

Tele-rehabilitation to Promote Exercise in Veterans Post-Stroke: An Observational Pilot Study

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Abstract

Objectives: The objectives of this study were to: 1) explore the feasibility of implementing in-home exercises via a tele-rehabilitation program for Veterans with stroke in Home-Based Primary Care (HBPC) in a single US Department of Veteran's Affairs Medical Center (VAMC); and 2) assess exercise adherence and progression in Veterans with stroke during the program.

Materials and Methods: Study participants completed 3 televideo visits and 5 telephone visits with a physical therapist (PT) over a 3 month period. Participants were instructed in an exercise program and were asked to report adherence with the exercise program and reasons for non-adherence per a standardized questionnaire throughout the program. Televideo visits were conducted using a video link installed on a lap top computer taken to the participant's home and a desk-top computer at the PT work station. The Late Life Function and Disability Instrument (LLFDI) were used to assess self-report of disability and function at baseline and 3 months.

Results: Six male Veterans with a mean age of 61 years enrolled in the study. Four study participants completed the intervention with an average exercise adherence rate of 90%. Self-reported reasons for non-adherence were lack of strength, lack of understanding and lack of needed assistance for the exercises. Increased exercise intensity was demonstrated by all 4 participants. Modest improvements in disability (7%) and function (6%) were reported on the LLFDI.

Conclusions: Veterans with stroke were able to actively participate in a tele-rehabilitation program. Study participants reported good exercise adherence and improved disability/function that was not statistically significant as well as increased exercise intensity throughout the intervention. Based on these preliminary findings with a small sample, a tele-rehabilitation program aimed at promoting exercise adherence and progression in Veterans who have had a stroke may be feasible and beneficial.

Keywords: Stroke; Tele health; Rehabilitation; Exercise; Home-based care; Exercise adherence; Implementation

Introduction

Substantial numbers of people with stroke experience significant motor disability [1-3] which contributes to long-term limitations in activity [4] and participation [5]. These long-term limitations frequently persist after completion of physical rehabilitation. This persistence of ongoing limitations is further complicated by increasingly shorter duration rehabilitation programs [6], making it imperative that people with stroke learn to self-manage their long-term physical limitations. One way to manage these ongoing physical limitations is through engagement in appropriate physical activity or exercise. In fact beneficial effects of exercise have been documented for people greater than 6 months post-stroke [3,6-12], and recommendations propose that people with stroke engage in ongoing

exercise after 6 months and/or discharge from rehabilitation [3,11,13,14].

Rehabilitation therapists frequently provide home exercise programs (HEP) at the time of discharge to promote ongoing, unsupervised continuation of exercise activity. Unfortunately adherence with exercise recommendations made by physicians [15] or physical therapists [16] is less than ideal. Several reasons for non-adherence have been reported in the literature including; low motivation [17], fatigue [17], not enough time [17], musculoskeletal issues [17], fear of falling while exercising [16], exercise is boring [16], exercise is painful [16], not knowing what exercises to do [16], and doing different exercises other than the ones given by the therapist [16].

This less than ideal adherence rate, suggests that people with stroke need more support than a HEP to continue with appropriate ongoing physical exercise. Jurkiewicz et al. [17] reported a 100% adherence with a structured community-based post-rehabilitation group exercise

program that quickly dropped off when the participants were asked to continue exercises on their own [17]. Unfortunately, many people living in the community after discharge from rehabilitation do not have access to community-based exercise programs.

Technology applications such as telehealth, which is the use of electronic information and telecommunication technologies to facilitate long-distance clinical healthcare and patient related education [18], provides a promising option for providing this support [19]. While others have reported on telehealth applications, none, to our knowledge, have reported the use of tele-rehabilitation to promote exercise adherence and progression in people with post stroke. Singh et al. [20] have reported that sustainable rural telehealth innovation and programming is realistic with appropriate health care technology applications, and home tele monitoring has been shown to improve glycemic control in patients with diabetes, improve peak expiratory flows in patients with asthma, and reduces blood pressure in patients with hypertension [21].

Furthermore, in a randomized controlled trial, Chumbler et al. [19] reported improved physical function in Veterans participating in a post-stroke tele-rehabilitation program (STeleR) which included instruction for functionally-based exercises and adaptive strategies. The authors concluded that the STeleR program might be a useful supplement to traditional post-stroke in-home care [19].

