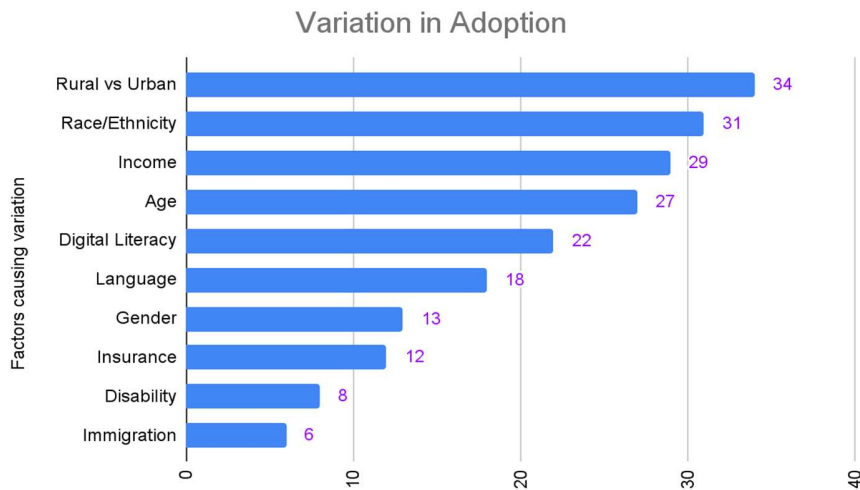


Figure 7: Factors causing variation in Adoption

Population-Level Disparities

Age, socioeconomic status, and digital literacy further shaped patterns of telehealth adoption. Older adults often encountered usability challenges, low-income households reported difficulty affording devices and internet services, and individuals with limited digital literacy experienced barriers navigating patient portals or participating in video visits. Insurance type, disability status, and immigration background also influenced adoption, though these factors were reported less frequently. Together, these population-level disparities illustrate how digital inequities continue to shape telehealth engagement beyond basic access to technology, as shown in Figure 8.

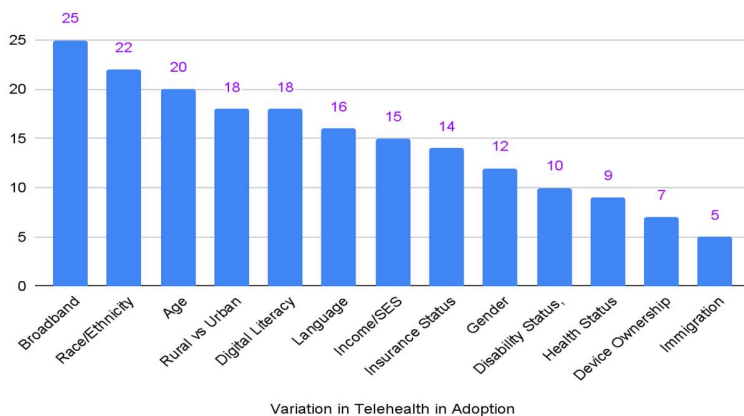


Figure 8: Population-Level Disparities.

Health Outcomes Associated with Broadband Connectivity

Health outcomes associated with telehealth participation varied considerably across studies and were strongly conditioned by broadband connectivity quality. In settings supported by reliable, high-speed internet, telehealth was associated with improved appointment adherence, reduced missed visits, enhanced continuity of care, and improved management of chronic and mental health conditions [15], [17]. Patients in these contexts frequently reported higher satisfaction and improved engagement [18].

In contrast, studies conducted in low-connectivity environments reported mixed or negative outcomes. Poor or unstable broadband disrupted video visits, limited follow-up, and constrained remote monitoring, resulting in diminished clinical effectiveness [5], [14]. In some cases, telehealth implementation exacerbated existing disparities by shifting care delivery to digital platforms that underserved populations could not reliably access [17]. Across studies, positive health outcomes were reported primarily in high-connectivity settings, indicating that infrastructure quality conditions the effectiveness of telehealth interventions [17].

Strategies and Methodological Approaches to Advancing Telehealth Equity

Across the reviewed studies, several strategies were consistently identified as critical for advancing equitable telehealth adoption and outcomes. The most frequently recommended strategy was expansion of broadband infrastructure, particularly in rural and underserved communities [12], [13]. Additional strategies included subsidized internet and device access, digital literacy training, deployment of digital health navigators, culturally and linguistically responsive telehealth models, and sustained reimbursement and regulatory support [15], [16].

Figure 9 summarizes the distribution of theoretical frameworks across studies. The literature demonstrates substantial heterogeneity, with technology acceptance and diffusion-oriented models appearing most frequently, while equity-focused frameworks such as the Digital Divide and social determinants perspectives were applied less consistently [8], [10], [17]. Many studies did not explicitly specify a guiding framework. Methodological approaches were similarly diverse. Most studies employed observational, cross-sectional, or retrospective designs, limiting causal inference [11], [17]. Variation in broadband definitions and measurement further constrained cross-study comparison and synthesis [13].

