Stroke

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Telehealth Trials to Address Health Equity in Stroke Survivors

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ABSTRACT: Telehealth has seen rapid expansion into chronic care management in the past 3 years because of the COVID-19 pandemic. Telehealth for acute care management has expanded access to equitable stroke care to many patients over the past two decades, but there is limited evidence for its benefit for addressing disparities in the chronic care of patients living with stroke. In this review, we discuss advantages and disadvantages of telehealth use for the outpatient management of stroke survivors. Further, we explore opportunities and potential barriers for telehealth in addressing disparities in stroke outcomes related to various social determinants of health. We discuss two ongoing large randomized trials that are utilizing telehealth and telemonitoring for management of blood pressure in diverse patient populations. Finally, we discuss strategies to address barriers to telehealth use in patients with stroke and in populations with adverse social determinants of health.

GRAPHIC ABSTRACT: A graphic abstract is available for this article.

Key Words: health equity ■ outcomes ■ prevention ■ stroke ■ telehealth

Telemedicine has been essential to efficient, accessible acute stroke care for decades.[1] Through expansion of reimbursement through the Furthering Access to Stroke Telemedicine (FAST) Act, and inclusion of telemedicine in the response to the COVID-19 public health emergency, the utility and availability of telehealth has been expanded across the continuum of stroke care. However, widespread use has highlighted both benefits and barriers to use for addressing disparities in care. While acute stroke evaluation via telemedicine may alleviate disparities in stroke care,[2,3] ambulatory telemedicine is less widely used by underserved populations including Medicaid, low-income, rural, Black, and low English proficiency patients across multiple studies both before and during the pandemic.[4–6]

See related articles, p 374, p 379, p 386, p 407

Trials evaluating the use of telestroke have traditionally focused on the acute stroke evaluation. In-hospital outcomes are easily evaluated in acute telestroke, and trials have shown increased thrombolytic use and support for development of inpatient stroke units.[7] There are very few studies that have looked at long-term clinical outcomes after telestroke evaluation, but there appears to be no significant difference in mortality or functional status at 6 months compared to in-person stroke care.[8,9] Use of ambulatory telemedicine in multiple neurologic subspecialties has demonstrated diagnostic accuracy and similar or increased patient and caregiver satisfaction compared to in-person visits, but clinical outcomes have been lacking.[10]

A recently published review, *Moving Towards Equity with Digital Health Innovations for Stroke Care,* provided an overview of the use of digital health technologies across the continuum of stroke care, from primary prevention to stroke recovery.[11] Authors review potential benefits and barriers to equity, and provide examples of digital health solutions for each phase of stroke care using clinical vignettes. In this article, we delve further into the current evidence and ongoing trials addressing health equity in telehealth delivery to stroke survivors, with an emphasis on early poststroke care and chronic care for secondary stroke prevention. We use a broad view of telehealth, but focus on care delivery through virtual and telephonic care, asynchronous care, and digital tools involved in the care of chronic illness. We begin with a discussion of the impact of telehealth on disparities in acute stroke care and transition to a discussion of telehealth use for

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the ambulatory management of patients with neurologic and non-neurologic chronic disease. We follow this with a discussion of advantages and barriers to telehealth in stroke survivors, while highlighting factors related to racial, ethnic, socioeconomic, and urban/rural disparities in stroke outcomes. We review specific ongoing trials in stroke populations and conclude with a discussion of strategies to address barriers in telehealth use for chronic stroke care.

