Implementation of a Teleneurology Clinic in Zambia during the COVID-19 Pandemic

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Objective: The objective of this study was to assess the feasibility, acceptability, and benefits of a teleneurology clinic serving adults usually attending a neurology outpatient clinic in Lusaka, Zambia during the coronavirus disease 2019 (COVID-19) pandemic.

Methods: Televisits were offered to patients scheduled for neurology appointments between March and July 2020 using the telephone, WhatsApp video, or Zoom calls based on patient accessibility. Visit outcomes were documented, and patient and neurologist satisfaction surveys were completed.

Results: Of 323 patients, 195 (60%) were reachable by telephone, 179 of these were alive, and 74% (133/179) of those alive agreed to a televisit. Stroke (30%), seizures (20%), and headache (16%) were the most common diagnoses seen via televisit. Most televisits (80%) were by telephone call, 14% by WhatsApp video call, and 6% by Zoom. Nearly one-third (30%) of the patients were stable and discharged from the clinic, 32% only required medication refills, and 19% required an in-person visit. Sixty patients (out of 85 reachable and 71% response rate) and 7 of 9 neurologists (78% response rate) completed satisfaction surveys. Neurologists reported greater assessment confidence with Zoom, but confidence was high for all modalities. Patients preferring televisits (75%, 45/60) noted reduced expense and time requirements, whereas those preferring in-person visits (22%, 13/60) cited the desire for physical examinations. Overall, 98% of patients and 100% of neurologists were satisfied with televisits.

Interpretation: Teleneurology visits were acceptable and feasible for adults attending an outpatient neurology clinic in Zambia and their neurologists. They offer a promising supplement to in-person visits in resource-limited settings, even when video-conference capabilities and electronic medical records are absent.

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Telemedicine is the provision of medical care to a patient by a physician at a distant location through the use of tele- or electronic communication.[1] Teleneurology is the provision of neurological services using telemedicine and has several potential benefits, including overcoming geographical barriers, expanding patient access to limited neurology expertise, and overcoming patient mobility and transportation limitations. Additionally, in high-income countries, its safety, efficiency, and cost-effectiveness have been shown to be comparable to in-person visits.[1–4] However, several factors have limited its widespread utilization, such as reimbursement and

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insurance concerns and technological, regulatory, and political barriers.[4,5] The use of telemedicine in low- and middle-income countries (LMICs), particularly in sub-Saharan Africa (sSA), is rarely reported. When it is utilized, it usually involves engaging foreign experts to provide clinical care or teaching rather than leveraging local expertise.[5–7]

The coronavirus disease 2019 (COVID-19) pandemic greatly accelerated the use of telemedicine services in high-income countries as a means of continuing essential medical care delivery to patients in a safe way and resulted in the resolution of several regulatory and reimbursement barriers.[2] Many, including neurologists, have reported the effectiveness of these initiatives in high-income settings.[8–10] However, data for LMICs remain scarce, even though it is likely that these settings could similarly benefit from teleneurology services both during the COVID-19 pandemic and beyond.

Zambia is a land-locked country located in south-central Africa with a population of about 18 million people. In Zambia, the only specialist adult neurology clinic in the country is held twice weekly at the University Teaching Hospital (UTH) in Lusaka. The clinics serve a vulnerable population with the majority of patients living below the international poverty line ($1.90/day). The clinics are usually crowded without space for social distancing and without means for adequate ventilation. Additionally, a large proportion of patients attending the clinic have multiple comorbidities, including diabetes, heart disease, hypertension, and advancing age, all of which impose an additional risk of acquiring severe COVID-19 disease.[11] At the peak of the COVID-19 pandemic in 2020, all outpatient clinics at UTH were temporarily closed, and urgent alternative ways of meeting the needs of outpatients were required. It was out of this need that a teleneurology service was created and implemented at UTH.

The aim of this study was to assess the feasibility, acceptability, and benefits of a teleneurology clinic serving adults who usually attend the UTH neurology outpatient clinic in person. To our knowledge, this is the first study that utilizes teleneurology in an LMIC by leveraging local expertise to provide televisits.

