THE IMPACT OF TELEHEALTH ON PATIENT OUTCOMES IN RURAL COMMUNITIES: A COMPARATIVE ANALYSIS

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Abstract

Background
Rural communities face challenges in describing and implementing technology interventions for disease treatment and addressing health determinants.

Objective
This study aims to review the current literature on telehealth interventions in rural communities across the United States, focusing on applications, therapeutic areas, and outcomes.

Methods
A narrative review was conducted, examining studies published on PubMed from January 2017 to December 2020. Key search terms included "telehealth," "telemedicine," "rural," and "outcomes."

Results
Out of 15 studies included, 9 focused on telehealth interventions for patients, 3 for healthcare professionals, and 3 for both. The studies generally reported positive outcomes and experiences with telehealth in rural areas, including increased acceptability and satisfaction. Notable benefits observed were decreased direct and indirect costs for patients (e.g., travel expenses and time) and healthcare providers (e.g., staffing), reduced onsite healthcare resource use, improved physician recruitment and retention, enhanced access to care, and increased education and training for both patients and healthcare professionals.

Conclusions
Telehealth models demonstrated positive outcomes for both patients and healthcare professionals, indicating that these models are feasible and effective. Further research is needed to explore telehealth interventions, particularly in rural communities, and to assess the impact of the increased use of telehealth resulting from the COVID-19 pandemic.

Keywords: telehealth, telemedicine, rural health, health outcomes, social determinants of health, eHealth, health care accessibility

Introduction

The healthcare sector is increasingly driven by technology, with telehealth emerging as a prominent method for remote healthcare service delivery. Telehealth enables real-time communication between patients and healthcare providers, offering an alternative model for expanding treatment access and reducing barriers to care, especially in underserved and rural areas. It supports healthy behaviors, condition management, and has shown promising effects such as increased patient participation, satisfaction, and reduced rates of chronic illnesses.

Telehealth Applications

Telehealth provides a convenient way for patients to access healthcare from their homes. For instance, ter Huurne et al. [2] demonstrated through a web-based program that 54% of participants with chronic eating disorders completed all program tasks, leading to significant improvements in BMI, body dissatisfaction, quality of life, and both physical and mental health.

Kruse et al. [3] reviewed literature on telehealth and patient satisfaction, finding that telehealth decreases travel time, enhances communication with providers, increases access to care, boosts self-awareness, and empowers patients to manage chronic conditions. Benefits from a healthcare system perspective include fewer missed appointments, reduced wait times, decreased readmissions, better medication adherence, and improved quality and timeliness of care. Telehealth also serves as an effective educational tool.

In rural areas, telehealth addresses physician shortages and burnout. Ward et al. [4] reported that 75% of rural family physicians cover local emergency departments, a condition that may deter practice in these areas. Telemedicine can alleviate this issue by enhancing physician recruitment and retention.

Challenges in Rural Areas

Rural residents often face significant health disparities, including limited healthcare access, long travel distances for care, and delayed treatment until emergencies arise. These challenges result in poor health outcomes and impose economic burdens on both patients and the healthcare system, such as travel costs, lost work hours, and increased caregiver or childcare expenses.

Gaps and Opportunities

Despite the benefits, the literature on telehealth effectiveness remains ambiguous, with many interventions unverified. There are gaps in understanding the design and impact of technology interventions in rural settings, which is crucial for developing future interventions and policies. This study defines telehealth broadly to include telehealth, telemedicine, mobile health, and digital health solutions such as electronic health records, artificial intelligence, videoconferencing, wearables, and remote monitoring tools.

Objective

The objective of this study is to review and evaluate the literature on the current applications,

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therapeutic areas, and outcomes of telehealth interventions in rural communities across the United States. This synthesis is essential for guiding future telehealth interventions and policy development.