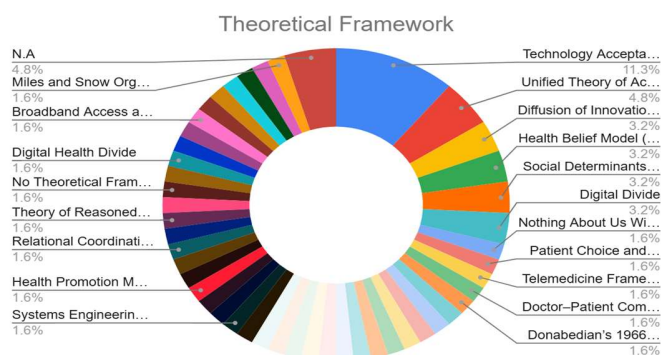


Figure:9. Theoretical Framework across studies

DISCUSSION

Interpreting the findings through the Digital Divide framework clarifies how broadband connectivity shapes telehealth adoption and outcomes through interacting layers of access, capacity, and engagement. Rather than functioning as a single barrier, the digital divide reflects interactions among engineered infrastructure, user capacity, and system-level implementation. [1], [12].

Across the reviewed studies, telehealth adoption and positive health outcomes were consistently associated with reliable broadband connectivity, while low-connectivity environments were linked to disrupted care, reduced engagement, and limited clinical benefit. Evidence further indicates that broadband connectivity and digital capacity interact rather than operate independently. Studies reporting lower adoption among older adults, low-income households, and racially or ethnically marginalized populations identified both connectivity constraints and limited digital literacy as contributing factors. [5], [14], [16], [18].

At the infrastructure layer, access to reliable broadband emerged as a foundational requirement for telehealth participation across geographic contexts. Weak, intermittent, or unaffordable connectivity constrained video visits, remote monitoring, and continuity of care, particularly in rural and structurally marginalized communities. [14], [16].

At the capacity layer, disparities in device access, digital literacy, language support, and technical assistance shaped whether patients and providers could meaningfully engage with telehealth services. These findings underscore that broadband availability alone is insufficient without systems designed to accommodate user needs and contextual constraints. [8], [18], [21].

At the engagement layer, sustained use and positive outcomes were observed primarily when infrastructure reliability and digital capacity were jointly present. In low-connectivity or low-support environments, telehealth often resulted in fragmented care and widening disparities. [5], [15], [17], [23].

Policy and regulatory environments intersect with all layers of the digital divide. Pandemic-era reimbursement expansions and regulatory flexibilities accelerated telehealth adoption, while uncertainty regarding long-term policy support threatens sustainability and equity. Taken together, the findings indicate that telehealth equity is not solely a healthcare delivery issue but the outcome of interactions among broadband infrastructure, system design, user capacity, and policy context. [9], [21].

CONCLUSION

This systematic review demonstrates that broadband connectivity is a foundational condition for equitable telehealth adoption and health outcomes, particularly in underserved communities. Across the reviewed studies, telehealth was most effective in contexts where reliable broadband connectivity, adequate digital capacity, and supportive policy environments were jointly present. In contrast, low connectivity settings were associated with disrupted care, reduced engagement, and mixed or negative outcomes, indicating that telehealth adoption alone does not guarantee equitable benefit.

The implications of these findings extend beyond telehealth program implementation. Treating broadband connectivity as essential healthcare infrastructure has direct relevance for broadband investment strategies, reimbursement policies, and digital inclusion initiatives. Evidence from the reviewed studies suggests that healthcare organizations and policymakers should consider broadband connectivity, device access, digital literacy, and culturally responsive system design as interconnected components of equitable telehealth systems rather than as isolated interventions.

Several unanswered questions remain and point to important directions for future research. The existing evidence base is geographically concentrated and methodologically heterogeneous, limiting understanding of how broadband connectivity shapes telehealth adoption and outcomes in low-resource and non-United States contexts. In addition, the predominance of observational and cross-sectional study designs constrains causal inference regarding the mechanisms linking broadband connectivity to health outcomes. Greater use of longitudinal and experimental approaches, along with standardized measures of broadband connectivity and telehealth engagement, would strengthen future synthesis and comparison across studies.

Addressing these gaps is critical to ensuring that telehealth contributes to reducing rather than reproducing digital health inequities. Without sustained attention to broadband connectivity as a structural determinant of health and continued investment in inclusive digital health systems, telehealth risks reinforcing existing disparities rather than advancing equity.

References

- [1] E. Wali, “‘Nothing About Us Without Us’: Designing equitable digital heart-health programs in low-resource and Indigenous communities,” M.S. thesis, University of Toronto, 2025.
- [2] T. Adeogun and M. Faezipour, “A quantitative study on health and telemedicine satisfaction before and during COVID-19,” M.S. thesis, University of Bridgeport, 2025.
- [3] P. Bathija, S. Benoit, and S. Miyamoto, “Achieving digital health equity by personalizing the patient experience,” *NEJM Catalyst Innovations in Care Delivery*, vol. 4, no. 7, 2023.
- [4] J. Alvares, “An examination of patient experience and telehealth utilization patterns among primary care providers,” M.S. thesis, Rutgers University, 2023.