Patients and Methods

Study Design and Participants

This study consisted of 2 components: (1) a retrospective single-center observational study of teleneurology visits at UTH between June and July 2020; and (2) a cross-sectional survey of patients and neurologists who participated in these visits (Fig 1). All adult patients (≥18 years old) who were contacted for a televisit and all neurologists (comprising attending neurologists and neurology residents) that participated in the televisits during the study period were eligible to participate in the study. Exclusion criteria included (1) patients who could not be reached by telephone, (2) patients who were deceased at the time of contact, (3) patients whose neurology clinic appointments were not between March and July 2020, and (4) physicians that did not participate in a televisit between June and July 2020.

Study Procedures

Televisits. Between March and July 2020, all outpatient clinics at UTH were temporarily closed as a safety measure to reduce the spread of COVID-19, and thus all patients with appointments during this period had to be rescheduled. In June and July 2020, attempts were made to contact all adult patients scheduled for neurology outpatient appointments in June and July 2020 and those with missed appointments between March and May 2020 in order to offer them televisits. UTH neurologists and neurology residents conducted teleneurology visits via telephone calls, WhatsApp video calls, or Zoom calls depending on what technology was accessible to and most convenient for the patient. There is no electronic medical record system (EMRS) in Zambian public hospitals, so no prior patient records were available to the doctor conducting the televisit unless they could personally recall the patient details at the time of the televisit or the patient had their hospital records with them at home. For all visits, the neurologist obtained a history from the patient or their caregiver. If the patient had their paper medical file at home and had access to WhatsApp, they were often asked to send photographs of their most recent clinic notes to the neurologist for review. For video-based calls, a virtual physical examination was also conducted, usually with the assistance of a patient's relative or caregiver. At the end of each visit, the neurologist would provide a summary of the clinical assessment and make an appropriate management plan.

Post-visit Surveys. Neurologists completed a survey about each visit or attempted visit, including patient age, sex, diagnosis, whether they were able to reach the patient, and whether the patient accepted a televisit. For successfully conducted televisits, neurologists also documented what method was used to complete the visit, rated the technical quality of the call or video, and listed visit outcomes, which included discharging stable patients from the neurology clinic, recording whether a new medication was prescribed, or a medication adjustment was made; and listing whether additional referrals or investigations were ordered. For patients who the doctors felt needed a more detailed physical assessment or who could not communicate their problem adequately during the televisits,

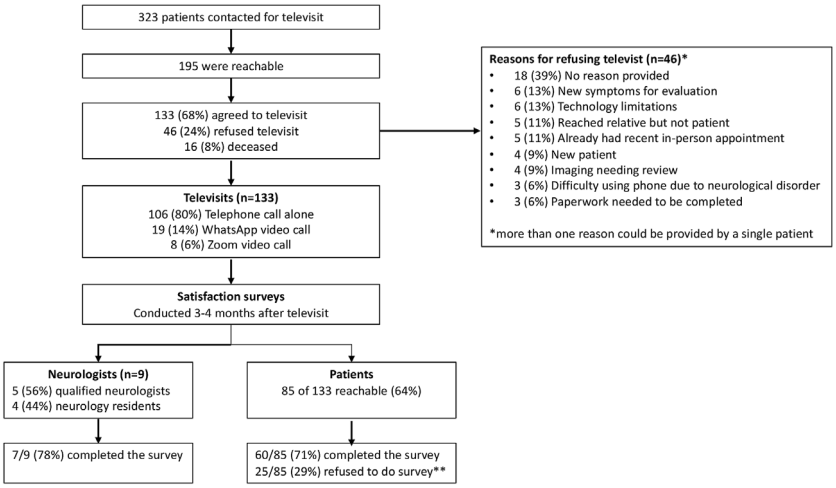

FIGURE 1: Study flow diagram. **Those who refused to respond to the survey reported that they did not remember the televisit. We postulate that it is likely that the caregiver who was reached was different from the one contacted at the initial televisit phone call, or the owner of the telephone number had changed, or the individual did not want to give a specific reason for refusal.

arrangements were made for an in-person visit at the UTH clinic. Additionally, patients who were deemed to need urgent medical attention were advised to present to the nearest community clinic or hospital emergency department. Neurologists also rated their confidence in their clinical assessment and documented whether they thought an in-person or televisit was most appropriate for the patient's follow-up visit.