TELEHEALTH AND DISPARITIES IN ACUTE STROKE CARE

Racial disparities in acute stroke care have been observed as delays in treatment times and lower rates of thrombolysis and underutilization of mechanical thrombectomy in Black and Hispanic adults compared to Non-Hispanic White adults.[12–14] Data suggest that organized systems of care reduce disparities in stroke care.[15] Telestroke has been shown to improve overall access to acute stroke therapies for groups with lower access, however recent studies on the impact of telestroke on racial disparities in acute stroke care have shown mixed results. In a recent large retrospective study of rates of thrombolysis and thrombectomy within a telestroke network, there were no racial disparities in access to acute therapies nor delays in care when time to treatment metrics were analyzed.[3] A similar retrospective review of a different telestroke network, however, found that White stroke patients were more likely than Black stroke patients to receive thrombolysis and among those treated with thrombolytics, White patients were more likely to have shorter door to needle times.[16] It is still unclear if telehealth can address health equity, or if it can widen disparities in some instances. Lyerly et al[2] published the results of a study of statewide access to acute stroke care and found that adding telestroke services increased access to acute care for all racial groups while not worsening any racial disparities in access to primary stroke centers. As recent research has focused on the causes of racial disparities in stroke outcomes, large studies are still needed to confirm a positive impact of telestroke in this area.

Few studies have reported on the impact of telestroke on gender disparities in acute stroke care. Women have been reported to have lower rates of treatment with acute stroke therapies. However, studies in multiple telestroke networks have shown no difference in acute treatment between sexes.[17,18]

Expansion of telestroke has been expected to address geographic disparities, particularly for rural communities. Seabury et al[19] conducted a study on system factors associated with disparities in stroke care in metropolitan and non-metropolitan hospitals. They simulated the impact of incorporating telemedicine services into care at a rural hospital and concluded that telemedicine would likely improve rates of thrombolytic administration. Similar findings were published from the REACH-MUSC study, which showed increased access to thrombolytic therapy after initiation of a telestroke network in rural regions.[20]

Taken together, the available data suggest that telestroke has increased access to acute stroke care for populations at risk for poor outcomes. To our knowledge, no studies have shown an increase in treatment disparities with acute telestroke and some have shown mitigation of racial disparities. Beyond the use of telemedicine for acute stroke care, the use of telehealth applications for expanding access to other aspects of stroke patient care and for reducing disparities in stroke outcomes has been under-studied. Evidence for use and potential benefits of telehealth for ambulatory stroke care can be gathered from data in other populations, as discussed in the next section.

TELEHEALTH IN OTHER CHRONIC DISEASES

During the COVID-19 pandemic, telehealth emerged as a potential solution for expanding access to ambulatory care for patients with chronic diseases. However, telehealth use for chronic disease management has existed for many years, with the best example being in the US Veteran's Health Administration Telehealth service program.[21] More than 70 000 veterans receive primary and specialty care through this program, which has been previously cited as one of the world's largest telehealth programs. Here we sought to evaluate evidence for benefit of ambulatory telehealth care within and outside of the Veteran's Health Administration in heart failure (HF), diabetes (DM), Parkinson's disease (PD), and neurocognitive disorders.

Some of the most robust data for use of telehealth to improve outcomes in chronic disease populations comes from the HF literature. A 2020 network meta-analysis of 29 randomized controlled trials (RCTs) and nearly 11 000 participants compared effectiveness of telemedicine (telemonitoring or structured telephone support with interactive vocal response) to standard care in adults with HF and found that telemedicine was more effective than standard care for reducing all-cause and cardiac-related hospitalization, and all-cause mortality.[22] While trials addressing health disparities are sparse, some trials have focused on primarily Black and/or Hispanic populations. A randomized trial compared telehealth self-management to standard outpatient management in 104 Black and Hispanic patients living with heart failure and found no significant between-group differences for 90-day health care utilization, quality of life (QoL), or depression.[23] In a multicenter randomized controlled trials focused on patients wit acute HF discharged directly from the ED, 63% of participants were Blacks, and 77% of participants were considered "vulnerable" according to race/ethnicity, health literacy, or socioeconomic disadvantage.[24] The telehealth intervention added self-care coaching sessions via telephone to the usual care received by the control group. While there were no significant between-group differences in the primary outcome (composite of cardiovascular death and HF-related events, and health status/QoL) at 90 days, at 30 days the intervention group demonstrated significantly better composite scores and health status/QoL in comparison to the control group.[24]