Methods

For this narrative review, we searched PubMed MEDLINE from January 2017 to December 2020. Key search terms included ("telehealth" AND "telemedicine"), "rural" AND "outcomes." Filters were applied to identify free full-text studies published in English over a 4-year period to include the most recent evidence available in this research area. We included randomized controlled trials, mixed methods studies, qualitative studies, post hoc analyses, and prospective and retrospective cohort studies. Included studies contained at least one type of telehealth service and one primary measurable outcome and were assessed in rural communities/settings. We excluded systematic reviews, meta-analyses, editorials, conferences, unpublished studies and abstracts, studies outside the United States, and articles that were missing criteria based on the Critical Appraisal Skills Programme criteria. The Critical Appraisal Skills Programme has developed a set of 8 critical appraisal tools to assess the quality of evidence-based research; they have been widely used in previous studies [5].

To organize our review of the literature, we used Covidence, a review management tool, to conduct a review of titles and abstracts, and a full review of the articles. We used Covidence to exclude duplicate records. Both authors screened studies for relevance based on titles and abstracts. Both authors reviewed the full-text articles of relevant articles for study inclusion. Article discrepancies on study inclusion were resolved through formal discussion and consensus between the two authors. The Critical Appraisal Skills Programme checklists [6] were used to assess the quality and content of the articles. Additionally, we examined the reference lists of all included articles for other relevant references. Figure 1 outlines the article review process. We excluded articles due to irrelevance (n=13), wrong study design (n=8), wrong intervention (n=1), and wrong outcomes (n=1). We extracted the following information from each article: study design, telehealth type, therapeutic area, population, risk of bias, key message, and the primary outcome. We grouped the articles according to study population into the following categories: health care professionals, patients, and health care professionals and patients. This narrative literature review was exempt from ethics review as no human participant protection was required because no human participants were involved in this research.

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Figure 1
PRISMA flow diagram. PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Results

Overview

A total of 38 eligible articles were identified, of which 15 reported telehealth intervention outcomes and were included. The therapeutic areas examined included mental health (n=3), HIV

(n=2), reproductive care/women's health (n=3), osteoporosis (n=1), orthopedics (n=1), acute ischemic stroke (n=1), cancer (n=1), substance use disorder (n=1), ophthalmology (n=1), and emergency medicine (n=1). The majority of the studies (n=9) analyzed telehealth interventions in patients, followed by health care professionals (n=3) and both patients and health care professionals (n=3). Of the patient-centered studies, two studies were specific to veterans, two to Medicare beneficiaries, and one to Medicaid beneficiaries. Table 1 outlines the characteristics the studies included in this review. The outcomes of these studies were focused on the following main themes: feasibility and acceptability of telehealth, diagnostic and treatment validation of telehealth, patient satisfaction and self-confidence, education and training, and telehealth design features including prevalence and access, type of service, and therapeutic area.

Table 1
Characteristics of the studies included in the review.

Study	Study design	Telehealth type	Therapeutic area	Outcomes	Risk of bias
Ward, 2018 [4]	Mixed methods	Tele-ED (emergency department)/telemedicine	Emergency medicine	Feasibility and acceptability	Medium
Hicken, 2017 [7]	Randomized	Internet and telephone-based care	Mental health	Feasibility and acceptability	Low
Stringer, 2018 [8]	Mixed methods	Electronic adherence monitor	HIV	Feasibility and acceptability	Low
Uscher-Pines, 2019 [9]	Randomized	Telelactation/telehealth	Reproductive care/women's health	Feasibility and acceptability	None
Huskamp, 2018 [10]	Retrospective	Tele–substance use disorder/telemedicine	Substance use disorder	Telehealth use	None
Mehrotra, 2017 [11]	Retrospective	Telemental/telemedicine	Mental health	Telehealth use	None
Sinha, 2019 [12]	Qualitative	Telemedicine	Orthopedics	Patient satisfaction	Low
Brecthel, 2018 [13]	Retrospective	Telestroke Network	Acute ischemic stroke	Diagnostic validation	Low
Kapinos, 2019 [14]	Post hoc analysis	Telelactation	Reproductive care/women's health	Design and demand	None
Talbot, 2019 [15]	Retrospective	Telehealth	Mental health	Prevalence, diagnosis, and type of service	Low