Satisfaction Surveys. Patient and neurologist satisfaction regarding the televisits were collected through surveys conducted 3 to 4 months post-visit (Fig 2). Information collected included ease of conducting the televisit, overall satisfaction with the televisit, and cost- and time-saving when compared to in-person visits. A neurology clinic nurse called all patients who had accepted a televisit during the study period and administered the satisfaction survey over the telephone. All neurologists who had conducted televisits during the study period were invited to complete an anonymous online survey about their overall satisfaction with the televisit service.

Consent and Ethical Approvals

This study was approved by the University of Zambia Biomedical Research Ethics Committee, the Zambia National Health Regulatory Authority, and the Johns Hopkins University Institutional Review Board. A waiver of consent was obtained for the cross-sectional information collected about individual televisits as no identifiable patient information was collected. Patients provided verbal consent for the telephone satisfaction surveys. Neurologists were provided with a written explanation of the study at the beginning of the online neurologist satisfaction survey, and consent was assumed when the survey was completed. No identifiable participant information was collected during any portion of the study.

Statistical Analysis

Data are reported using means and standard deviations for normally distributed continuous variables, medians with interquartile ranges (IQRs) for non-normally distributed continuous variables, and frequencies and percentages for categorical data. The t tests were used to assess group differences in continuous parametric variables, and chi-square tests were used to analyze group differences for categorical variables. All statistical analyses were performed using STATA version 14.0 (StataCorp, College Station, TX). Significance levels were set at $p < 0.05$.

Results

Televisit Characteristics

Of 323 attempted telephone calls to patients to offer a televisit, 195 (60%) patients were reachable by telephone, of whom 133 (68%) agreed to a televisit, 46 (24%) refused a televisit, and 16 (8%) were deceased (Table 1). Overall, 74% (133/179) of patients reachable and alive agreed to a televisit. Reasons for refusing a televisit included new symptoms needing re-evaluation (13%), technology limitations (13%), telephone call reaching a relative instead of the patient (11%), recent in-person appointment (11%), new patient (9%), imaging needing review (9%), difficulty using a telephone due to a neurologic condition (6%), and paperwork that needed to be completed (6%; see Fig 1).

The majority of the televisits were completed by telephone call alone (80%), with WhatsApp video calls (14%), and Zoom video calls (6%) being less frequent.

A Patient Satisfaction Survey

Patient Satisfaction Survey					
Sex: Age: Education: Preferred language: Language used: Mode of televisit: Phone call/ WhatsApp call/ WhatsApp video/ Zoom/ Other platform(specify) Respondent: Patient /Relative (Caregiver)					
Compared to an in-person visit, how would you rate the following:	**Worse**	**Same**	**Better**		
• the length of time with the neurologist during the visit?					
• the thoroughness, skilfulness, and carefulness of the neurologist?					
• your ability to explain your problem to the neurologist?					
• the neurologist's understanding of your condition?					
• the explanation of your condition by the neurologist?					
• the explanation of your treatment by the neurologist?					
• the overall treatment experience?					
How satisfied were you with:	**Very unsatisfied**	**Satisfied**	**Neutral**	**Satisfied**	**Very satisfied**
• your personal comfort and privacy during the visit?					
• the audio quality of the call? (ability to hear and be heard)					
• the video quality of the call? (ability to see and be seen) (If applicable)					
• the overall treatment experience with the video/ phone visit?					
How much money did the tele-visit cost you?	K				
How much would you normally spend on an in-person visit – including transport and lodging?	Transport (K) Lodging – if applicable (K)				
How much time did it take to set up and attend the televisit?					
How much time would you usually spend on an in-person visit? (from the time you leave home, to the time you return)					
For your next visit, which method would you prefer?	In-person	Tele-visit	Unsure		
Give a reason for your answer?					
Would you recommend a teleneurology visit to another person with a similar condition?	Yes	No			
Give a reason for your answer?					
Additional comments					