Telehealth interventions for DM primarily focus on self-management of glycemic control. A systematic review and meta-analysis, which included an analysis of 29 unique RCTs from four systematic reviews, concluded that compared to standard care, telehealth interventions resulted in small but significant improvements in HbA1c levels.[25] Heitkemper et al[26] conducted another systematic review (n=13 RCTs) and meta-analysis (10 RCTs) of the impact of health information technology interventions on glycemic control in medically underserved adults with DM (74% racial-ethnic minorities). They reported small but statistically significant improvements in glycemic control at 6 months that diminished but remained significant at 12 months. These improvements were similar in the in-person treated patients. Of the remote technology-based interventions, those that included interactive telemedicine were most effective.[26]

In consideration of poststroke sequelae of impaired mobility and cognition, we examined evidence regarding telehealth usage in PD and neurocognitive disorders.

For PD, a 12-month long study with 195 individuals compared four telehealth-based neurologist virtual visits (in addition to usual care) with usual care for primary outcomes of PD-specific QoL and feasibility. While the trial was deemed feasible, saving time and travel for participants, the there was no significant difference between groups for the QoL measure (MD=0.3 [95% CI, −2.0 to 2.7]; *P*=0.78). In a sample of US military veterans (n=90) with PD and depression, the virtual cognitive behavioral therapy group demonstrated statistically significant improvements in depression measures compared to usual care.[27] These improvements were evident immediately after the 10 weeks of the intervention and were sustained at 6-month follow-up.[27] While racial and ethnic disparities in PD management have been reported, we did not find any trials focused on addressing health disparities, or trials conducted in primarily medically underserved populations.[28,29]

Remote assessments for neurocognitive disorders with instruments such as the Telephone Interview for Cognitive Status, Montreal Cognitive Assessment, the Mini-mental State Examination, and the Boston Naming Test have demonstrated feasibility and utility.[30,31] A 2021 Cochrane review, which included 3 studies and a total of 136 participants, found that compared with face-to-face assessment, telehealth assessment demonstrated accuracy (sensitivity and specificity ≥0.80) for diagnosing dementia and mild cognitive impairment (sensitivity 0.71, specificity 0.73), but estimates for both diagnoses were considered imprecise due to risk of bias, small sample sizes, and heterogeneity between studies.[32] Similar results regarding telehealth assessment accuracy and reliability have been reported in 2 additional systematic reviews with meta-analyses, while also noting similar limitations including heterogeneity of data,[30] and the need for further studies comparing telephone to face-to-face assessments.[31] High-speed network connections are associated with improved accuracy,[30] while tests that have a motor component (eg, Mini-mental State Examination, Clock Drawing Tests) may negatively impact accuracy when compared to tests with only verbal responses.[30] Other barriers include participant sensory impairment, lack of technological access or literacy, and loss of nonverbal cues, especially for telephone assessments.[31]

Telehealth is increasingly used in the ambulatory management of patients with neurologic and non-neurologic chronic diseases. While several studies across chronic disease states show either no differences or improvements in outcomes with use of telehealth compared to in-person care, there have been few studies focused on addressing health inequities in populations at highest risk for poor outcomes. Future studies in these chronic disease populations should be conducted in socially high-risk populations to determine whether telehealth can be useful for expanding access to and decreasing disparities in racial and ethnic groups.

POTENTIAL ADVANTAGES OF TELEHEALTH FOR POSTSTROKE CARE

Despite decreased stroke incidence over the past two decades, aging of the US population and declines in stroke mortality are expected to lead to an increase in stroke prevalence in the coming years.[33] By the year 2030, it is projected that nearly 4% of the US population will have had a stroke.[34] The prevalence of stroke is expected to increase most dramatically in Hispanic and Black groups in the United States.[34] With these projected increases in stroke prevalence, the remaining extensive gaps in approaches to transitions of care, early post-hospital care, and chronic care of stroke survivors become even more important. Ninety-day readmission rates following acute stroke are as high as 23.4% for patients discharged home following acute inpatient rehabilitation and 19.6% for patients discharged home with home health.[35] Stroke risk factors, including hypertension, atrial fibrillation, diabetes, and dyslipidemia remained inappropriately managed or poorly controlled for many stroke survivors, leading to increased risk for recurrent stroke.[36–39] Stroke sequelae, including physical disability, depression and anxiety, cognitive impairment and sleep disorders profoundly impact quality of life in stroke survivors, yet are often underrecognized and undertreated.[40–42] Racial and ethnic disparities exist in the control of each of the aforementioned stroke risk factors, as well as stroke recurrence and stroke morbidity.[43–51] Novel interventions are urgently needed to address these extensive gaps in care.