- [5] S. Dix, "Analyzing Veterans Affairs telehealth services: Comparative analysis of rural and urban veterans," Ph.D. dissertation, University of Kansas, 2023.
- [6] O. Adeogun and M. Faezipour, "Assessing the impact of telemedicine on patient satisfaction before and during COVID-19," M.S. thesis, University of Bridgeport, 2025.
- [7] M. Tierney, "Virtual diabetes and hypertension care in community health centers," Ph.D. dissertation, University of Notre Dame, 2023.
- [8] J. Lawrence, E. Wang, and S. Yoon, "Chinese Americans' use of patient portal systems: A scoping review of barriers and facilitators," *J. Am. Med. Inform. Assoc.*, vol. 29, no. 11, pp. 2012–2025, 2022.
- [9] S. Schriger, L. Nguyen, and K. Bhat, "Community mental health clinicians' perspectives on telehealth during COVID-19: Mixed-methods study," *JMIR Mental Health*, vol. 9, no. 8, e35022, 2022.
- [10] R. Valdez and C. Rogers, "Consumer health informatics for racial and ethnic minoritized communities: A review of design factors," *JAMIA Open*, vol. 5, no. 4, 2022.
- [11] A. Sheon *et al.*, "Addressing disparities in diabetes management through novel approaches to encourage technology adoption," *J. Diabetes Sci. Technol.*, vol. 11, no. 5, pp. 950–958, 2017.
- [12] A. Owoyemi *et al.*, "Digital solutions for community and primary health workers: Lessons from implementations in Africa," *BMC Public Health*, vol. 22, Art. no. 2145, 2022.
- [13] M. Johnson and A. Stevens, "Disparities in mental health telehealth adoption among Medicaid populations," *Public Health Reports*, 2023.
- [14] Y. Tang, "Essays on digital technology-enabled mental healthcare delivery," Ph.D. dissertation, University of California, Berkeley, 2024.
- [15] K. Frisbee, "The impact of mobile health (mHealth) technology on veterans' health outcomes," Ph.D. dissertation, Walden University, 2024.
- [16] A. Funk, "The last mile: COVID-19, telehealth, and broadband disparities in rural Indiana," Ph.D. dissertation, Purdue University, 2021.
- [17] K. Blackwell, "Existing barriers to healthcare access for the immigrant Latinx/é community," Ph.D. dissertation, Walden University, 2024.
- [18] C. James, "Factors influencing work performance and technology adoption among healthcare providers," M.S. thesis, Capella University, 2024.

[19] S. Bastien, "Telehealth's fulfilment: Bridging or exacerbating healthcare disparities among South Florida Haitian immigrant communities," Ph.D. dissertation, Florida Atlantic University, 2025.

[20] M. Kragen, "Impact of secure messaging on health equity, care coordination, and diabetes outcomes," Ph.D. dissertation, Brandeis University, 2024.

[21] R. Saiyed, T. Williams, and J. Morris, "Implementing a digital-health navigator program to alleviate digital equity barriers," *J. Med. Internet Res.*, vol. 26, no. 4, e54987, 2024.

[22] T. Crowe, A. Keller, and M. Johnson, "The digital divide: Understanding telehealth adoption across racial lines in rural Illinois," Ph.D. dissertation, University of Illinois at Chicago, 2024.

[23] K. Carver, "Patient satisfaction and perceived quality of telehealth services in ambulatory care," M.S. thesis, University of North Carolina at Chapel Hill, 2025.

[24] L. Walters, "Organizational capacity of nonprofit organizations in rural areas of the United States: A scoping review," Ph.D. dissertation, Walden University, 2020.

Appendix A. Characteristics of Included Studies

Table 2: Bibliographic details of all included studies

Title	Authors	Year	Geographical	Country Level	Us Distribution	Telehealth Interventions	What Factors Facilitated Adoption?	Populations Patterns	Theoretical Framework	Methodological Framework	Health Outcomes	Key Findings
Development of a patient-centered digital health self-care program for marginalized, underserved populations with heart failure	Sahr wali	2023	1,2	2,3	0	1,6,10	Perceived usefulness covid-19: community and cultural factors	Adoption variation across different populations	"nothing about us without us"	The study used an integrated framework combining CBPR, UCD, and kta principles.	Improvements in patient self-care and health-related quality of life	Digital heart failure programs are more likely to be adopted and effective when co-designed with marginalized communities and aligned with their cultural and contextual realities
A quantitative study on healthcare access in rural locations	Oetan sosanya osifeso	2025	1	1	2	2,5,6,10	Perceived usefulness provider readiness covid-19 acceleration	Adoption variation across different populations	Technology acceptance model (TAM) and the unified theory of acceptance and use of technology (UTAUT).	Secondary quantitative study using onc hitech data with regression, anova, and GIS.	Improved diagnostic accuracy, faster response times, and increased healthcare accessibility	Telemedicine and AI significantly improve diagnostic accuracy, reduce costs, and expand access to care in rural healthcare settings.
Achieving digital health equity by personalizing the patient experience	Priya bathija	2023	1	1	14	1,2,4,5,6	Perceived usefulness covid-19 acceleration provider readiness	Yes, adoption varied significantly	N.a	Summarizing the proceedings of an expert panel discussion held at a symposium	Improved patient outcomes and increased medication management	Addressing digital health disparities requires personalized, population-specific strategies rather than one-size-fits-all virtual care models
An examination of patient experience with telehealth medication abortion services in the United States	Anna fiastro	2023	1	1	5,6,7	1,2,4	Perceived usefulness covid-19 acceleration	Yes, telehealth adoption varied by geography, age, race, language, and health status disparities.s.	Patient choice and empowerment framework, telemedicine, and doctor-patient communication theoretical frameworks	Study 1: quantitative ehr analysis with logistic regression. Study 2: qualitative interviews with hybrid thematic analysis. Study 3: mixed-methods chart review and message content analysis.	N.a	Telehealth medication abortion was highly satisfactory and preferred for convenience, though disparities exist for non-English speakers, younger patients, and those with health conditions.
Analyzing veterans affairs telehealth services between rural and urban centers in West Virginia	Vicki dix	2023	1	1	8	2	Covid-19 acceleration	Yes	Donabedian's 1966 framework	Samples t-test and the Mann-Whitney U test	Wait times for appointments	Telehealth appointment types and rural location were associated with longer primary care wait times among veterans.
Assessing the impact of telemedicine on patient satisfaction before and during the COVID-19 pandemic	Ashiat adeogun	2025	1	1	2	8	Covid-19 acceleration provider readiness and support perceived usefulness (benefits)	Yes, urban areas showed higher satisfaction; rural barriers persisted. Satisfaction increased among older and minority patients.	Systems thinking approach	Quantitative analysis conceptual causal loop modeling	Improved continuity of care during the pandemic better chronic disease management enhanced access to healthcare	Telemedicine significantly increased patient satisfaction and care continuity during covid-19 but exposed disparities in rural and older populations.
Virtual diabetes and hypertension care in community health centers:	Aaron Alexander Tierney	2023	1	1	2,9,10,11,6,12,5	1,2	Telehealth expansion is driven by COVID-19, patient acceptance,	Yes, adoption and preferences varied across different populations.	The study drew on cfr, social capital theory, TAM, the pis framework, the	Prisma caps (critical appraisal skills programme) modified modified	Telehealth intervention for depression in rural fqhcs led to better	Successful telehealth implementation in community health centers depends on care continuity, organizational