B Neurologist Satisfaction Survey

Neurologist Satisfaction Survey					
Mode of visit: Phone call/ WhatsApp call/ WhatsApp video/ Zoom/ Other platform (specify) Diagnosis:					
Compared to an in-person visit, how would you rate the following:	**Worse**		**Same**		**Better**
• the length of time with the patient during the visit?					
• your ability to understand the patient's explanation of their condition?					
• your ability to explain the condition to the patient?					
• your ability to explain the patient's treatment?					
• the overall treatment experience?					
Regarding the televisit:	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
• Televisit allowed for adequate history taking					
• Televisit clinical examination provided me with sufficient information					
• I was confident with my assessment at the end of the visit					
How satisfied were you with:	**Very unsatisfied**	**Satisfied**	**Neutral**	**Satisfied**	**Very satisfied**
• your personal comfort and privacy during the visit?					
• the patient's comfort and privacy?					
• the audio quality of the call? (ability to hear and be heard)					
• the video quality of the call? (ability to see and be seen) (If applicable)					
• the overall treatment experience with the video/ phone visit?					
How did you perform the visit?	Personal computer/phone		Hospital equipment		
How much money did the tele-visit cost you?	K				
How much time did it take to set up and attend the televisit?					
How much time would you usually spend on an in-person visit?					
For the next visit, which method would you prefer?	In-person	Tele-visit	Unsure		
Give a reason for your answer?					
Would you recommend a teleneurology visit to another patient with a similar condition?	Yes	No			
Give a reason for your answer?					
Additional comments					

FIGURE 2: Patient and neurologist satisfaction survey instruments.

The mean technical quality rating out of 5 (for all televisits), was highest for Zoom calls (4.6 ± 0.5), then telephone calls (4.2 ± 0.7), and least for WhatsApp video calls (3.4 ± 1.0).

Outcomes of the televisits are shown in Figure 3. Of all televisits, 65 patients (49%) were managed exclusively by televisit, 28 (21%) needed a subsequent near-term in-person visit, and 40 (30%) were assessed as stable without further follow-up needs and discharged from the neurology clinic to their community clinics. The majority of those discharged were stable patients who has sustained a stroke who only required continued stroke risk factor management. Of the patients who were not discharged from the clinic, neurologists recommended that 46% (43/93) of the patients could be followed up by televisit in the future, 41% (38/93) needed in-person follow-up, and 11% (10/93) were unsure about the appropriate next visit type. No response was given for 2% (2/93).

Patient Televisit Satisfaction Survey

Eighty-five patients were reachable for the follow-up survey (64% of televisits), and 60 of those who were reachable consented to participate in the survey (71%; see Fig 1). Most of the responses were provided by caregivers

TABLE 1. Demographic Characteristics and Diagnoses of Patients Who Accepted or Refused Televisits

	Refused televisit (n = 46)	Accepted televisit (n = 133)	*p*	Post televisit survey (n = 60)
Age, mean (SD)	47.8 (17.3)	46.4 (18.4)	N.S.	50.3 (19.6)
Male, n (%)	25 (54)	69 (52)	N.S.	37 (62)
Diagnosis, n (%)				
Stroke	17 (37)	40 (30)	N.S.	21 (35)
Seizures	4 (9)	26 (20)	N.S.	6 (10)
Headache	4 (9)	21 (16)	N.S.	9 (15)
Dementia/confusion	5 (11)	7 (5)	N.S.	5 (8)
Neuromuscular disorders	0 (0)	7(5%)	N.S.	2 (3)
Movement disorders	3 (6)	5 (4)	N.S.	4 (7)
Neuropathy	5 (11)	6 (4)	N.S.	1 (2)
Myelopathy	4 (9)	4 (3)	N.S.	2 (3)
Tumor	0 (0)	4 (3)	N.S.	2 (3)
Functional neurological disorder	0 (0)	2 (2)	N.S.	0 (0)
Other[a]	5 (11)	11 (8)	N.S.	7 (11)

[a]Other refers to unspecified diagnoses.
N.S. = non-significant difference.