The use of telehealth in transitional care and post-stroke care has potential to address gaps of care in stroke survivors who may face unique challenges compared with other patients with chronic disease (Table 1). The same stroke sequelae that impact quality of life in stroke survivors may also impact their ability to access care. Many stroke survivors may have physical disability including hemiplegia/hemiparesis, ataxia, or other impairments contributing to impaired mobility following stroke.[52] These mobility requirements may make it difficult to travel to a doctor's office because of the need for special vehicles, assistance with transfers, or assistance navigating in an outpatient clinic. Stroke survivors may rely on others for transportation not only because of physical immobility, but also because of cognitive impairment, impaired vision, or other imposed driving restrictions after stroke. The need for transportation to visits may serve as an additional barrier to attend in-person visits. With limited access to stroke subspecialists in many regions, going to in-person appointments may involve traveling long distances.[53] Remote care, especially in home, is an appealing solution to these barriers to care. Additionally, stroke survivors who transition to skilled nursing facilities or inpatient rehabilitation centers could also benefit from remote neurology follow-up visits. These early postdischarge visits may be essential for preventing readmission, ensuring adherence to medication and other treatment regimens, and enabling further testing when needed. Care coordination between the hospital, rehabilitation facility, and neurologist, such as that provided by a social worker case management system, could prevent missed appointments and lessen time away from rehabilitation sessions.[54]

Multidisciplinary models of transitional care and post-stroke care have shown potential for improving post-stroke outcomes[55]; however, implementation is limited by some of the aforementioned patient-level barriers to in-person care.[56,57] Delivery of outpatient care through telemedicine has the potential to address these barriers by

Table 1. Advantages and Barriers to Telehealth Use to Address Disparities in Stroke Outcomes

	Telehealth advantage	Telehealth barrier
Stroke complications		
Stroke disability Physical weakness and gait impairment Impaired vision Cognitive Impairment	Addresses barriers related to mobility challenges and special equipment needed to access clinic spaces Obviates need for help with transportation when there are driving restrictions	Impaired ability to independently manage telehealth or telemonitoring equipment because of weakness, incoordination, visual impairment, or cognitive impairment
Poststroke care provided by multiple disciplines Primary care Neurology Cardiology Rehabilitation specialists Psychologists	Decreases number of in-person visits Opportunity for multidisciplinary visits over telehealth Opportunity for remote monitoring of blood pressure, cardiac arrhythmias	Inability for providers to complete comprehensive physical assessment (neurologic/cardiac) Need for patients to navigate different platforms Need for providers to have access to the same telehealth platforms
Social determinants of health		
Economic instability	May address costs related to transportation to visits, parking, missed days of work for patients and/or caregivers	Inconsistent access to phone and internet services because of affordability/competing needs Housing insecurity or homelessness limiting ability to attend private visits
Geographic location (urban/rural)	Addresses barriers associated with distance to providers, access to specialist clinics, and transportation to clinics via bus or train in urban areas	Inconsistent access to internet because of limited broadband access and/or inner city/rural dead zones
Low educational attainment	Ability to reinforce health-related information using mhealth and telehealth tools	Impaired digital literacy limiting ability to connect to telehealth visits, utilize patient portals, or troubleshoot challenges when they arise
Limited english proficiency	May increase access to language concordant providers	Telehealth platforms, patient portals, and telemonitoring tools must be structured to accommodate patients with different language preferences
Limited social support	May increase access to care for patients with limited support systems/caregivers for transportation to visits	Limits access for patients who need assistance with telehealth visits

removing the need for a patient to be moved from their physical space, and for some patients, by removing the need for a caregiver to be present. In addition, with multidisciplinary needs following hospitalization, telemedicine has the potential to assist with merging visits from providers to optimize care.