use, quality, and patient preferences.							provider readiness, and policy changes.	Due to the "digital divide	Donabedian model, the health belief model, and the transtheoretical model.	continuity index (mmci) joint analysis and latent class analysis	outcomes than practice-based care.	factors, and understanding underserved patient preferences
Chinese Americans' use of patient portal systems: scoping review	Katharine lawrence	2022	1	1	13	6	Perceived usefulness provider readiness covid-19 acceleration	Yes, portal adoption varied by race, age, and socioeconomic status.		Prisma	N.a	Research on Chinese Americans' patient portal use is limited and often aggregated, masking unique access barriers and cultural needs
Community mental health clinicians' perspectives on telehealth during the COVID-19 pandemic: mixed methods study	Simone h schriger	2022	1	1	6	8	Covid-19 pandemic overall satisfaction clinicians endorsment	Yes, engagement varied; children and low-income clients faced telehealth access barriers.	Evidence-based practice (EBP)	Qualitative data used open thematic coding; quantitative data applied descriptive and post hoc correlations, guided by cherries.	No client health outcomes were reported.	Consumer health technologies show moderate progress in addressing disparities, but lack robust cultural tailoring and community engagement
Consumer health informatics for racial and ethnic minority communities: minor progress, major opportunities	Rupa S. Valdez	2022	1	1	3	3,6,4	Improved access through social media and workflow-aligned, patient-centered digital interventions.	Yes, health technology use varied; minoritized groups showed lower portal engagement but higher social media ehealth use.	Not stated	Not stated	N.a	Telehealth was acceptable to clinicians but created engagement challenges and digital access barriers for low-income youth.
Addressing disparities in diabetes management through novel approaches to encourage technology adoption and use	Amy r sheon	2017	1	1	0	6,4	Mobile apps and short message service (text) messaging Remote glucose monitoring has shown cost savings for Medicaid	Yes, portal adoption lagged among black and Hispanic patients, seniors, low-income, uninsured, and less-educated groups.	Digital inclusion framework/perspective	N.a	Remote glucose monitoring has been shown to result in cost savings (e.g., \$939 yearly per diabetic patient for California Medicaid)	Disparities in patient portal and HIT use risk widening diabetes inequities, requiring digital inclusion strategies and community partnerships to improve adoption.
Digital solutions for community and primary health workers: lessons from implementations in Africa	Ayomide owoyemi	2022	2	4, 5,6,7,3,9,10, 11,12,13,14, 15	2	6	Perceived usefulness satisfaction with increased efficiency and reduced burnout provider readiness/training stakeholder involvement covid-19 acceleration	Public digital adoption reflects a rural-urban divide driven by poor connectivity and digital illiteracy.	Universal health coverage	Systematic literature search	Reduced the incidence of missed and wrong diagnoses and the ability to manage patients just as accurately as trained professionals	Mhealth tools in African primary care are effective when accompanied by onsite training, intuitive design, stakeholder involvement, and infrastructure support.
Disparities in mental health telehealth services between 2020 and 2022 in north central California	Jasleen kaur	2023	1	1	14	1,2,5,6	Covid-19 acceleration perceived usefulness	Yes, adoption and satisfaction varied by geography, income, education, and age-related technology barriers.	Donabedian theory	A quantitative methodology with an experimental design was used. Statistical analysis was conducted using spss, employing tests such as chi-square and multiple linear regression.	Enabling regular updates to treatment plans may support earlier interventions and could help reduce mortality rates.	Telehealth encounter type was not associated with wait time or satisfaction, but rural-urban location significantly influenced patient satisfaction in behavioral health
Electronic health records and health information	Joedda finda pessima	2020	1	1	1	6	Perceived usefulness:	Yes, adoption lagged in rural and	Diffusion of innovation (DOI), the	Quantitative correlational design	Over half of clinicians reported that EHR/HIT	Greater EHR/HIT adoption in rural Georgia was associated