Building upon this successful randomized controlled trial, the present study examines translation of the STeleR program into routine clinical practice with Veterans who have had a stroke. Translation is achieved through implementation of the STeleR in the HBPC at a single US Department of Veteran's Affairs Medical Center (VAMC) to assess exercise adherence and progression in Veterans with stroke. Evaluations of implementation of telehealth programs like STeleR are particularly important given that few studies have achieved full implementation in real world settings. Information from our study could identify factors that can allow better judgment of transferability of STeleR to other clinical settings and guide clinicians and managers with salient information to better tailor the program for present-day clinical settings.

Methods

Study Design

The study was a prospective, observational pilot study which implemented STeleR into clinical care.

Participants

Participants in the study were Veterans who had experienced an ischemic or hemorrhagic stroke within the previous 24 months. The participants were had completed all structured rehabilitation and were enrolled or eligible to be enrolled in HBPC. HBPC is an in-home medical management program designed for Veterans who have medical issues that need to be followed such as diabetes or hypertension.

The HBPC program uses in-home monitoring and nurse follow-up to manage these chronic conditions while minimizing trips to the VA for clinic appointments by the Veteran. Participants were recruited through HBPC and VA primary care medical clinics. Once patients were identified by clinical staff and referred to the study coordinator, screening assessments were completed at the next primary care

medical clinic visit. Other specific inclusion criteria include: 1) between ages of 45-90, 2) no more than 4 errors on the Short Portable Mental Status Questionnaire, 3) able to follow a 3-step command, 4) enrolled or eligible for HBPC, and 5) able to understand and sign the informed consent.

Setting

The setting for the study was the HBPC Service of a single large urban VAMC. HBPC services are delivered to the Veteran in the Veteran's home. HBPC uses in home monitoring, telehealth and in-home visits to monitor and manage chronic conditions such as diabetes and hypertension, making this program ideal for monitoring and managing exercises with Veteran's who have had a stroke and residing in the community.

STeleR Intervention

Details of the STeleR intervention have been previously published elsewhere [19]. The present study employed all of the STeleR intervention components, but did so by integrating STeleR in the HBPC program of the VAMC. Implementation of the STeleR program into routine clinical practice is an important step in translating the previous work, which was completed in a controlled research environment, into clinical care. The HBPC program provides at home clinical support and education services for Veteran's with complex medical problems and high risk of re-hospitalization. HBPC was chosen for implementation of STeleR due to it being a referral program for Veteran's with stroke that have ongoing clinical support and education needs.

Consistent with the STeleR intervention, participants in this study had 3 televideo visits and 5 telephone visits with a physical therapist (PT) over a 3-month period. The televideo visits were conducted through a video link installed on a lap top computer delivered to the participant's home and a desk top computer at the PT workstation. Participants were prescribed a home exercise program including exercises for lower extremity strength and balance that were tailored for each Veteran's specific PT needs.

The exercises were selected from a menu of exercised approved for the study. The menu of exercises allowed the physical therapist to select exercises in a variety of postures including supine, sitting, and standing based on participant need and ability. Participants also answered daily questions Monday-Friday about exercise adherence and falls on an in-home monitoring device (IHMD) which was reviewed by the PT.

The in-home monitoring device was a HEALTH Buddy installed in the participant's home and connected to a standard telephone line. Participants answered questions on exercise adherence, barriers to exercise, and falls.

These responses allowed the physical therapist to collect exercise adherence data to answer the research question and also monitor the participants for safety issues related to falls for clinical follow-up as needed. The data were downloaded to the VA monitoring site each night with a new questionnaire added for the participant to answer the following day. The PT viewed and responded as needed to the participant responses. All visits were documented in the Computerized Patient Record System (CPRS), which is the electronic medical record at the VAMC. A timeline of the study and a summary of each visit are provided in Table 1.