Study	Study design	Telehealth type	Therapeutic area	Outcomes	Risk of bias
Lewiecki, 2017 [16]	Prospective	TeleECHO	Osteoporosis	Acceptability and self-confidence	Medium
Moeckli, 2017 [17]	Mixed methods	Extension for Community Health Outcomes (ECHO)/telemedicine	HIV	Application and acceptability	Low
Gilbertson-White, 2019 [18]	Mixed methods	Oncology Associated Symptoms and Individualized Strategies (OASIS)	Cancer	Patient needs and satisfaction	Low
Liu, 2019 [19]	Qualitative	Teleophthalmology	Ophthalmology	Feasibility and acceptability	None
Demirci, 2018 [20]	Qualitative	Telelactation/telemedicine	Reproductive care/women's health	Feasibility and acceptability	Low

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Patients

Of the nine studies that analyzed telehealth interventions in patients, three (33%) of them examined the feasibility and acceptability of telehealth. These studies demonstrated that internet, electronic adherence monitors, and telelactation are feasible and accepted in rural, underserved populations and improve access to care (Table 2). The disadvantages were the following: comparative effectiveness outcomes were not different between caregivers receiving technology interventions and those receiving telephone-delivered support, results were not statistically significant in detecting differences in breastfeeding duration and exclusivity, and technological difficulties, such as loss of connectivity [7-9].

Table 2

Key messages from included studies.

Study	Key message
Ward, 2018 [4]	Telemedicine led to decreased staffing costs and improved physician recruitment and retention.
Hicken, 2017 [7]	Technology demonstrated feasibility and acceptability for delivering caregiver support to a group of largely older, rural, spousal caregivers of veterans with dementia.
Stringer, 2018 [8]	Electronic adherence monitor is acceptable and feasible in a rural US setting, but technological difficulties were present and may impede effectiveness.

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Study	Key message
Uscher-Pines, 2019 [9]	Telelactation participants were breastfeeding at higher rates and telelactation can be implemented in a rural underserved population.
Huskamp, 2018 [10]	There were low use rates of tele–substance use disorder (Tele-SUD) overall. Future studies should evaluate the effect of Tele-SUD on access and outcomes.
Mehrotra, 2017 [11]	States with a telemedicine law and a pro–telemental health regulatory environment had significantly higher rates of telemental health use.
Sinha, 2019 [12]	Telemedicine visits decreased indirect and direct costs, reduced travel time, and resulted in similar patient satisfaction.
Brecthel, 2018 [13]	Telestroke provides less restrictive criteria for clinical risk factors associated with the inclusion of hypertensive patients with stroke for thrombolysis.
Kapinos, 2019 [14]	Telelactation showed both demand for and positive experiences with telelactation in an underserved population.
Talbot, 2019 [15]	Rural Medicaid beneficiaries were more likely to use telehealth services than their urban counterparts, but absolute rates of telehealth use were low.
Lewiecki, 2017 [16]	TeleECHO showed substantial improvement of self-confidence in 20 domains of osteoporosis care and can improve osteoporosis care with greater convenience and lower cost than referral to a specialty center.
Moeckli, 2017 [17]	There was limited uptake of HIV Extension for Community Health Outcomes (ECHO) telemedicine in settings where veterans traveled to distant specialty clinics. Other telemedicine models should be considered for HIV care.
Gilbertson-White, 2019 [18]	Oncology Associated Symptoms and Individualized Strategies (OASIS) is easy to use, contains relevant content, and has pleasing graphics. Rural stakeholders perceived OASIS positively.
Liu, 2019 [19]	Patients and primary care providers have limited familiarity with teleophthalmology for diabetic eye screening and primary care providers reported difficulties with use.
Demirci, 2018 [20]	Telelactation was convenient and efficient, was accepted in rural areas lacking breastfeeding support services, increased maternal breastfeeding confidence, and showed several advantages over in-person and telephone-based support. Telelactation appears to be an acceptable delivery model for lactation assistance in rural areas.

