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Case Report

Feasibility of Using Standardized Outcome Measures in the Remote Assessment of Patients with Chronic Stroke: A Case Series

Ricieline Evans[*1]

[1]University of the Philippines Manila, Manila, Philippines

*Address all correspondence to Ricieline Evans at: rmjaner@up.edu.ph

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Abstract

Introduction. With the increase of telerehabilitation utilization worldwide after the COVID-19 pandemic, a review of the current literature shows a concurrent increase in telerehabilitation studies focusing on interventions and delivery models. There is a gap in research on valid and reliable tests and measures that can be used in the physical therapy examination of people with stroke via telerehabilitation. Current reports on psychometric properties of most standardized outcome measures are only applicable in an in-person setting and may not be directly applicable in a remote setting where various challenges contribute to the reliability of results. This report describes the feasibility of administering selected standardized outcome measures in the remote assessment of three patients with chronic stroke with different contexts.

Methods. Three patients with chronic stroke underwent physical therapy examination and intervention sessions via telerehabilitation with varying contexts including device used, internet connectivity, presence and skills of caregiver, etc. The patients were remotely assessed with physical therapy outcome measures commonly used in an in-person clinical setting.

Results. Various factors affected the results of the assessment including patient and caregiver's (if present) ability to follow instructions, availability of material and spatial resources, and stability of internet connection. Strategies to improve reliability of assessment results can also be employed such as performing repeat trials, reviewing recordings for accuracy and confirmation, using highly visible markers, and confirming measurement accuracy on video.

Discussion. Physical therapy outcome measures that can feasibly be administered remotely are the Timed Up and Go Test, the 10-Meter Walk Test, the 6-Minute Walk Test, the 5-Times Sit to Stand Test, and the Stroke Impact Scale. The Mini Balance Evaluation Systems Test could not be administered remotely as close to standard protocol as possible due to the difficulty of administering the reactive postural component with patient anxiety and safety considerations and materials required.

***Keywords*:** telerehabilitation, examination, assessment, outcome measure, remote assessment

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Introduction

Telerehabilitation refers to the delivery of rehabilitation services including physical therapy through a variety of technological methods such as videoconferencing and telephone calls, among others (College of Physical Therapists of British Columbia, 2020). It has allowed for increased access to physical therapy services especially considering the precautions and restrictions on in-person services due to the COVID-19 pandemic. World Physiotherapy (2021) reported a 50 to 120% growth across all areas of remote physical therapy service delivery during the COVID-19 pandemic (World Physiotherapy, 2021).

In response to the increasing demand for remote physical therapy services, several countries and their representative organizations have attempted to develop best practice recommendations in the provision of telerehabilitation services including stroke rehabilitation. These include the Canadian Stroke Best Practice Recommendations (Dylan et al., 2017), the Telerehabilitation Guide published by the College of Physical Therapists of British Columbia (2020) and the Allied Health Best Practice Guide for Telehealth (Allied Health Aotearoa New Zealand, 2018) among others.

The American Physical Therapy Association (n.d.), the Australian Physiotherapy Association (2020), the Chartered Society of Physiotherapy (2020) and Stroke Foundation (n.d.) in Australia have developed and collated online resources (e.g., webinars, courses, resource collection) to assist clinicians in learning about recommendations for the provision of telerehabilitation.

These guidelines and resources include suggested practice methods to improve service delivery in telerehabilitation in areas such as hyperacute stroke management and continuing stroke assessment and management (Dylan et al., 2017), or practice standards in areas such as informed consent, client safety, privacy, and documentation (College of Physical Therapists of British Columbia, 2020).

Assessment is an essential part of physical therapy service delivery. Using standardized outcome measures provides quantitative assessment supported by sound psychometric properties. Clinicians also find its use to help in quality of care assurance, improved communication between providers, and tracking patient progress among others (Jette et al., 2009). Administration of standardized outcome measures in the remote setting may be different from an in-person setting due to a variety of factors. There are challenges found in telerehabilitation in a developing country such as the Philippines which include but are not limited to, safety considerations, resource and space availability, technology literacy of the patient/client and the caregiver when available, and technological aspects such as internet connectivity, device availability, and audio and video clarity (Leochico et al., 2020).

Current literature is lacking on detailed recommendations on the use of standardized outcome measures in telerehabilitation. The lack of resources specific to remote standardized outcome measure administration in chronic stroke management can prove an issue when clinicians attempt to directly administer an outcome measure remotely just as they would in an in-person setting when environmental and other circumstances are not directly replicable. It can also affect the reliability of results gathered when standardized outcome measures' psychometric properties are based on methodologies done in-person or in a standard clinical setting. It is simply not known if these tests are valid or reliable when administered in the remote setting.