Visit	Purpose of Visit	Staff Involved
VV 1	Set-up in home telehealth equipment Assess current exercise routine and develop appropriate exercise program as needed	In-home assistant Set-up in-home equipment Help with placement of equipment for teletherapist viewing Teletherapist Assess current exercise routine through observation Develop exercise prescription Make appropriate home safety or adaptive equipment recommendations based on observations Document visit in CPRS
PV 1	Develop rapport with positive feedback Clarify any concerns Review any safety recommendations made at televideo visit 1 Discuss any exercise preferences	Teletherapist Answer questions and address concerns Follow-up on safety recommendations Seek subject input before finalizing exercise plan Document visit in CPRS
VV 2	Initiate exercise plan Review and clarify any concerns	Teletherapist Answer questions and address concerns Instruct subject in exercise plan Document visit in CPRS
PV 2	Review and clarify any concerns Assess adherence with exercise plan Answer questions about exercise plan	Teletherapist Answer questions and address concerns Query subject about exercise adherence with standardized interview questionnaire Document visit in CPRS
VV 3	Review and clarify any concerns Assess adherence with exercise plan Answer questions about exercise plan Modify/advance exercise plan as appropriate Review mobility safety	Teletherapist Answer questions and address concerns Query subject about exercise adherence with standardized interview questionnaire Instruct in exercise plan modifications Observe and assess any mobility safety issues Document visit in CPRS
PV 3	Review and clarify any concerns Assess adherence with exercise plan Answer questions about exercise plan Modify/advance exercise plan as appropriate	Teletherapist Answer questions and address concerns Query subject about exercise adherence with standardized interview questionnaire Instruct in exercise plan modifications Document visit in CPRS
PV 4	Review and clarify any concerns Assess adherence with exercise plan Answer questions about exercise plan Modify/advance exercise plan as appropriate	Teletherapist Answer questions and address concerns Query subject about exercise adherence with standardized interview questionnaire Instruct in exercise plan modifications Document visit in CPRS
PV 5	Review and clarify any concerns Assess adherence with exercise plan Answer questions about exercise plan Modify/advance exercise plan as appropriate	Teletherapist Answer questions and address concerns Query subject about exercise adherence with standardized interview questionnaire Instruct in exercise plan modifications Document visit in CPRS

Table 1: Summary of Visits. Key: VV=Televideo visit; PV=Telephone visit

Outcomes measures

Stroke characteristics were collected with a standardized chart abstraction tool during pre-enrollment screening (IRB approved waiver of authorization for recruitment only). All other data were collected after enrollment in the study and signing of informed consent. Demographics and disability and function data were collected through post-enrollment phone interview prior to the first televideo visit. Exercise adherence data were collected with standardized participant interview questions during telephone visits 2-5 [19]. Participants were asked to report adherence or non-adherence with each individual exercise previously prescribed by the PT. Exercise progression data were collected through chart review and abstraction of PT written notes. Specifically the number of exercises, the amount of resistance, and the number of repetitions, were collected from each clinical note. The Late Life Function and Disability Instrument (LLFDI) was administered by phone interview and used to assess self-report of disability and function. The LLFDI is a patient-report instrument which is considered a valid substitute for physical performance measures of disability and function in older adults [22]. The LLFDI has been used in research studies as a measure of patient-reported function and disability in people with ischemic stroke [23]. In contrast to some other performance-based functional measures, the LLFDI can capture self-perceived changes in physical functioning

ability. The instrument has 2 domains (function and disability) with disability divided further into 2 dimensions (frequency and limitation). The LLFDI has 32 items that rate self-reported difficulty with functional tasks [22,23]. Raw scores are transformed into scale scores ranging from 0-100 with higher scores representing less impairment or better function [23]. The LLFDI was administered at baseline and at 3-months by phone interview.

Data Analysis

Demographics and stroke characteristics were analyzed with descriptive statistics. Exercise adherence and exercise progression data were analyzed with frequencies, proportions, and ratios. Exercise adherence rate was calculated as a percentage of the number of exercises performed/number of exercises prescribed X100%. Patient report of disability and function were analyzed with Wilcoxon Signed Rank Test (p=0.05) and percentage change (Time1 (T1)-Time 2 (T2)/T1 x100) between baseline and 3-month scores per each domain and dimension on the LLFDI. All analyses were completed with SPSS 21.0.

Results

Details of demographic results are shown in Table 2. Six male veterans (3 black and 3 white) enrolled in the study. The mean age was 61 years and the mean time since stroke was 9.5 months. Two subjects (33%) dropped out of the study with no significant difference between groups. One participant dropped out after enrollment but before the first televideo visit due to falling in the bathroom at home and being re-admitted to the VAMC. The second participant who dropped out was re-hospitalized for a new medical problem not related to the study after televideo visit 1. The four study participants who completed the intervention were included in the rest of the analyses. The overall exercise adherence rate for the group was 90%, with specific subject break down as follows; 3 out of 4 subjects (75%) were 100% adherent with the prescribed exercises, and 1 out of 4 (25%) was 60% adherent with the prescribed exercises. The subject with 60% adherence reported 3 specific barriers to exercise including; 1) not enough strength, 2) I don't understand the exercise, and 3) I need help to do the exercise. All 4 subjects were able to progress the intensity of their exercise activity over the course of the intervention: Four subjects (100%) increased the total number of exercises being performed: Two subjects (50%) increased the number of repetitions being completed of each exercise: One subject (25%) increased the resistance of the exercises. Finally, modest improvements that were not statistically significant were demonstrated by the group on LLFDI domains as follows; disability frequency 7% improvement (62 to 66, p=0.465), disability limitation 0.5% improvement (49 to 50, p=0.715), and function 6% (47 to 51, p=0.273).