technology adoption in rural Georgia: a quantitative correlational study							provider readiness/training covid-19 acceleration	uninsured-serving providers, worsening minority health disparities.	technology acceptance model (TAM), and the unified theory of acceptance and use of technology (UTAUT)		supports diagnosis and care planning, and higher adoption was significantly associated with better perceived healthcare quality.	with improved perceived quality of healthcare delivery, particularly through enhanced interoperability and reduced provider burden.
Enhancing telehealth use to reduce no-shows in a rural Arizona outpatient clinic	Karina chacon	2025	1	1	6	1,2	Perceived usefulness positive baseline perceptions of telehealth usability and perceived benefits provider readiness covid-19 acceleration	Telehealth improved access in underserved areas, especially for low-income, disabled, and frail patients.	Everett Rogers' 1962 diffusion of innovation (doi) theory	Project applied psda implementation model and evaluated outcomes using a modified tuq.	The project focused on reducing no-show rates, with external studies showing telehealth lowers missed appointments by 29–50% and achieves outcomes comparable to in-person care.	Increasing telehealth integration in a rural outpatient clinic was designed to reduce no-show rates by leveraging diffusion of innovation strategies and provider education.
Equity in healthcare artificial intelligence: a qualitative study of congressional policies and federal regulatory frameworks	Mia keeys	2025	1,3,5,4	1	5	6,10,5	Covid-19 acceleration perceived usefulness provider readiness/policy shift	Yes, telehealth improved equity, but marginalized groups remain underrepresented in AI.	Equity-focused decision-making frameworks: (1) the framework for digital health equity (which utilizes digital determinants of health, or ddoh), and (2) the racial equity and policy (reap) framework	Mixed methodological approach using historical narrative and case study analyses.	Direct clinical outcomes were rarely the primary focus. Service outcomes included the study's primary success of reducing patient no-show rates.	Federal AI healthcare policy must explicitly center equity frameworks to prevent amplification of racialized health inequities in emerging health technologies.
Essays on digital technology-enabled mental healthcare delivery	Yi tang	2024	1	1	15	6,2,10	Covid-19 acceleration perceived usefulness provider/policy factors	Yes and no. Mhma use was similar across groups; telemental health faced geographic and affordability barriers.	Diffusion of innovation (doi) theory the 3a-framework	Quantitative panel data analysis qualitative design (essay 2): abductive reasoning	Greater mhma app use is associated with improved mental health, and higher telemental health uptake is linked to small but measurable reductions in mental illness prevalence, particularly in states with full parity laws.	Digital mental health technologies improve equity and population mental health outcomes when broadband access and telehealth parity laws function synergistically.
Examining differences in time to appointment and no-show rates between rural telehealth users and non-users	Kristin pullyblank	2024	1	1	15,4,13,14	1,2	Covid-19 acceleration perceived usefulness/accessibility provider readiness/preference	Yes, utilization differed by age, medicaid status, rurality, and patient portal engagement.	Penchansky and Thomas's five dimensions of access (availability, accessibility, accommodation, affordability, and acceptability), and the digital health equity framework, adapted from Crawford and Serhal (2020)	Retrospective analysis utilizing the healthcare network's electronic health record (ehr) data (both encounter data and billing data).	The study analyzed two indicators of access to care: time to appointment (days) and no-show rate. These measures indicated structural efficiency rather than clinical health outcomes.	Rural telehealth users had shorter times to appointments and lower no-show rates, suggesting non-users may face greater access barriers
Evaluating the implementation and effectiveness of telemedicine in office-based buprenorphine treatment for	Melissa Jean Davoust	2024	1	1	16	1,2	Covid-19 acceleration perceived usefulness of telemedicine removal or	Yes, telemedicine adoption varied, risking disparities; vulnerable, minority, and	Systems engineering initiative for patient safety (SEIPS) model	Qualitative: team-based coding and the framework method. Quantitative: the difference-in-difference (did) approach using	High telemedicine adoption was linked to increased outpatient engagement and buprenorphine use,	Telemedicine expansion in safety-net settings increased outpatient engagement and buprenorphine use without increasing adverse outcomes.

opioid use disorder among safety-net patient populations							relaxation of regulatory barriers openness to more flexibility in care practices	Spanish-speaking patients faced lower access.		ordinary least squares (OLS) regression	with no associated changes in ed visits or inpatient admissions for OUD.	
Existing barriers to healthcare access for the immigrant latinx/é community: a mixed methods study	Ronnie lawrence	2024	1	1	5	1,2,3,6	COVID-19 accelerated digital health; telehealth improved access, flexibility, and mental health engagement.	Yes, the digital divide hindered adoption among older Latinx immigrants, with language and navigation barriers.	Minority stress theory framework. The study was guided by the adaptation of Meyer's (2003) minority stress theory framework applied to undocumented latinx/é immigrants by valentín-cortés et al. (2020)	Used convergent parallel mixed-methods; qualitative data analyzed via inductive grounded theory coding.	Na	Latinx/é immigrants continue to face insurance costs, specialist access, wait times, information, and technology barriers, despite telehealth expansion.
Exploring telehealth utilization through data analytics, statistical analyses, and machine learning techniques	Aysenur betul cengil	2024	1	1	13	1,2	COVID-19 and insurance expansion boosted telehealth; broadband, literacy, and convenience drove adoption.	Yes, telehealth adoption varied by density, education, insurance, and disability; broadband mattered most.	Na	The methodological approach utilized data analytics, statistical analysis, and machine learning techniques to gain insights into telehealth utilization patterns.	Specific health outcomes were not reported; the conclusion highlights that telehealth is associated with significant cost reductions in chronic disease management through fewer hospital admissions and emergency visits.	Telehealth adoption is significantly influenced by broadband access, computer use, education level, and insurance policy changes, with psychiatry showing notably shorter wait times via telehealth.
Factors influencing work performance and prospective mobile health applications among village health support groups: a formative study for i-momcare development to enhance maternal, newborn, and child healthcare in Cambodia	Hendra goh	2025	3	16	3	6	Mhealth seen as useful in remote care; staff open to training; no covid impact reported.	Yes, digital health use varied by literacy, age, rural infrastructure, and device ownership barriers.	The socio-ecological model, which divides factors into five dimensions: (1) individual, (2) interpersonal, (3) organizational, (4) community, and (5) health system.	The study methodology was anchored to the consolidated criteria for reporting qualitative research (COREQ) checklist. The data analysis employed a reflexive thematic approach.	No improved health outcomes were reported because this was a formative study conducted to lay the groundwork for a future randomized controlled trial (i-momcare) aimed at improving mental outcomes.	Village health support group performance in Cambodia is shaped by multilevel socio-ecological factors, and health adoption potential depends on addressing systemic resource and trust barriers.
Socioeconomic disparity level and telehealth utilization among outpatient healthcare providers in California	Brittney goodgame	2024	1	1	0	1,2,4,5	Covid-19 acceleration perceived usefulness					Communities with lower socioeconomic disparity were 3.72 times more likely to use telehealth, demonstrating inequitable telehealth uptake across socioeconomic strata.
How does the use of telehealth for early psychiatric evaluation and treatment in adolescents reduce psychiatric-related er visits pre-, during-, and post-covid-19 pandemic?	Sharonshay hudson	2024	1	1	17	1,2,4	COVID closures accelerated telehealth; valued for convenience and reduced stigma; provider training supported readiness.	Yes, adoption disparities stemmed from the digital divide, rural internet limits, socioeconomic gaps, and gender imbalances.	The health promotion model (hpm), developed by Nola J. Pender	The research question was structured using the PICOT framework (population, intervention, comparison, outcome, and time frame). The empirical phase utilized a logistic regression factorial design approach	The study found no significant reduction in adolescent er visits associated with telehealth access across covid-19 periods, and those with access averaged 3.606 more er-related visits than those without access.	Early telehealth-based psychiatric evaluation and treatment can reduce adolescent psychiatric-related emergency visits by improving timely access and continuity of mental healthcare.