Studies have mentioned use of standardized outcome measures in telerehabilitation but with no specific guidelines especially in cases of chronic stroke. For example, the scoping review by Veras et al (2016) investigated the most common outcome measures used in telerehabilitation and virtual reality after stroke. The study identified what outcome measures were used and what concepts they were trying to measure but did not specify how the outcome measures were set up for remote implementation, or recommendations for the use of the tests during remote administration.

A systematic review by Walsh et al (2022) examined the psychometric properties of performance-based measures of physical function administered remotely for people with chronic conditions. Only one study included patients with stroke and investigated stroke-related outcome measures such as the European Stroke Scale and the Functional Reach Test (Palsbo et al., 2007). In this study, setup recommendations for remote testing included the use of an enlarged paper yardstick, videoconferencing equipment prepared by the researchers before administration, and the use of a physical therapy technician to guard and position the participants as needed. Zischke et al (2021) also described the utility of telehealth assessments in their systematic review where some included studies looked at the validity and reliability of select standardized outcome measures. However, in most of the studies, controlled telehealth environments were used such as setups provided by researchers or assessments performed in the same building but not the same room.

Transferability to real-life situations may be limited because of the controlled environments of these studies. The physical environment and resources available in these studies are not usually directly replicable in a patient's home environment.

The aim of this report is to describe the feasibility of administering commonly used standardized outcome measures in the remote assessment of patients with chronic stroke in the local Philippine setting. Eldridge et al. (2016) describes the term 'feasibility' as whether it is possible to do something, and if so, how. In this paper, this will refer to the remote administration of physical therapy outcome measures including the Mini Balance

Evaluation Systems Test (MiniBESTest), the Timed Up and Go Test (TUG), the Stroke Impact Scale (SIS), the 10-Meter Walk Test (10MWT), the 5-Times Sit to Stand Test (5XSTS), and the 6-Minute Walk Test (6MWT).

Methods

Case Description

Three patients with chronic stroke were referred for online physical therapy services. These patients were selected for analysis amongst a small caseload pool due to the COVID-19 pandemic period and their similarities in similar outcome measures administrations. They were assessed remotely and independently through videoconferencing software (i.e., Zoom and Viber). In this paper, only information directly affecting administration of outcome measures will be disclosed.

Patient A. Patient A was a 42-year-old male diagnosed with cerebrovascular disease with multiple infarcts in 2021. He was referred for online physical therapy management in 2022. The physical therapy problem list for this patient included job participation restrictions, limitations in Basic Activities of Daily Living (BADLs) and Instrumental Activities of Daily Living (IADLs), balance and upper extremity (UE) and lower extremity (LE) strength limitations. In performing BADLs and IADLs, he required minimal assistance from caregivers in preparing his meals for him, carrying heavy bags for him, or being closely guarded or supervised when walking outside. Patient was alert and oriented to person, place, time, and event during the session and had no problems in recall during the interview.

He was a college instructor working remotely due to his movement limitations. He lived in a rural area with his brother who was also his main caregiver. They lived in a two-story home with a spacious backyard and a paved walkway. His main caregiver was his 35-year-old younger brother who remained at home with him most of the time but ran errands outside the home 3-4 times a week for a few hours. The caregiver was able to understand instructions in both English and Tagalog, was able to use technology well, and was highly involved during therapy sessions. His caregiver had no medical background but had been his primary caregiver since he first incurred his condition. He was also knowledgeable in using an aneroid sphygmomanometer and pulse oximeter as he had been taught to use this to monitor the patient's vital signs. The caregiver was also able to follow instructions correctly in terms of preparing needed materials, providing the appropriate level of assistance, and guarding as needed with proper instruction from the therapist through the call.

Physical therapy sessions were conducted mainly in the living room with an approximately six-square meter floor space available when all the furniture and clutter were pushed to the sides. Internet connectivity through home broadband was sufficiently stable but was occasionally affected by bad weather or power outages in the area. Patient had a laptop but preferred to use a cellphone with a stand for attending online physical therapy sessions due to ease of changing angles or locations when needed. Other methods of communication with the patient included instant messaging applications such as Viber, and email. Patient was able to understand English instructions but preferred to communicate in Tagalog. Vital signs were monitored by the caregiver before and after each test.