(58%). Survey participants were 62% male patients with a mean age of 50 ± 20 years and resided in Lusaka (82%). Most televisits were conducted in English (92%) despite variable language preferences, with 40% preferring English, 35% Nyanja, 20% Bemba, and 3% Tonga. The most common neurological diagnoses encountered were stroke (35%), headache (15%), and epilepsy (10%; see Table 1).

Overall, 75% (45/60) of respondents preferred the televisit over an in-person visit, 3% (2/60) had no preference, and 22% (13/60) preferred in-person visits over the televisit. Most felt that televisits were better than in-person visits with regard to time spent in the visit (70%); thoroughness, skillfulness, and carefulness of neurologist (58%); the patient's ability to explain the problem (75%); the neurologists' understanding of the patient's problem (63%); and the neurologists' ability to explain the patient's condition (67%) and treatment (70%). The remaining respondents thought the various factors were the same as an in-person visit, and <4% reported that they were worse for any item. Fifty respondents (83%) said they would recommend a televisit to someone with a similar condition.

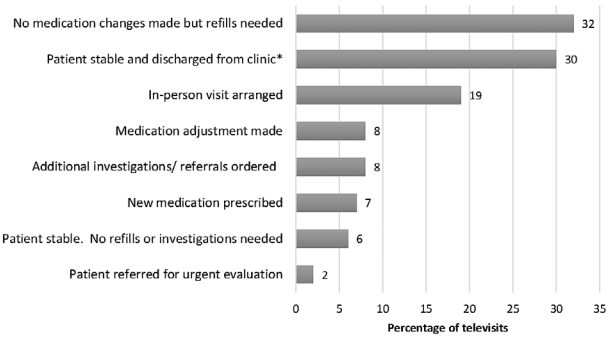

FIGURE 3: Outcomes of televisits represented as a percentage of the total number of televisits (n = 133). *The majority of the discharged patients were stable patients who had undergone a stroke and only required continued stroke risk factor management by primary care physicians.

Respondents were most satisfied with the comfort and privacy of the televisit (75% extremely satisfied). Reasons for televisit and in-person visit preferences and recommendations are shown in Table 2. Common reasons for preferring televisits over in-person visits were that they were less expensive (32/45, 71%), less time-consuming (21/45, 47%), and offered more privacy (12/45, 27%). The most common reason for preference for an in-person

TABLE 2. Patient Reasons for Preferred Visit Type and Recommendations[a]

	n (%)[b]	Illustrative quotes
Reasons for preferring televisit (n = 45)		
Less expensive	32 (71)	It is cost-efficient.
Less time involved	21 (47)	No waiting for a long time in queues. It is time-efficient. It's good when you have busy schedules because it is very fast.
More privacy	12 (27)	Privacy guaranteed. Very private in your own home.
More convenient	8 (18)	
Protection from COVID-19	6 (13)	
Doctor less distracted and rushed	5 (11)	The doctor is not rushing and has all the time to examine the patient. The doctor is not rushing to see another patient.
Less stressful	4 (9)	It's stressful coming to the hospital.
Less mobility issues	3 (7)	Very good if the patient has difficulties moving. No need to lift the patient.
Some problems do not require physical examination	1 (2)	Some things you just explain, and the doctor cannot see, so there's no need to be seen in person.
Reasons for preferring in-person visit (n = 13)		
No physical examination	11 (85)	I want the doctor to examine him by touch. Because I want to be seen physically. In case I need to show the doctor where I'm experiencing pain. I want the doctor to see and examine fully, not by phone. It's not a normal way to be seen by a doctor.
Discomfort communicating on some topics over the telephone	1 (8)	
Visit to the hospital is still required	1 (8)	I have to get my medicine from there.
Reasons for recommending televisit (n = 50)		
Less expensive	27 (54)	No expenses to incur.
More convenient	10 (20)	
Less time-consuming	7 (14)	
Better privacy	5 (10)	It's good to be reviewed in your own home. It allows patients and carers to 'open up.'
More comfortable	3 (6)	It's nice being in your own home.
COVID prevention	2 (4)	Issues of COVID while traveling on the bus.
Patient's mobility issues	1 (2)	It's good because there's no need of moving the patient.
Reasons for not recommending televisit (n = 10)		
No physical examination	7 (70)	The doctor is not there to examine the patient. There's no physical contact.