Stroke survivors with a higher proportion of adverse social determinants of health, including economic instability, low educational attainment, low health literacy, and low levels of social support, may have even further limited access to poststroke care. Costs associated with travel to in-person visits, missed days of work for appointments (for patients and/or caregivers) cannot be underestimated for individuals with economic instability who may have missed days of work for a stroke hospitalization. Differences in care access related to these social factors may help to explain racial and ethnic disparities in stroke outcomes.[58] Telehealth may help to address access related issues and therefore holds promise for addressing disparities in stroke outcomes.

BARRIERS TO TELEHEALTH USE IN STROKE SURVIVORS AND SOCIALLY HIGH-RISK GROUPS

Despite the demonstrated benefits for telehealth use in the acute care of stroke survivors, and the potential benefits for transitions of care and chronic care, there are additional barriers to use of telehealth in the outpatient population compared to acute care (Table 1). In fact, many of the advantages to telehealth in stroke survivors also highlight the barriers to care delivered by technology. Telestroke in its original form—delivery of remote acute stroke evaluation—includes built in infrastructure support, with continuous internet coverage to ensure connection, bedside health care providers to assist with communication and examination, and often available real time technical support for both sides of the consultation. Outpatient care delivery via telehealth, especially when conducted with the patient in their home, requires the patients or caregivers to be able to utilize technology in a way that is typically not required for acute stroke care. The need for a patient to access care via telehealth requires digital literacy, consistent telephone and internet access, and increasingly, the ability and willingness to engage with the electronic medical record through patient portals.

Digital literacy is essential to effectively and efficiently use telehealth. Digital literacy is defined by the American Library Association as "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills." According to a US Department of Education Report, 16 % of adults (31.8 million) lacked the technical competence to use a computer (US Department of Education on literacy, 2018).[59] Black, Hispanic, and foreign-born adults and those who were older, less educated, and work in lower-skilled jobs were identified in the report as lacking digital literacy. While we did not find studies evaluating digital literacy in the stroke population, we found studies evaluating a proxy for digital literacy, specifically internet use, among patients with cardiovascular disease. A study conducted in an outpatient population of patients with cardiac disease showed lower internet use in patients who were older and less educated.[60] Another study evaluating internet use among patients followed in a stroke clinic and their caregivers showed higher internet use in caregivers compared to stroke survivors.[61] Younger and Non-Hispanic White participants reported higher usage of internet compared to older, Hispanic, and Black participants. In a different study comparing internet use in a nationally representative sample of individuals with and without stroke, the overall prevalence of internet use among stroke survivors was much lower than that among non-stroke individuals (57.8% versus 84.3%) but was comparable for women and men.[62]

In addition to digital literacy, reliable internet access and affordability are necessary for robust, sustainable, and equitable telehealth care delivery. Limited broadband access remains a challenge faced by many in the United States, especially in rural areas. According to a 2022 report from the NPD Group, a national market research company, only 50% of homes in the United States have a broadband speed of 25 Mbps download or higher, while 34% receive at a speed of <5 Mbps and 15% have no access.[63] The states most affected include some of those with high stroke prevalence, including Mississippi and West Virginia. Consistency of telephone and internet access may also be a barrier. Multiple factors affect the speed and quality of internet connection including location, number of people using the connection, type of device, and transfer technology.[64] Speed also depends on the distance between the terminal device and the network centralizer, the number of devices connected to the internet services at home and other coverage areas, in addition to other factors. The presence of dead zones in rural and urban areas can serve as an additional barrier to accessing telehealth, as dead zones can occur anywhere and prevent Wi-Fi from working correctly.[64] Digital redlining, defined as a "failure to provide service, or the provision of inferior service, to people of color" contributes to disparities in internet access in economically disadvantaged and racial and ethnic minoritized communities.[65] Digital redlining is a systematic and structural process that not only serves as a patient and community-level barrier to digital health access, but as a barrier to telehealth innovation.[66]

The consistency of internet and telephone access may also be impacted by economic instability. Patients with lower income may have difficulties paying bills regularly to maintain access. Currently in the United States, the economic downfall caused by the pandemic and recession have left many people struggling to meet daily needs. As a result, people with low income may forgo utility payments to address immediate life necessities. Black and Hispanic communities have been more impacted by the economic challenges associated with the COVID-19 pandemic, and have seen the highest levels of food insecurity and others indicators of economic instability in the population.[67,68] The differential impact of the pandemic on these communities may contribute to disparities in access to telehealth.