Discussion

In this pilot implementation study, Veterans who had been discharged from traditional post-stroke rehabilitation were successfully enrolled into a tele-rehabilitation program that served as an adjunct to a VAMC Home-Based Primary Care Program. Four out of six enrolled veterans (66%) completed the program and the 4 veterans who completed the program reported an overall exercise adherence rate of 90% during the program. Findings from our study fill an important void in the literature. Very few studies report on evaluations of implementation programs given that few programs or

interventions have achieved full implementation in real world settings. To our knowledge this is the first implementation of a tele-rehabilitation program through routine clinical home care to focus on exercise adherence and safety at home after discharge from traditional rehabilitation. Our findings are novel in that it reports data after an intervention from a RCT was implemented in routine clinical practice in a hospital home care setting.

Variable	Whole sample N=6	Completed N=4	Drop out N=2	P- value
Age (Years)	61+4.5	62+5.1	59+2.8	0.350
Time since stroke (Months)	9.5+6.1	6.5+3.6	15.5+6.3	0.252
Gender (Male)	6 (100%)	4 (100%)	2 (100%)	1.0
Race (Caucasian)	3 (50%)	2 (50%)	1 (50%)	1.0

Table 2: Demographics.

The overall reported exercise adherence rate (90%) through this program is better than exercise adherence rates previously reported in people with stroke who were given a HEP by physical therapy (65%), [16] or given exercise recommendations by a physician (57%) [15]. The exercise adherence rate in this study may be related to the tele-rehabilitation intervention which provided structured follow-up between the physical therapist and Veterans. The structured follow-up provided a mechanism of accountability, encouragement, and education for the Veterans. However, it is interesting that even with the structured follow-up, 1 Veteran reported barriers to exercise such as inadequate strength, needing help, and lack of understanding about the prescribed exercises. This seems to suggest that a telehealth application might not be sufficient for some individuals to overcome all barriers to exercise. It is not known if a traditional approach of face to face instruction rather than instruction through a telehealth application would have been more effective at eliminating the identified barriers to exercise. This may be an important question to ask in future studies. Another important finding of this study was the progression of exercise intensity through the program. During the 12-week intervention the Veterans were able to increase their exercise intensity with increased number of exercises (100%), increased number of repetitions of exercises (50%), and increased resistance while exercising (25%). Modifying and advancing the exercise program is important for long-term management of physical disability after stroke. To our knowledge, this is the first report of exercise program modification after discharge from traditional rehabilitation after stroke. Making modifications to advance the exercise program is important for long-term disability management, and it has been identified as an educational need for patients as they are being discharged from traditional rehabilitation [17]. Based on the results of this study, a tele-rehabilitation program such as STeleR may be able to provide this needed education on exercise progression to people with stroke after discharge from traditional rehabilitation.

Finally, the function and disability improvements reported in this study were modest and not statistically significant. The amount of change reported on the LLFDI function domain (improvement in 4

points) is consistent with the minimal detectable change (MDC) on the same domain in people participating in outpatient cardiac rehabilitation [24], suggesting a real change in function between baseline and 3 months in this sample. However the changes in the disability domains (frequency, 4; and limitation, 1) did not reach the MDC levels of the same domains (frequency, 7.8; and limitation, 16.7) reported for people in outpatient cardiac rehabilitation [24]. Due to the sample size in this small pilot study, future studies are needed with larger samples in clinical settings to better assess the efficacy of the STeleR program on patient-reported function and disability. As with all studies this study had some limitations that deserve mention. The primary limitation was a small sample size which limits power in statistical tests and inference to other populations. However, the sample was adequate to establish feasibility of implementing a tele-rehabilitation intervention for people with stroke to improve exercise adherence and safety at home. Another limitation is implementation of the STeleR program in one large urban VAMC in a single clinical service. Future studies will need to include larger samples, other clinical services, and a more diverse geographical recruitment area.

Conclusion

The objectives of this pilot study were to; 1) implement a tele-rehabilitation program with Veterans who have had a stroke in a real world clinical setting, and 2) assess exercise adherence, exercise progression, and changes in function and disability during the program. Veterans were successfully enrolled in the program with excellent exercise adherence and progression during the intervention. Improvements in function and disability were modest and not statistically significant but encouraging for such a small sample. In conclusion the results of this study suggest that a tele-rehabilitation program designed to promote appropriate exercise and safe function at home can be implemented and may be beneficial as part of in-home care after stroke.

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