COVID-19 = coronavirus disease 2019.

[a]Respondents could give multiple or no responses for each question. Thus, totals may not add to 100% for each section.

[b]Percentages are calculated based on the number of respondents for each preference and their corresponding reasons. That is, 45 respondents preferred televisits, 13 respondents preferred in-person visits, 50 respondents recommended televisits, and 10 did not recommend televisits.

TABLE 3. Televisit satisfaction of patients and neurologists

	Patient, mean (SD)	Neurologist[a], mean (SD)	*p*
Satisfaction with comfort/privacy of patient during televisit	1.3 (0.5)	2.6 (1.1)	0.01
Satisfaction with quality of audio during televisit	1.6 (0.8)	1.8 (0.7)	0.53
Satisfaction with quality of video during televisit	1.5 (1.1)	2.1 (0.9)	0.17
Overall satisfaction with televisit	1.3 (0.5)	1.6 (0.5)	0.14

Satisfaction rated on a scale of 1 to 5 (1 - extremely satisfied, 5 extremely dissatisfied). The lower the score, the greater the satisfaction.
[a]Neurologist included both qualified neurologists and neurology residents.

visit over a televisit and for not recommending a televisit to another person was the lack of physical examination during the televisit. Most respondents completed their visit via a telephone call alone, with 93% either extremely or somewhat satisfied with the audio quality. Six of the 8 (75%) who had video visits were extremely satisfied with this mode of contact.

Respondents reported they did not incur any costs from a televisit as opposed to a total median cost of K150 ZMW (approximately US $8, IQR = 100 to 200 ZMW) for an in-person visit. Furthermore, with regard to the time spent for a visit, respondents spent a median of 40 minutes (IQR = 30 to 40 minutes) for a televisit, as opposed to 5 hours (IQR = 4 to 6 hours) for an in-person visit, including waiting time, resulting in estimated time savings of 4.2 hours (IQR = 3.3 to 5.2 hours) by having a televisit instead of an in-person visit.

Physician Satisfaction Survey

Seven of 9 (78%) eligible neurologists responded to the post-visit survey. All televisits were completed either using a personal mobile phone (100%) or a personal laptop/computer (71%); no hospital equipment was used. The majority (5/7, 71%) reported the length of time spent on a televisit was shorter than an in-person visit while being comparable to in-person visits with regard to patients' and doctors' explanations of the condition and their ability to explain the treatment plan to the patient. Six neurologists (86%) thought the overall treatment experience was the same as in-person visits with the other respondent finding it better. Six respondents (86%) agreed that televisits allowed for adequate history taking and 5 (71%) agreed that it allowed for adequate virtual examination when visits were conducted with video capability. Most respondents either moderately (4/7, 57%) or strongly (2/7, 28%) agreed that they were confident with their assessment after televisits, although one commented that "it is difficult to see patients without access to their medical records." All respondents were somewhat (57%) or extremely (43%) satisfied with the televisit overall. Table 3 shows a comparison between patient and neurologist satisfaction with televisits.