Patient B. Patient B was a 42-year-old female diagnosed with cerebrovascular disease mainly with right middle cerebral artery affectation. She was referred for online physical therapy management in 2022. The physical therapy problem list for this patient included participation restrictions, limitations in BADLs and IADLs, balance and UE and LE strength limitations. Patient's BADL and IADL performance were limited by needing assistance in preparing her food, some assistance in bathing and dressing, and needing close to contact guarding when ambulating in the community. Patient was alert and oriented to person, place, time, and event during the session with occasional problems in long-term recall when asked about her history. Patient had no problems in short-term recall when asked to repeat instructions.

She was a housewife and a retired elementary school teacher, living with her children and her 14-year-old daughter acting as her main caregiver. Her main caregiver was able to communicate in English and Tagalog, was literate in using technological devices, and was able to follow instructions. She was also highly involved during therapy sessions. Her caregiver was able to prepare all materials correctly. She provided assistance and guarding as needed with no medical background, but with proper instruction by the therapist through the call. They lived in a two-story home situated in a compound although the outdoor space was not available for use due to hazards such as uneven terrain or parked vehicles.

Physical therapy sessions were conducted mainly in the common area on the first floor with approximately two by six meters of floor space available. Although they lived in an urban area, their internet connectivity through home broadband was occasionally unstable with lagging of videos evident during sessions. Patient's daughter had a laptop, but they preferred to use their mobile phone for attending online sessions. Patient preferred communications to be sent to her daughter through instant messaging applications such as Viber, and email. Patient was able to understand English instructions but preferred to communicate in Tagalog. Vital signs were monitored by the caregiver before and after each test using a digital blood pressure monitor which also showed the patient's heart rate.

Patient C. Patient C was a 65-year-old male with chronic cerebrovascular disease with right-sided weakness. He was diagnosed with cerebrovascular disease in 1999 and had been receiving intermittent physical therapy services ever since. The physical therapy problem list for this patient included balance and UE and LE strength limitations. Patient was alert and oriented to

person, place, time, and event during the session and had no problems in recall during the interview.

He was retired and depended on his pension for his financial needs. He was mainly independent on all his activities of daily living. He lived in a two-story home with two housemates who perform most of the household chores. Physical therapy sessions were conducted inside his bedroom with approximately two square meters of floor space available.

He used his mobile phone to attend online sessions. He also used mobile data connectivity during online sessions which was often unstable, evident in lagging of audio and video and blurriness of images or videos. The only other method of communication with the patient was through instant messaging such as Viber. He was also able to understand English instructions but preferred to communicate in Tagalog. Vital signs were monitored by the patient himself before and after each test through a digital blood pressure monitor which also showed the patient's heart rate.

Examination

Mini Balance Evaluation Systems Test (Mini BESTest). The Mini BESTest is a 14-item assessment tool used to evaluate multiple components of balance including postural control, sensory orientation, and gait stability (Potter & Brandfass, 2015). It was chosen for its comprehensiveness in the assessment of balance issues and its good psychometric properties for patients with chronic stroke (Tsang et al., 2013) although there is absence of evidence for its psychometric properties in remote administration with this population. It was also chosen due to the ease of administration with simple instructions and use of easily accessible resources for the patients. These include a standard height chair without arm rests, Temper® foam, incline ramp, a 9-inch box, and a 3-meter walkway (Oregon Health and Science University, 2005). For all three patients, a dense pillow was substituted for foam, hardcover books stacked to act as ramps, and any object of a 9-inch height were used in place of a box.

This test was administered to all three patients (A, B, and C). All patients were able to prepare all resources with the modifications mentioned above. For patient A, internet speed remained stable all throughout with good audio and video quality. Camera angles were also easily changed by the caregiver to ensure the patient remained fully visible throughout the tests. For patient B, internet speed would sometimes slow down with audio cutting off and video blurring occasionally. The patient would sometimes not be fully visible in some tests due to limitations in space such as the dynamic gait components and all standing tests. For patient C, internet connectivity lagged all throughout with audio cutting off regularly and video becoming blurry. Instructions had to be repeated, but the patient was able to keep himself fully visible throughout all tests. Patient is also familiar with the test items since he had previously undergone physical therapy.

All patients were able to easily follow all instructions, given in Filipino, for all components except for the reactive postural control component. Patients A and B had caregivers to assist and guard them all throughout while patient C was by himself. Patient C's housemates could not assist during the session at the time. For the reactive postural control component, patient's A and B's caregivers were respectively instructed to be ready to catch the patient should they fall and remain stable as they catch the weight of the patient. Patients A and B were instructed to put all their body weight towards the caregiver's hand as per the test items. However, both patients had increased anxiety in doing the test. Thus, it was not done on both occasions. It was also not done for patient C because he was by himself. All the test items (except for the reactive postural control and use of different foam surface) were able to be administered as close to the original intent of the tool as possible.