Impact of secure messaging on health equity, care coordination, and diabetes outcomes	Ben kragen	2024	1	1	18,6,19,20,21	4,6	COVID drove 63% sm increase; smartphone access and cms billing enabled adoption.	Adoption is similar by insurance and setting; lower among spanish speakers and older patients.	The digital divide, structural racism (including residential and workplace segregation), technology acceptance model (TAM), reverse innovation (or “trickle-up” innovation), relational coordination theory, and media richness theory	Cross-sectional survey with longitudinal data; stratified sampling and propensity score matching.	Secure messaging for medication refills was associated with improved glycemic control, including better hba1c outcomes and reduced rates of poorly controlled type 2 diabetes (HEDIS < 8%).	Secure messaging improved relational care coordination and HbA1c control in type 2 diabetes, with smartphone-based access supporting health equity among
Implementing a digital health navigator: strategies and experience in the hospital setting to alleviate digital equity	Salim m. Saiyed	2024	1	1	17	8	High satisfaction (98%); strong stakeholder coalition; COVID accelerated DHN adoption.	Higher youth/elder acceptance via proxies; slight female lead; mid-older low-income declined.	N.a	Implementation with DHN visits, brief survey data collection, protocol refinement, and statistical analysis.	The program reported no direct clinical outcomes but achieved strong engagement, with over half of patients adopting the portal and 53% activating or self-activating accounts among 260 participants.	A hospital-based digital health navigator program significantly improved patient portal adoption and reduced digital access barriers during hospitalization.
Leveraging artificial intelligence and wearable technology to overcome health inequities: a study of clinical quality outcomes for all of us	Yvonne Latoya Mosley	2025	1	1	17	5,10,6	Tam highlighted usefulness; readiness mixed; covid accelerated telemedicine context.	Yes, AI adoption is lower among poc and rural patients; older, lower-income patients faced worse outcomes.	Diffusion of innovation (DOI) theory, technology acceptance model (TAM), theory of reasoned action (TRA), health belief model (HBM), and the social determinants of health (SDH) framework.	Binary logistic regression. The structuring of the literature review utilized a realist review methodology.	The study found mixed equity effects in adverse outcomes, with AI increasing risk for people of color and wearables lowering risk for Hispanic individuals but raising risk for uninsured users.	AI adoption showed no significant overall improvement in clinical outcomes and was associated with increased risk among people of color, highlighting concerns about algorithmic bias, while wearable effects were mixed
The impact of digital health solutions on bridging the health care gap in rural areas: a scoping review	Karla c maita	2024	1	1	9	2,6,5,10	Adoption driven by perceived usefulness, COVID acceleration, wi-fi access, and strong social support.	Yes, adoption and effectiveness varied across populations, particularly due to baseline disparities and literacy.	N.a	Scoping review methodology	Digital tools improved health outcomes and expanded access to care while helping reduce disparities.	Digital health tools improve rural healthcare access and outcomes through teleconsultations and remote monitoring, but connectivity limitations remain major barriers.
Organizational capacity of nonprofit organizations in rural areas of the United States: a scoping review	Jayme e. Walters	2020	1	1	22	11	Technology is seen as useful for rural access; barriers include staffing, training, and funding limits.	Rural populations face poverty, resource shortages, disparities, and lower ai adoption.	Andersson et al. (2016) and de vita and fleming (2001)	Scoping review methodology	The review found that rural Americans have poorer physical and mental health, including higher rates of chronic disease, suicide, and overall mortality.	Rural u.s. nonprofits face significant organizational capacity challenges that limit their ability to address complex rural social and health issues, highlighting the need for further capacity-building research
Patient-level factors associated with telemedicine use in a tertiary complex care center	Marie a. Pfarr	2022	1	1	15,29	2	COVID-19 rapidly accelerated telemedicine to maintain care while	Yes, adoption varied significantly based on socioeconomic and demographic	Digital divide	The study utilized a single retrospective study design	The primary outcome was the binary utilization of telemedicine (any versus no use). Direct	Telemedicine utilization among children with medical complexity was significantly associated with clinical and demographic factors, with most