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A total of two studies examined the outcomes of telehealth use in Medicare patients with substance use disorder (SUD) and mental health disorders, designated as Tele-SUD and telemental, respectively. Huskamp et al [10] concluded that Tele-SUD has low use rates and is primarily used to complement in-person care and is disproportionately used by those with relatively severe SUD. Mehrotra et al [11] concluded that beneficiaries who received a telemental visit were more likely to be younger than 65 years old, be eligible for Medicare because of disability, and live in a

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relatively poor community; in addition, states with a pro–telemental health regulatory environment had significantly higher rates of telemental health use than those that did not.

The outcomes of the other four patient-centered studies included patient satisfaction, diagnostic validation, design and demand, and prevalence, diagnosis, and type of service. The advantages of telemedicine visits found in these studies included the following: decreased indirect and direct costs, lower travel costs and travel times, similar patient satisfaction compared to onsite visits, and patient satisfaction among telelactation users [12-14]. In addition, telestroke technology provides less restrictive criteria for clinical risk factors associated with the inclusion of hypertensive patients with stroke for thrombolysis [13]. Talbot et al [15] concluded that rural Medicaid beneficiaries were more likely to use telehealth services than their urban counterparts, psychotropic medication management was the most prevalent use of telehealth, the proportion of users who accessed nonbehavioral health services through telehealth was significantly greater as rurality increased, and significantly higher proportions of telehealth users received services to address attention deficit hyperactivity disorder. There were no direct disadvantages reported in these four studies.

Health Care Professionals

A total of three studies analyzed telehealth interventions in health care professionals and reported outcomes. Lewiecki et al [16] examined the acceptability of TeleECHO and found that self-confidence in 20 domains of osteoporosis care showed substantial improvement. In addition, they determined that TeleECHO can contribute to alleviating the osteoporosis care crisis by leveraging scarce resources; providing motivated practitioners with the skills to provide better skeletal health care, closer to home, with greater convenience; and being lower cost than referral to a specialty center. Additionally, TeleECHO can be applied to any location worldwide with internet access, allowing access in local time zones and a variety of languages [16].

Another study examined the application and acceptability of a telemedicine intervention called HIV ECHO. Moeckli et al [17] showed a limited adoption of ECHO, which was attributed partly to shifting ownership of care from HIV specialists to primary care providers (PCPs) and low HIV prevalence and long treatment cycles that prevented rapid learning loops for PCPs. More specifically, there was limited uptake of HIV ECHO telemedicine programs in settings where veterans historically traveled to distant specialty clinics [17]. The third study evaluated the feasibility and acceptability of a technology intervention for emergency departments, Tele-ED. Ward et al [4] concluded that Tele-ED hospitals tended to have decreased ED staffing costs—while the hospitals not applying this policy showed continually increasing staffing costs over time—and improved physician recruitment and retention. The only disadvantage to the study was limited uptake of Tele-ED (7/19 hospitals, 37%); however, these results conclude that more hospitals will likely use telemedicine to provide physician backup for advanced practice providers staffing the ED [4].

Patients and Health Care Professionals

A total of three studies analyzed telehealth interventions in patients and health care professionals. Gilbertson-White et al [18] examined patient needs and satisfaction with an electronic health tool, Oncology Associated Symptoms and Individualized Strategies (OASIS), and concluded that the

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web application is easy to use, contains relevant content, has pleasing graphics, and was perceived positively. There were infrequent users of OASIS in the group; however, both frequent and infrequent internet users positively evaluated the web application [18]. Liu et al [19] tested the feasibility and acceptability of teleophthalmology and concluded that patients and PCPs have limited familiarity with teleophthalmology for diabetic eye screening. A major disadvantage to teleophthalmology was that PCPs reported significant difficulty identifying when patients are due for diabetic eye screening and could not sufficiently initiate referrals [19].

Another study examined the feasibility and acceptability of telelactation. The advantages of telelactation were as follows: convenient and efficient, provided a needed service in rural areas lacking breastfeeding support services, and increased maternal breastfeeding confidence [20]. The barriers to use included maternal reluctance to conduct video calls with an unknown provider, preference for community-based breastfeeding resources, and technical issues, including limited Wi-Fi in rural areas [20].