Neurologists reported providing care by televisits was satisfying (43% strongly agreed and 57% moderately agreed) and similar to in-person visits. All respondents agreed that televisits offered distinct advantages over in-person visits for a significant proportion of patients and agreed televisits should continue even after the COVID-19 pandemic is over. Almost all respondents (86%) felt follow-up visits for stable patients were the most amenable to a televisit. Other conditions deemed amenable to televisits were stroke (71%), headache (3%), epilepsy (3%), and new patients with video call capability (14%). Conditions deemed least amenable to televisits were new patients without video call capability (57%), myelopathy (28%), neuropathy (28%), functional neurologic disorders (28%), movement disorders (28%), myasthenia gravis (14%), and pain disorders (28%).

Discussion

This study found that teleneurology visits were feasible, acceptable, and satisfactory for both patients and neurologists at a neurology clinic in Zambia during the COVID-19 pandemic. Stable follow-up patients were deemed most amenable to a televisit. Telephone call visits, which were the majority, were as satisfactory as video call visits. Patients preferred televisits to in-person visits because they were less expensive, less time-consuming, and more comfortable. Previous studies, nearly all in high-income countries,[12,13] have shown that telemedicine services are acceptable and feasible among both patients and physicians. Our study is one of the first investigating teleneurology services implemented for clinical care in sSA.

Prior to the COVID-19 pandemic, telemedicine use in LMICs was uncommon, especially in neurology. According to a systematic review of teleneurology in sSA, there were no available studies evaluating the acceptability and efficacy of teleneurology in the region.[5] However, the use of telemedicine in non-neurology medical specialties has been evaluated in sSA,[5] with most studies involving international experts providing telemedicine services to sSA. However, like our study, some studies utilized local expertise. In Mali, local radiologists remotely read x-rays and mammograms for regional hospitals and found that diagnostic accuracy and certainty of non-radiology doctors improved.[14] In Zimbabwe, retina images obtained at remote sites were sent to a specialist in Harare to determine which patients needed an in-person visit, which significantly improved screening times.[15] Another study in Cameroon linked urban hypertension specialists with general practitioners in remote areas and showed that more participants in the intervention group achieved optimal blood pressures.[16] An innovation from our study was that neurologists directly communicated with patients and provided direct clinical care during the televisit.

During the COVID-19 pandemic, telemedicine use increased exponentially, including among neurologists. Although this increase was relatively lower in Africa and LMICs, several reports emerged on its use during the pandemic,[17–20] whereas others gave recommendations for its use.[21–24] A recent study in Mexico, also an LMIC, reported the implementation of a novel outpatient teleneurology service utilizing primarily WhatsApp video calls, with only 8.5% of visits conducted exclusively by telephone, that resulted in high patient satisfaction.[25] In contrast, our teleneurology clinic relied almost exclusively on telephone calls. A neurologist in Kenya performed audio teleconsultations on 31 of 58 patients requiring follow-up visits. Like our study, the majority of patients were satisfied with the service, reporting that it was convenient, timesaving, and prevented the need to travel long distances. Interestingly, 21% of those contacted for a televisit refused it, preferring to wait for the next available in-person visit.[18]

Factors such as poor internet access and lack of video-capable devices are often listed as barriers to telemedicine services in LMICs.[5] Despite nearly exclusive use of telephone calls to conduct televisits, both physicians and patients in our study found this mode of contact satisfactory, especially for follow-up visits. Most adults in sSA now have access to a mobile phone. Thus, lack of internet services and videoconferencing technology, although helpful for assessment, should not prevent pilot telemedicine programs in LMICs for selected patients. Another challenge is the lack of EMRS in most LMICs, and neurologists in our study also noted that this made televisits more difficult. Furthermore, nonoptimal patient databases with high rates of missing or incorrect contact information may result in loss to follow-up of patients. The study in Mexico found that records for approximately 50% of patients were outdated and, thus, they could not be reached.[25] Similarly, 40% of patients in our study were unreachable for a televisit.