							reducing virus spread.	factors, highlighting disparities			clinical patient health outcomes were not reported	patients (72%) using telemedicine during the COVID-19 period
Patient satisfaction and perceptions on telehealth utilization at federally qualified health centers in the southeastern United States: a mixed-methods study	Alicia Monet Watts	2023	1	1	16,29,23, 11,17,14, 24,13,25, 26,27,28	1,2,4	Telehealth was chosen mainly due to canceled visits, reflecting covid-19 acceleration.	Rural communities experience poverty, limited resources, health disparities, and reduced AI adoption.	The rural telehealth and healthcare system readiness measurement framework, developed by the national quality forum.	A convergent mixed methods research design	The study focused on satisfaction and perceptions. It found no statistically significant difference in the effectiveness of care between the telehealth and non-telehealth groups (p = .82)	Telehealth satisfaction and perceived effectiveness were comparable to in-person care, with improved access reported among telehealth users.
Post 9/11 rural veterans with PTSD: a meta-narrative analysis on how the use of telehealth can improve access to creative art therapy and decrease physician burnout	Alan Middleton	2019	1	1	2	1,2	Adoption driven by convenience, flexible scheduling, burnout reduction; pre-COVID rural rehab initiative.	Rural areas face poverty, resource gaps, health inequities, and low AI use.	There was no theoretical framework used; the author noted that a conceptualized research approach met the criteria for this dissertation.	Meta-narrative analysis	Telehealth use was associated with improved mental wellness in most domains, including reduced anger and decreased suicidal ideation.	Telehealth-based art therapy shows promise in improving mental wellness for rural veterans with PTSD while potentially reducing physician burnout
Provider-patient engagement and patient-centered care: a correlational study	Phuong Phan	2025	1	1	22	8	COVID accelerated adoption; telehealth training enhanced provider readiness and patient-centered care.	Yes, engagement perceptions varied by profession; telehealth-trained providers reported stronger patient-centered care.	The technology acceptance model (TAM) and the social cognitive theory (SCT)	A quantitative, correlational method and design	The study examined provider perceptions, while prior literature linked telehealth to better outcomes and fewer readmissions.	Higher provider-patient engagement in telehealth is significantly correlated with higher perceptions of patient-centered care
Telehealth utilization in mental health: the unexpected catalyst	John Perrys	2024	1	1	17	1,2	COVID catalyzed telehealth; PU, PCOU, and high provider uptake drove adoption.	Yes, visit type varied by age, race, gender, and location, with urban advantage.	The technology acceptance model (TAM)	A longitudinal analysis of cross-sectional time-series data, utilizing statistical analyses including time series regression and multiple linear regression	The study focused on access and utilization, but evidence showed telehealth expansion improved mental health service delivery and outcomes.	The COVID-19 pandemic significantly accelerated telehealth adoption in VHA mental health services, shifting care from in-person to video and phone modalities
Telehealth's fulfillment: bridging or exacerbating healthcare disparities among South Florida Haitian immigrant communities	Junior Andre Bastien	2025	1	1	17	1,2,3,4,5	Telehealth is promising for equity; language support, community workers, and education are recommended.	Yes. Low-income Haitian immigrants showed lower video HIV care use, reflecting socioeconomic disparities.	The social determinants of health (SDH) model	A qualitative, multiple-case study methodology using data collected through semi-structured interviews, focus groups, and document analysis. Data analysis employed thematic analysis and methodological triangulation.	Qualitative multiple-case study using interviews, focus groups, and documents; analyzed through thematic triangulation.	Telehealth implementation among Haitian immigrant communities was hindered by language barriers, limited digital access, and cultural factors that reinforced healthcare disparities
The digital health divide: understanding telehealth adoption across racial lines in rural Illinois	Jessica Crowe	2024	1	1	9	1,2,4,5,6, 10	Telehealth reduced rural travel and childcare costs; COVID spurred a sharp uptake.	Yes. Telehealth use varied by race, residence, and age, with urban non-black highest.	Digital health divide and contended that a "smart divide" is looming	Mail survey of residents in Cairo and Carbondale using a Dillman approach	The study examined adoption barriers, while cited research shows that telehealth improves access, quality, safety, and lowers costs.	Telehealth adoption in rural Illinois varies significantly by race and geographic residence, with broadband access and privacy concerns acting as key determinants.
The last mile: COVID-19, telehealth, and broadband disparities in rural Indiana	Kristin Funk	2021	1	1	22	1,2,3	COVID catalyzed telehealth; reduced transport barriers, no-shows, boosted	Yes. Rural telehealth adoption is limited by broadband gaps,	The paper is structured around the concept of a social and health justice issue and promotes	A critical review of the literature method, which included searches of Ebsco databases and the Rural Health Information Hub	The paper reviewed access and disparities, noting that telehealth expanded service delivery and supported	Telehealth expansion during COVID-19 exposed broadband infrastructure gaps in rural Indiana, highlighting internet