Patient portals are increasingly being utilized as a gateway to ambulatory telehealth access. However, patient portals are underutilized and disparities in portal usage persist. In a systematic review by Zhao et al,[69] a number of barriers to portal use were identified, including perceptions about the portal requiring extra work; feeling that portals represent unwelcome extensions of healthcare, concerns about erosion of personal patient-physician relationships, and mixed or negative attitudes among providers. In addition to patient, caregiver, and provider attitudes and perceptions, interface challenges exist that range from unintuitive design elements creating navigation difficulties to the use of language at a reading comprehension level that is too high for most users.

Multiple studies, conducted prior to and during the COVID-19 pandemic have revealed disparities in portal use based on race, ethnicity, gender, age, and socioeconomic factors. A retrospective study conducted at family medicine clinics over a 5-year period revealed lower portal usage in patients who were male, elderly, in minority groups, or living in rural areas. Individuals with public insurance were less likely to access portals compared to those with private insurance.[70] Another study conducted at Atrium Health Wake Forest Baptist between 2018 and 2019 examined portal use among 178 720 patients. They found that individuals 18 to 64 years of age, females, non-Hispanic Whites, those who were married, commercially insured, had higher disease burden and lower healthcare utilization were associated with portal usage.[71] Nationwide data reported increased portal use during the COVID-19 pandemic; however, available data indicate persistent disparities in portal use.[72]

Provider level barriers to telehealth adoption and use may contribute to disparities in patient access. One study evaluating provider characteristics associated with adoption of virtual healthcare showed that female, primary care (versus surgical care), and behavioral health physicians were most likely to be early adopters of virtual health.[73] In this same study, characteristics of physicians' patients showed a weaker association to early adoption than provider characteristics. However, notably, having a higher percent of patients from a racial or ethnic "minority" group was associated with lower odds of early adoption. It is unclear whether this finding can be attributed to patient or provider level barriers or a combination of these.

Health system barriers and policies around reimbursement for telehealth and telemonitoring may limit telehealth use in certain populations. Hospitals and health systems serving economically disadvantaged groups may not have the resources to invest in the infrastructure necessary for telehealth delivery. Restrictions on reimbursements for telephonic visits compared to video visits may adversely impact patients with impaired digital literacy and limited broadband access. Finally, infrastructure requirements and billing restrictions for remote telemonitoring serve as additional health system barriers for adoption of these technologies.

Stroke sequelae may compound the impact of the aforementioned factors on the ability of stroke survivors to engage in telehealth. Patients with aphasia and hand or arm weakness may have difficulties using smart devices and computers, or require caregiver assistance to log on or engage tech support. Those with poststroke cognitive impairment may have difficulty with the often-complex steps necessary to use the telemedicine portal, or trouble simply remembering usernames and passwords. Beyond poststroke functional limitations, patients with stroke may suffer from loss of work, loss of insurance, and others factors impacted by economic instability (food insecurity and housing insecurity), which may limit access to technology and therefore further limit opportunities to engage in telehealth visits.