Timed Up and Go Test (TUG). The TUG Test is a reliable tool to assess gait performance and changes in patients with chronic stroke (Flansbjer et al., 2005). It is also included as an item in the Mini BESTest under the dynamic gait subscale along with the TUG with Dual Task item.

Patients A and B had sufficient space to mark a 3-meter walkway. Patient C marked a 3-meter walkway in the living room which was slightly uneven and where he noticeably slowed down to maintain his balance. All patients showed the use of a tape measure to mark their walkways. For all trials with all patients, the test was timed simultaneously during the online session. This was compared with the time scored later when the recording of the session was reviewed. For patients B and C where video occasionally lagged, performance where the video and internet connection were most stable was recorded. To ensure accuracy of results when the video lagged severely, the test would not be recorded. The patients were asked to rest for a few minutes before repeating the test once the connection was more stable.

Stroke Impact Scale (SIS). The SIS is a self-report questionnaire assessing the effect of stroke on a patient's disability and health-related quality of life. It assesses multiple domains including physical ability, mobility, activities and participation, emotion, communication, and cognition. (Mulder & Nijland, 2016) It has good test-retest reliability (ICC = 0.79 - 0.93), excellent internal consistency (α = 0.89 - 0.98), and excellent concurrent validity with the Mini Mental Status Exam, Barthel Index, Instrumental Activities of Daily Living Scale, and the Hospital Anxiety and Depression Scale (r = 0.67 to 0.69) (Vellone et al., 2015) done in an in-person setting with patients with stroke.

The questionnaire was administered to patients A and B. The tool was introduced during their respective online sessions. Both were instructed in Filipino regarding how to answer the tool, but the items were not translated. Both were instructed to send any questions regarding the tool to the therapist through their preferred modes of communication (i.e., email or instant messaging). Electronic copies of the questionnaire were sent

through email (patient's daughter for patient B). Both patients did not have any questions and submitted the questionnaires back through email within a couple of days. During their next synchronous session, patients were probed regarding their answers to items that were more extreme or dissonant with the initial clinical picture formed by the therapist. This tool was not successfully administered with patient C because he was unable to read the extensive questionnaire or answer the document through his mobile device or on Viber. Synchronous administration was not performed due to time constraints and prioritization of other assessment procedures.

10-Meter Walk Test (10MWT). The 10MWT assesses walking speed in patients with gait impairments with the intent of classifying their walking abilities into being household, limited community, or community ambulators (Bowden et al., 2008). The test has excellent test-retest (ICC = 0.95 - 0.99) and intrarater reliability (ICC = 0.87 - 0.88) (Collen et al., 1990) and excellent convergent validity with the Dynamic Gait Index, Dynamic Gait Index-4, and Functional Gait Assessment (ρ = 0.61 - 0.87) (Lin et al., 2010).

The test was administered to patients A. He was sent a digital diagram of the needed test setup, hand-drawn by the therapist (See Figure 1). Patient A's caregiver was instructed to place 1-liter plastic bottles on the 0-, 2-, 8- and 10-meter mark along a 10-meter walkway. During the synchronous session, the therapist noticed that some bottles seemed misplaced, so the placements were remeasured by the caregiver through a tape measure and confirmed with the therapist on video prior to the test. The test was administered outside the patient's home on a paved walkway in their yard. The cellphone was placed far enough to give a full lateral view of the patient walking along the whole walkway. The test was simultaneously timed with a digital stopwatch and was done twice at a comfortable walking speed and twice at a fast-walking speed with a one-minute rest period in between the change in speed. No lagging was observed during the test. Caregiver remained on standby supervision throughout the test.

Patient B's household did not have a 10-meter-long pathway to administer the test. The test was modified to do a 5-meter walk test (5MWT) (Salbach et al., 2001) instead. Colored tapes were used to mark the start and end of the 5-meter path. Due to the space constraints, full lateral view of the patient walking and the whole path including the tapes could not be captured by the cellphone during the synchronous session. The cellphone was instead placed on the floor at the end of the walking path with the tapes and the patient's body fully visible at the start of the test. During the test as the patient approached the cellphone and the end of the path, only the lower extremities remained visible on video. The test was also simultaneously timed with a digital stopwatch and was done twice at a comfortable walking speed and twice at a fast-walking speed with a one-minute rest period in between the change in speed. However, during the fast-walking speed trials, the video would occasionally lag and the exact moment of the patient's foot crossing the lines were not captured on video. These trials were repeated after a one-minute rest period until stable and more accurate measurements could be documented. Caregiver remained on standby supervision throughout the test. Recording of the session was also reviewed after the session to ensure timing of the tests was accurate. Average of the best and clearest trials with minimal lagging was taken as the final score.