							provider confidence, and comfort.	restricting provider participation.	the idea of broadband access as a human right.	database, as well as a grey literature review	urgent health and mental health needs.	access as a social and health equity issue
The impact of mobile health (mhealth) technology on family caregivers' burden levels and an assessment of variations in mhealth tool use	Kathleen L. Frisbee	2015	1	1	22	6	Adoption linked to skills, rural living, spouse status; driven by usefulness, ease; pre-covid.	Yes. App use is higher in rural areas and among spouse caregivers; lower with older veterans.	The stress process model guided the Zarit burden study. The unified theory of acceptance and use of technology (UTAUT) guided the mHealth use study.	The research used a quasi-experimental pretest–posttest design with a nonrandomized control group and a prospective cohort design, applying glm, logistic, and negative binomial regression analyses.	The study found no significant effect of mhealth on caregiver burden, though high burden is linked to greater caregiver morbidity and higher hospitalization risk for care recipients.	The VA mHealth intervention did not significantly reduce caregiver burden, but app use was higher among caregivers with greater computer skills, rural residence, and veterans with mental health diagnoses.
The impact of telehealth on unnecessary emergency department visits among the Medicare dual special needs plan population	Syed Rizwan Rafiq	2025	1	1	15,29	2,5,10	COVID catalyzed telehealth; lower costs, convenience, and travel-free access drove adoption.	Yes, telehealth use is higher among females and under-65s; lowest in 75+, with rural barriers.	A telehealth framework was used to show how interaction and engagement with providers using telehealth can impact emergency department visits.	A quantitative correlational research design employing regression analysis, paired t-tests, and anova tests	The research suggests telehealth may reduce ed visits, lower hospital admissions, and support more timely disease management.	Increased telehealth utilization was associated with reductions in unnecessary emergency department visits among Medicare dual special needs plan beneficiaries.
Usability testing of a bystander bullying intervention for rural middle schools: mixed methods study	Aida midgett	2025	1	1	16,29,23, 11,17,14, 24,13,25, 26,27,28	3,6	Rural adoption driven by perceived usefulness, readiness, and administrative support; not COVID-related.	Rural low-income implementation showed similar usability ratings; demographics inconclusive; staff mostly female.	The study used the persuasive system design framework to adapt the intervention into the stack-t app and applied consensual qualitative research for analysis.	The study used a mixed methods design with surveys and qualitative interviews and focus groups analyzed thematically.	This usability study did not assess health outcomes, but the underlying stack program has been shown to reduce bullying and improve student mental health.	The stack-t technology-based bullying intervention demonstrated high usability, acceptability, and feasibility among rural middle school students and personnel.
Utilization and patient experiences of telehealth among rural Californians	Meghan Elizabeth Ferrara	2023	1	1	2	1,2	Covid accelerated telehealth; rural users valued convenience, cost savings, and access.	Yes. Rural telehealth has lower overall video use, with the lowest among older, Latino, Spanish-speaking, publicly insured patients.	Technology-enhanced strong structuration theory (TESST) and Miles' and Snow's organizational theory of strategic management	The research included a PRISMA-scoping review, a retrospective chart review with statistical analyses, and an interpretive phenomenological study using semi-structured interviews.	The study examined utilization and experiences, while cited evidence indicates telehealth can match or improve clinical outcomes and help reduce rural morbidity and mortality by overcoming access barriers.	Rural telehealth utilization disparities persist, with lower video visit and portal use among older, Latino, Spanish-speaking, and publicly insured patients despite overall positive telehealth experiences.
Electronic Health Record (ehr) Data Quality and Type 2 diabetes mellitus care	Kevin Keith Wiley	2022	1	1	22	1,2,5,6	The adoption and use of telehealth were further accelerated by the COVID-19 pandemic.	Telehealth users are mostly female, black, middle-aged Medicare; portal effects varied by demographics.	The study applied a modified Delone and McLean is success model and established data quality frameworks to measure dimensions such as timeliness and completeness and assess their associations with outcomes.	Outdated primary care lab tests were linked to higher subsequent inpatient hospitalizations and ed visits among patients with t2dm.	Among patients with T2DM, outdated primary care lab tests were associated with increased subsequent inpatient hospitalizations and ed visits.	Variations in ehr data timeliness and completeness are associated with healthcare utilization outcomes in patients with type 2 diabetes, with telehealth and portal use influencing data quality.

Table 3: Legends used for Bibliographic Data Extraxtion.

What types of telehealth interventions were used?	Geographical	Country Level	U.S Distribution
1.Phone 2.Video 3. Web 4. Text 5. Remote Monitoring 6. Portal / App 7. Broadband 8. General 9. VR 10. Smart Tech	1. North America 2. Africa 3. Asia 4. Europe 5. South America 6. Oceania	1 = USA 2 = Canada 3 = Uganda 4 = Ghana 5 = Kenya 6 = South Africa 7 = Malawi 8 = Ethiopia 9 = Nigeria 10 = Zambia 11 = Tanzania 12 = Rwanda 13 = Lesotho 14 = Botswana 15 = Sierra Leone 16 = Cambodia	1 = Arizona 2 = California 3 = Ohio 4 = Colorado 5 = New York 6 = Washington 7 = New Jersey 8 = West Virginia 9 = Illinois 10 = Iowa 11 = Delaware 12 = Kansas 13 = Pennsylvania 14 = Georgia 15 = Massachusetts 16 = Arkansas 17 = Florida 18 = Oregon 19 = Montana 20 = Wyoming 21 = Idaho 22 = Indiana 23 = Alabama 24 = Mississippi 25 = North Carolina 26 = Texas 27 = Tennessee 28 = Maryland 29 = Washington D.C.