ONGOING TELEHEALTH TRIALS FOR OUTPATIENT MANAGEMENT OF STROKE SURVIVORS

There are few published trials focusing on the use of digital technologies and telehealth to improve outcomes in stroke survivors. In the Michigan Stroke Transition Trial, access to web-based stroke-related information was incorporated into a social worker/case management intervention, and both groups were compared to usual care.[54] Access to the website with educational information was associated with increase patient activation and improvements in patient reported physical health scores, but not to improvements in mental health. The PINGS trial (Phone-Based Intervention under Nurse Guidance after Stroke) demonstrated feasibility of an m-health-based, nurse-guided, blood pressure (BP) control intervention for recent stroke survivors in sub-Saharan Africa.[74] A larger randomized trial (PINGS-II) is ongoing.[75] Finally, a recently published pilot trial of telehealth with remote BP monitoring in an underserved population in New York demonstrated potential for impact on BP control in stroke survivors.[76]

Two additional ongoing interventions have been designed to evaluate the utility of telehealth and telemonitoring for (1) improving poststroke care and (2) addressing disparities in poststroke care. The TEAMS-BP trial (Telehealth-Enhanced Assessment and Management after Stroke—Blood Pressure) is a comparative effectiveness trial to determine whether remote transmission of BPs, telehealth management through chronic care management and lifestyle coaching are more effective at lowering systolic blood pressure to <130 mm Hg than more traditional in-person clinic management (NCT 05539443). The trial design is based on the results of the Comprehensive Post-Acute Stroke Services cluster-randomized pragmatic trial, which showed that an individualized care plan for stroke patients in the transition from hospital to home increased the likelihood of self-monitoring of BP at 90 days. Other lessons learned from Comprehensive Post-Acute Stroke Services are that there were a few patient-level barriers that were critical for implementation of the new model of care, but the most important was that transportation and distance from the clinic prevented patients from keeping the appointment to receive the care plan.[53] In addition, there was no impact of the Comprehensive Post-Acute Stroke Services model of care on readmissions at 90 days or 1 year, and this clearly pointed to the fact that stroke care needs to continue beyond the transitional period of the first 30 days post-discharge.[77] The TEAMS-BP intervention spans the first 6 months after discharge, and also includes health coaching to reinforce the care plan with the patient and caregiver over time. The hypothesis, based on successful remote BP management in primary care settings, is that cellular transmission of BPs, physical activity, and self-reported medication adherence monitoring in nearly real time will make medication management of BP more efficient and effective.[78] The telehealth intervention arm will utilize existing chronic care management and remote patient monitoring codes developed by the Centers for Medicare and Medicaid Services (CMS). The pilot feasibility phase is currently underway.

The VIRTUAL study (Video-Based Intervention to Reduce Treatment and Outcome Disparities in Adults Living With Stroke) is a randomized comparative effectiveness trial comparing interdisciplinary poststroke care delivered via telehealth along with remote BP monitoring to best standard care (evidence-supported) for adults discharged home from acute care following stroke or transient ischemic attack (NCT 05264298). Patients have a comprehensive assessment of social determinants of health, and principles of social-risk informed care and social-risk targeted care are applied to address social-risk factors during the clinical encounter.[58] The hypothesis is that these social factors are related to poor BP control and racial and ethnic disparities in BP control. The telehealth visits are attended by the stroke patient (with or without a caregiver), a social worker, a pharmacist, and a neurology provider (nurse practitioner or physician). Data from the remote BP monitor is automatically transmitted to a customized portal, which is used by the pharmacist to adjust the BP according to an established algorithm. Patients who do not have smart devices or internet access to engage in telehealth visits are provided with these tools (tablets and/or modem) as needed. The standard care arm receives enhanced care in accordance with known strategies to reduce BP after stroke. The standard care patients are given outpatient neurology appointments for follow-up (via telehealth or in-person visits according to patient preference), are provided with a BP monitor, and are instructed to monitor and record their blood pressures for monthly review by a pharmacist. The pharmacist communicates blood pressure numbers to the patient's primary care provider, and recommends medication adjustment if the BP is out of goal range (>130/80 mmHg). The primary outcome is ambulatory blood pressure 6 months after stroke with a pre-specified analysis of the impact on the outcomes on disparities in BP control between Non-Hispanic White patients and Black and Hispanic patients. Enrollment began in March 2022, with planned enrollment of 534 stroke survivors.