Either test was not administered to patient C due to lack of sufficient space.

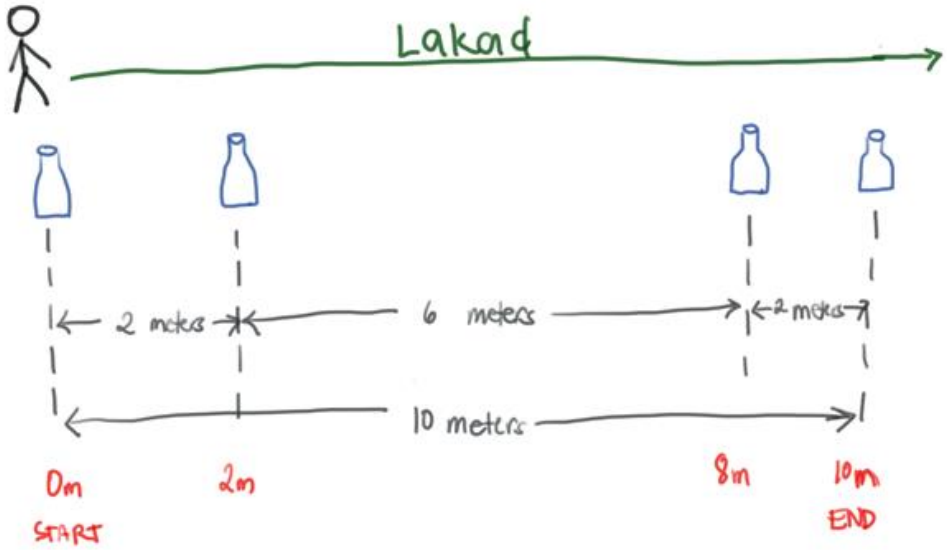

Figure 1. Hand-drawn diagram sent to patients or caregiver for the 10MWT setup

5 Times Sit to Stand Test (5XSTS). The 5 Times Sit to Stand Test is a measure used to assess functional strength in the lower extremities with good reliability (ICC = 0.970 - 0.999) for assessing patients with chronic stroke (Mong, Teo & Ng, 2010).

The test was administered to patients A and B who were both instructed to prepare a 17 to 18-inch-high chair or any chair of average height with a backrest. Both patients prepared monobloc chairs that were about 15 inches high. This was noted on both occasions. In both cases, patients were able to understand the instructions clearly. The video did not lag, and the connection remained stable. The camera was also angled keeping the head of the patients up to the ankles visible throughout the test. The tests were timed simultaneously with a digital stopwatch with only one trial each. No repeat trials were done due to the smooth flow of the test administration. Caregivers remained on standby supervision throughout the test.

The test was not administered to patient C with a different outcome measure assessing for functional leg strength implemented at the time.

6-Minute Walk Test (6MWT). The 6MWT is an outcome measure that can be used to assess aerobic capacity and walking ability as well as fall risk for patients with chronic stroke with good reliability (ICC = 0.99) (Regan et al., 2019). It involves measuring the distance walked by the patient along a measured hallway for six minutes.

For patient A, the initially measured 10-meter walkway in the yard was used. Patient was briefed before the test with the standardized instructions. The camera was again set up laterally to capture the patient's full body and the whole walkway while the caregiver remained on standby supervision by the camera. Timer was set using a digital timer, and patient was cued by the therapist through the phone. Video and internet connection remained stable all throughout. Upon termination of the test, the patient immediately stopped as soon as cue was given indicating no lagging in the connection. The caregiver was asked to measure the patient's distance from the starting point, and total distance was computed afterward by counting the laps the patient had made.

For patient B, cardiovascular endurance was not a significant concern and information on walking ability was gathered through the other outcome measures. However, to check any problems in fatigue that may arise as well as get a general picture of walking ability, the 2-Minute Walk Test (Rossier & Wade, 2001) was still administered. The 5-meter walkway was used with the same camera angle that was used in the 10MWT. The video and audio occasionally lagged including when cues to start and stop were given. Caregiver remained on standby supervision throughout the test. The test was timed with a digital timer and was only started when the patient started to walk despite giving the instruction a couple of seconds prior. The caregiver was asked to measure the patient's distance from the starting point. Due to the video occasionally lagging, simultaneously counting laps during the test was difficult. Lap count was double-checked after reviewing the session recording and total distance was computed afterward. This test was not administered with patient C due to the lack of space and the amount of turning that would be necessary to complete the test, and thus deviate heavily from the test instructions.