Discussion

Principal Findings

This literature review reveals that telehealth is utilized for a range of disease states and rural populations throughout the United States. Health technology interventions play a crucial role in rural healthcare by reducing staffing costs, travel expenses, and travel time while enhancing residents' access to care, including specialty services, which may otherwise be unavailable in remote areas. The review examined various telehealth models, including those for clinical use, healthcare professional and patient education, and preventive and primary care services. All these models demonstrated feasibility and acceptability in rural populations, underscoring their potential to enhance outcomes and access to care.

The reviewed studies generally reported favorable outcomes and experiences with telehealth in rural settings, highlighting benefits such as increased acceptability, satisfaction, convenience, and efficiency. Notable advantages included reduced direct and indirect costs for patients (e.g., travel expenses and time) and healthcare providers (e.g., staffing), lower onsite healthcare resource utilization, improved physician recruitment and retention, and enhanced education and training for both patients and healthcare professionals.

However, telehealth interventions also faced challenges, such as dealing with unknown providers during tele-visits and technological issues like connectivity problems and limited Wi-Fi access in rural areas. Some studies noted that comparative effectiveness outcomes between telehealth and traditional visits were not statistically significant, but telehealth technology was still well-received and effectively implemented in underserved populations. These studies also highlighted the need for further testing of various technology interventions to determine which telehealth programs are most effective.

The review emphasizes that feasibility and acceptability are essential for implementing new health technologies. It shows that rural populations and underserved communities are capable of successfully adopting telehealth, with reported satisfaction and perceived effectiveness. Even

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when telehealth programs did not show statistical significance, their feasibility and acceptability were evident. Issues commonly associated with technology, such as lack of Wi-Fi and connectivity problems, were reported less frequently than anticipated, suggesting successful implementation is possible.

A significant finding of this review is the need to evaluate different telehealth programs to identify the most effective models for specific communities. For example, diagnostic telemedicine and telehealth video calls may have different benefits depending on the setting and population. It is crucial to go beyond feasibility and acceptability to ensure telehealth programs are utilized to their full potential and tailored to community needs.

Although no studies focused primarily on telehealth use for COVID-19 met the inclusion criteria, the pandemic has accelerated telehealth adoption and may have mitigated some barriers to its use. Future reviews should investigate the impact of the COVID-19 pandemic on telehealth in rural communities.

Additionally, administrative regulations and reimbursement policies are crucial for telehealth programs, particularly in areas where state enforcement is lacking. Ensuring insurance coverage for telehealth services is essential for improving access in rural communities, which often face resource and staffing limitations. This review underscores the need for further research on telehealth programs and their long-term outcomes. Evidence-based studies are needed to establish their significance and comparative effectiveness against traditional healthcare services. Moreover, updating policies and securing funding for research are vital to enhancing telehealth access and quality of care in rural, underserved communities.

Limitations

This narrative review has several limitations. Firstly, there is a potential for publication bias, as we relied solely on PubMed MEDLINE and excluded grey literature such as reports, government documents, working papers, white papers, and evaluations. Including additional databases could have provided more articles for consideration. Secondly, by restricting our search to the past four years, we excluded earlier publications and data on health technology interventions and outcomes. However, the focus of this review was to present the most recent advancements in telehealth programs. Lastly, our review was limited to rural communities in the United States, making the findings not generalizable to non-US territories, urban communities, or populations affected by COVID-19. Despite these limitations, the study's findings are applicable to rural, underserved populations and potentially to the clinical settings and therapeutic areas examined in the reviewed articles..

Conclusion

This review examines the current application of telehealth interventions in rural areas across the United States. It identifies positive outcomes for both patients and healthcare professionals, indicating that these models are effective for ongoing education and training in various settings. However, the review's findings are limited to rural domestic communities and focus on specific therapeutic areas. The evidence reinforces the need to expand and validate telehealth interventions and to update and implement policies that enhance access to high-quality telehealth programs. Further research and intervention in rural communities are recommended, particularly to assess the impact of increased telehealth usage due to the COVID-19 pandemic.

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