Inability to perform a physical examination during televisits was one of the main reasons cited by our patients for their preference for in-person visits. However, a study assessing inter-rater reliability of bedside versus remote audio-visual clinical examinations were comparable in most aspects,[26] although conditions requiring detailed ophthalmological, vestibular, neuromuscular, and sensory examinations still benefit from in-person assessments.[25,27]

Similar to our findings, other investigators have found that conditions, such as non-acute headache disorders, epilepsy, and dementia, are most amenable to televisits. A Norwegian study of a headache clinic found no difference in patient satisfaction between televisits and traditional visits.[28] Additionally, the use of disease severity scores have been suggested to facilitate consistent documentation of findings, but this too requires an EMRS to ensure that providers have access to prior ratings.[4,27]

Cost and time savings are additional potential benefits of televisits, as they eliminate the time and money spent by patients travelling to and waiting for hospital appointments. Patients with multiple sclerosis reported televisits were shorter, more focused, and saved money by eliminating travel costs and missed days at work.[4] In our setting, where the only specialist neurology clinic is in the capital city, some patients travel from distant towns just for the appointment. The clinics are usually crowded, and patients are seen on a first-come, first-served basis, sometimes waiting up to 8 hours to be seen. Thus, it was not surprising that patients preferred televisits over in-person visits for this reason and reported saving considerable amounts of time and money by having a televisit in-lieu of an in-person one. This may be especially important in informal economies like Zambia in which many adults are dependent on daily work in order to earn their daily wages. Additionally, while a savings of approximately US $8 may not seem significant at first glance, nearly 60% of the population of Zambia lives on <$1.90 per day making this cost-savings equivalent to multiple days' wages.

Our study has several limitations. A significant proportion of patients were unreachable by telephone for the televisit due to network connectivity problems, use of shared devices, and non-robust pre-COVID systems for recording patient telephone numbers in our clinic. Given that this was a new program and patients were not

expecting telephone calls from the doctor, providing patients with a day and time for a scheduled televisit appointment and asking for a reliable telephone number for that appointment could improve accessibility for many patients in the future. Furthermore, we were unable to reach a significant proportion of patients who did participate in a televisit for the satisfaction survey, so the results of the survey may reflect a participation bias. This was further confounded by 29% of reachable participants who refused to complete the survey. If patients who were satisfied with their televisits were more likely to agree to participate, our results overestimate the acceptability and benefits of teleneurology clinics in our setting. We also cannot exclude that participants may have felt pressured to provide positive responses regarding the care they had received, but we attempted to minimize this courtesy bias by having a clinic nurse who was not involved in the televisit to conduct the survey. Low literacy levels in our patient population and the continued COVID-19 pandemic made self-administered and in-person surveys problematic. Finally, a majority of the satisfaction survey responses were from caregivers and, thus, may not accurately represent the patient perspective. However, many patients with neurological disorders have difficulty communicating, and the challenges of time, comfort, and money would be equally problematic for caregivers. Thus, we postulate that patient and caregiver satisfaction levels would be largely similar for these reasons. Of note, public hospitals in Zambia provide a free consultation service, and so the issue of reimbursement for televisits versus in-person visits that is a potential area of conflict in other countries[1] was not encountered here. However, the institutional costs of running a teleneurology service, such as cell phone airtime and data costs, could still pose a challenge.

In conclusion, teleneurology visits were acceptable and feasible for adults attending an outpatient neurology clinic in Zambia and neurologists providing their care during the COVID-19 pandemic. They are a promising supplement to in-person visits in resource-limited settings, even when video-call support and EMRS are absent. The continuation of teleneurology visits beyond the COVID-19 pandemic is likely to be beneficial in our setting. Standardized training in provision of teleneurology services would be ideal, and studies evaluating the outcomes of patients receiving these services in comparison to routine in-person care are also of utmost importance.

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Author Contributions

M.A., L.C., M.C., S.Z., S.S., A.M., and D.S. contributed to the conception and design of the study. M.A., L.C., M.C., S.Z., G.H., F.M., M.M., N.M., K.Y., and D.S. contributed to the acquisition and analysis of data. M.A. and D.S. contributed to drafting the text and preparing the figures.

Potential Conflicts of Interest

The authors declared no conflict of interest.

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