The feasibility and considerations for administering each outcome measure remotely as discussed are summarized in Table 1.

Table 1. Considerations, Feasibility, and Strategies for Remote Administration of Outcome Measures

Outcome Measure	Physical space considerations	Material resources*	Internet considerations	Caregiver assistance	Remote administration feasibility	Strategies to increase reliability of results
Mini BESTest	Does not need large amount of space except for TUG component Minimal clutter for safety	Temper® foam (or T-foam™ 4 inches thick, medium density T41 firmness rating) Chair without arm rests or wheels Incline ramp Stopwatch Box (9" height)	Low to moderate speed (e.g., some lagging)	Needed for safety Reactive postural control requires an extra person for assistance; however, the maneuver is too risky without a therapist present in person.	No Reactive postural control was not administered due to patient anxiety (2 cases) and an absent caregiver (1 case). Interpreting results with normative data available will be difficult (Tsang et al., 2013) as it requires the total scores from all components. Use of different density	Record video sessions for review. Repeat trials (after adequate rest) if too much lag occurred. Confirm accuracy of measurements accuracy on video with tape measure.

Table 1. Considerations, Feasibility, and Strategies for Remote Administration of Outcome Measures

Outcome Measure	Physical space considerations	Material resources*	Internet considerations	Caregiver assistance	Remote administration feasibility	Strategies to increase reliability of results
					foam can also affect validity of results.	
TUG Test	At least 3-meter distance plus space for a chair at the end	Tape measure Chair Stopwatch Tape or marker	Moderate to high speed due to timed component (e.g., minimal to no lagging)	Needed for patients with moderate to severe balance issues	Yes	**Record video sessions for review. Repeat trials (after adequate rest) if too much lag occurred. Confirm accuracy of measurements accuracy on video with tape measure. Use highly visible markers.
SIS	None	Device to view the questionnaire (if administered asynchronously)	Relatively low speed	None if patient can answer on device independently; needed if patient needs assistance in answering questionnaire	Yes	Practice questions after the tool is introduced to ensure comprehension. Probe answers randomly or based on the therapist's reasoning
10MWT	At least 10 meters At least 5 meters if substituted with 5-Meter Walk Test	Stopwatch Tape measure Markers (e.g., bright tape or bottles)	Moderate to high speed due to timed component (e.g., minimal to no lagging)	Needed for patients with moderate to severe balance issues	Yes	Record video sessions for review. Repeat trials (after adequate rest) if too much lag occurred. Confirm accuracy of measurements accuracy on video with tape measure. Use highly visible markers.
5XSTS	Enough space for a chair	Chair of average height with a backrest or 17 to 18 inches in seat height	Moderate to high speed due to timed component (e.g., minimal to no lagging)	Needed for patients with moderate to severe balance issues	Yes	Record video sessions for review. Repeat trials (after adequate rest) if too much lag occurred.
6MWT	At least 12 meters of smooth,	Stopwatch Chair	Moderate to high speed due to timed	Needed for patients with moderate to	Yes	Record video sessions for review.

Table 1. Considerations, Feasibility, and Strategies for Remote Administration of Outcome Measures

Outcome Measure	Physical space considerations	Material resources*	Internet considerations	Caregiver assistance	Remote administration feasibility	Strategies to increase reliability of results
	consistent surface May be administered in shorter distances but must be consistent at reassessment (therapist's discretion)	Tape measure Markers (e.g., bright tape or bottles)	component (e.g., minimal to no lagging)	severe balance issues		Repeat trials (after adequate rest) if too much lag occurred. Confirm accuracy of measurements accuracy on video with tape measure. Use highly visible markers.

**Vital signs monitoring devices (e.g., blood pressure monitor, pulse oximeter), internet, and communication devices are also required.*
***Provided that video remained stable for at least one trial for review.*

Results and Discussion

Ease of administration of the outcome measures

Among the outcome measures discussed and administered, the outcome measures that were easiest to administer remotely were the 5-Times Sit to Stand Test, the Stroke Impact Scale, and the Timed Up and Go Test component of the Mini BESTest. Due to the smooth flow of administration, these tests could also be deduced to have the most reliable results gathered. Further, the Mini BESTest items with shorter and more straightforward instructions such as anticipatory, sensory orientation, and dynamic gait components also flowed more smoothly and had more accurate results. However, it should be noted that some difficulty in scoring items where observation of smaller details was necessary was encountered due to clarity of the video and camera positioning. As an example, if the camera was angled too far away in heel raising, it becomes too difficult to distinguish the actual height of heel clearance. In these instances, the caregiver was asked to position the camera closer to the feet.