ADDRESSING BARRIERS TO TELEHEALTH USE IN THE OUTPATIENT MANAGEMENT OF STROKE SURVIVORS

While the outpatient management of stroke survivors through telehealth is prone to multiple barriers, it offers many advantages for addressing health equity in stroke survivors. As such, strategies to address the barriers should be considered (Table 2). Increased access to free or low-cost broadband internet helps to overcome barriers related to limited internet. During the COVID-19 pandemic, federal subsidies were put in place to expand internet access for purposes of school and work. The Affordable Connectivity Program was established in the US in 2021 as a national program offering discounts for internet access as well as discounts toward the purchase of a laptop, desktop computer, or tablet.[79] While patients may have limited knowledge of these programs, social workers or community health workers can be utilized to assist patients with applying for these programs. For patients who do not qualify for discounted programs, mobile hotspots can be provided to assist with engagement in telehealth. Additionally, telehealth outposts, or easily accessible sites equipped with internet and medical technicians or nursing staff, can facilitate telehealth visits with remote providers for patients with limited access.

In addition to improving access to internet for technologies requiring higher bandwidth, another approach to addressing barriers includes developing interventions that utilize technologies requiring cellular service, or lower internet bandwidth. As an example, monitoring

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Table 2. Strategies to Address Telehealth Barriers

Barrier	Strategy
Stroke disability (physical)	Develop telehealth tools to accommodate patients with hemiparesis or in coordination
	Engage informal caregivers and family members to participate in telehealth interventions
Stroke disability (cognitive)	Avoid use of tools (platforms/ monitoring equipment) that require multiple steps for set-up/ or need regular troubleshooting
	Engage informal caregivers and family members to participate in telehealth interventions
Limited access to internet	Utilize social workers or community health workers to connect patients to available federal programs
	Provide mobile hotspot devices to patients with limited Wi-Fi access
	Use community-based telehealth outposts for visits
	Use cellular services for telemonitoring (ie, BP monitoring) instead of services or devices requiring Bluetooth
	Use texting, secure messaging, smart phone applications, and other tools that do not require high-speed internet
Limited digital literacy	Develop digital tools to accommodate patients with impaired literacy or cognitive limitations
	Provide digital literacy training as a component of interventions
	Use digital health navigators
	Include patients with impaired digital literacy in intervention or study design
Limited english proficiency	Develop telehealth platforms, telemonitoring tools, and other digital health tools to accommodate patient and caregiver language preferences

devices that transmit data via cellular towers may make this type of service more widely available to patients in underserved or rural areas as compared to service requiring access to broadband. Similarly, interventions that use texting, smart phone applications, secure messaging, and other solutions that do not require access to high-speed internet may help to address care gaps.

Multiple strategies have been employed to address digital literacy in adult learners, with mixed effectiveness and limitations related to inclusion of elderly patients and those with cognitive impairment.[80–83] To our knowledge, there are no studies addressing digital literacy in stroke survivors. Potential strategies to address digital literacy barriers include (1) developing digital health tools that consider health literacy, age, physical disability, and/or cognitive impairment in their design; (2) providing training or education to populations at risk for low digital literacy; (3) using navigators to assist patients with digital literacy challenges; (4) partnering with organizations with expertise in digital literacy training; (5)engaging in human-centered intervention design whereby patients with limited digital literacy are involved in the development of telehealth interventions.[84,85]

Also, studies focused on implementation science methods could be designed to understand the ideal strategies to increase uptake of new technologies, such as telehealth and mobile health. This approach can provide the evidence for best implementation of technologies to reduce inequities in stroke care in diverse health care and home settings. In addition, use of existing reimbursement codes through CMS, such as chronic care management and remote patient monitoring can provide incentives for health systems by increasing revenue for work that is already being done to review and monitor blood pressures, as well as other measures that can be collected remotely. This could improve stroke prevention for survivors and be a win-win for both health systems and providers.

In conclusion, as remote care modalities expand across the continuum of stroke care, it is essential that systems are built with health equity in mind. With an equity focus, increased availability of outpatient telemedicine for chronic stroke care has the potential to be as paradigm changing as acute telestroke.

ARTICLE INFORMATION

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Disclosures

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