Tests that required more space such as the 6-Minute Walk Test, the 10-Meter Walk Test were more challenging to administer due to the clients' space limitations. Results gathered from these tests were less accurate and valid compared to the other tests. It should be noted that Patient A's home had more space allowing for test administration closer to standard requirements while Patient B had less space in her home, needing modifications to the tests (i.e., shorter walkway for 6MWT and change to 5-MWT) Further, patient B's setup only allowed for the camera to be placed at the end of the walkway for the 5MWT where seeing the exact moment that her feet would cross the markers for timing purposes was difficult. To improve reliability, the caregiver was requested to use brightly colored tape to mark the distances for better contrast and visibility.

Scores gathered from patient B's 5MWT (instead of the 10MWT) were carefully interpreted with observational analysis of patient's level and non-level ambulation, balance ability, along with multiple trials of the actual test to arrive at a picture of patient's actual ambulatory levels (i.e., household, limited community, or community).

For the Mini BESTest, the reactive postural component was not administered successfully in both patients due to patient anxiety. Difficulty could also be due to the caregiver's ability to comprehend the instructions and purpose of the test and execute the instructions while assuring the patient. It was also skipped altogether with patient C due to the absence of any caregiver. The use of a different-density foam surface can also affect the validity of the results obtained for the relevant test item. This provides insight into the feasibility of administration of this component of the test as well as other outcome measures with more complex instructions, that need more advanced skills from the caregiver in terms of medical background and comprehension, or with not easily accessible materials used. Tests of this nature may not be feasible for remote administration and may need to be substituted with other outcome measures that assess the same construct.

Timed tests were also challenging to administer. These include the 10MWT, 6MWT, 5XSTS, and the TUGT. Stability of internet connection played a big role in administering these tests. It was only possible to time a patient's performance when the video did not lag during the exact moments of starting and stopping time. Otherwise, the trial would have to be redone to ensure accuracy.

Factors that could increase reliability of results in remote outcome measure administration

In looking at the assessment sessions conducted, general factors that could assist in ensuring that outcome measures were administered as close to standard protocols as possible and that results were as accurate as possible were 1) patient's ability to follow instructions, 2) caregiver's ability to follow instructions, 3) stability of internet connection, and 4) resources available including materials and space.

Despite the nature of their conditions, all patients had no difficulties in understanding and following instructions. They were also able to communicate with their therapists and their respective caregivers easily and effectively and were able to use the technology without difficulty. This is consistent with participant characteristics in telerehabilitation assessment studies by Russell et al (2010), Hwang et al (2016), and Cottrell et al (2018) where they had to be able to communicate, use the device and follow instructions effectively to be able to participate in the remote assessment. Patient C's prior experience of being assessed with the Mini BESTest also helped in his ability to replicate the setup at home and follow instructions more easily. Patients A and B, being fluent in English, did not encounter any difficulties in answering the SIS on their own. Additionally, answers were probed during follow-up for certain items to ensure that patients' answers were as accurate as possible. Response bias is one of the issues encountered in answering self-report questionnaires where patients may tend to answer a question regardless of the content (Demetriou et al., 2015). After the tool is introduced, asking a few practice questions synchronously can be done to ensure comprehension of instructions.

The caregivers' availability, willingness to participate in the assessment, and ability to follow instructions were also crucial in the successful administration of the outcome measures. Both caregivers were able to follow the instructions easily with a combination of visual and verbal cues when needed. This included re-measuring distances with a tape measure and during the session to assure that measurements were accurate for the tests. Galiano-Castilo and colleagues (2013) reported in their study on face-to-face and telehealth assessment of patients with lymphedema that caregiver involvement in assessment has been seen in multiple cases and that their role in remote assessment is significant in the care of these patients. The preliminary findings of their study vouch for the role of caregivers in monitoring patients with lymphedema in a telehealth setting (Galiano-Castilo et al., 2013). In cases where patients may have more severe communication issues or decreased ability to follow instructions, the role of caregiver support in assessment may be amplified.

Leochico et al's study (2020) also identified concerns about safety to be one of the barriers to the use of telerehabilitation in the Philippines. The presence of an able-bodied caregiver who can catch the patient should they fall is imperative especially if performing balance testing. Cabana et al's study (2010) of the interrater agreement between telerehabilitation and face-to-face implementation of outcome measures for total knee arthroplasty had research assistants on-site during the telerehabilitation portions of their assessment to ensure patient safety. This could be similar to having an able-bodied caregiver close by to assist during remote assessment.

Stability of connection also played a crucial part in procuring reliable results in all cases. This is in line with the findings of Valera et al (2022) in their cross-sectional study of telerehabilitation where clients and health providers both highly recommend more reliable internet connection for the conduct of telerehabilitation with internet connectivity being an identified barrier to telerehabilitation prior to the pandemic.

For patient A, connection was stable all throughout, thus, ensuring smooth flow of administration of the tests. For patients B and C, internet connection was occasionally unstable causing video or audio to lag. In these instances, instructions or tests had to be repeated to ensure that results remained accurate and reliable. Hwang et al (2016) used similar problem-solving approaches to resolve internet freezing and audio and video instability during the telehealth assessment portion of their study using 6MWT and TUGT.

In addition, if the video or audio lagged, trials were stopped immediately so that patients would not get fatigued completing the trial. Where tests had to be repeated, adequate rest periods were given between trials to ensure that fatigue would not alter the patient's performance on the repeat trial. It was also important to record sessions so that the recordings could be reviewed later to recheck accuracy and reliability of results obtained such as timing of timed tests (e.g., 5XSTS or TUG) and counting of laps (e.g., 6MWT). An example of using recordings to check reliability of assessment was done by Russell et al in their 2010 study of telerehabilitation for non-articular lower limb musculoskeletal disorders. This is also an advantage of online assessment over in-person assessment. However, this is only applicable and useful if camera angles were appropriate all throughout and recorded videos remained stable.

Lastly, availability of resources played a big role in remote administration of outcome measures. All patients were able to procure all material resources needed to administer the tests or modifications thereof. Palsbo et al (2007) showed an example of this by using an enlarged paper yardstick to administer the Functional Reach Test remotely in their study, to compensate for video clarity when viewing from a screen.

In cases when modifications are required, it was imperative that modifications were noted for replicability of the tests upon reevaluation. However, this can affect validity of testing and results. Limitations in space most affected test administration in cases of patient B and C. In these cases, the test itself had to be

adjusted or carefully interpreted to account for the differences (e.g., a chair of a different height or walkway of different length). In administering tests with measured walkways, markers, or other resources, asking the caregiver to show the measurement with a tape measure while on video ensures that the test is done as accurately as possible.

The findings discussed in this paper are limited by circumstances encountered during the administration of these outcome measures that are separate from the outcome measure characteristics. These include the different circumstances of Patient C where different outcome measures were administered compared with Patients A and B. Results gathered from the tests could also not be confirmed for validity without meeting patients face-to-face which was difficult with the pandemic restrictions at the time and the remote locations of the patients relative to the therapist. Due to the limited patient caseload during the COVID-19 pandemic period, these patients were chosen because they had the most similar outcome measures administrations for comparison. As for the SIS administration with Patient C, this was limited by external factors such as difficulty in asynchronous administration through digital means where the patient could not access the file and limited time for synchronous administration due to clinic protocol. Other options that could have been explored include synchronous administration outside of official clinic hours or sending the questionnaire through a courier or mail.

Conclusion

Various factors affect administration of outcome measures in telehealth. These include patient and caregiver's (if present) ability to follow instructions, availability of material and spatial resources, and stability of internet connection. These factors can either positively or negatively affect outcome measure administration depending on the patient's situation. Good ability to follow instructions and communicate effectively allows for self-report questionnaires to be answered remotely. Stable internet connectivity allows for timed tests to be scored smoothly. On the other hand, unstable internet connection can render some timed trials as invalid. These challenges can be mitigated by doing repeat trials or reviewing recordings. Reliability can also be ensured by using highly visible markers and reconfirming measurement accuracy on video using a tape measure. Adjustments or modifications done during remote assessment should be carefully documented for replicability of tests during reevaluation. However, this may affect the validity of the tests.

This report outlines factors that affect outcome measure administration during assessment in online sessions. It provides valuable information on the feasibility of administering outcome measures remotely and the possible reliability challenges that can be encountered as well as possible strategies to overcome these challenges. Based on the cases discussed in this report, physical therapy outcome measures that can feasibly be administered remotely are the TUG Test, the 10MWT, the 6MWT, the 5XSTS, and the SIS. The Mini BEST Test could not be administered remotely as close to standard protocol as possible due to the difficulty of administering the reactive postural component with patient anxiety and safety considerations and required specific materials.

Suggestions for future studies include the feasibility of remote administration of commonly used standardized outcome measures especially for patients with chronic stroke. This also includes research on their psychometric properties, generation of normative data, and cutoff scores. Studies should also explore the challenges most faced during remote assessment especially in the local Philippine context and what modifications can be applied while still ensuring reliability of results obtained.

Conflict of interest statement

The author declares no conflict of interest.

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