eRehabilitation after stroke: the interplay between the effectiveness, the implementation and the context
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What works and why in the implementation of eRehabilitation after stroke: a process evaluation

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ABSTRACT

Background: The implementation of an eRehabilitation intervention (consisting of cognitive and physical exercise applications, activity-tracking and psycho education) in stroke rehabilitation resulted in small health-related improvements. This process evaluation aimed to understand what worked and why in the implementation and to identify areas for improvement for future implementations by 1) evaluating implementation activities, 2) exploring mechanisms of impact and 3) and identifying contextual factors influencing the implementation.

Methods: Predefined implementation activities (including information provision for healthcare professionals and patients, integration of the intervention into conventional rehabilitation, instruction, practical support and motivation of professionals directly involved) were carried out over a 14-months period in a specialized rehabilitation facility. Mixed-methods were used, guided by the Medical Research Council framework for process evaluations. Implementation activities were evaluated by field notes, surveys and user data; mechanisms of impact by surveys; contextual factors by field notes and interviews. Field notes were made during the implementation. Interviews were held with 11 professionals. Surveys on satisfaction with the implementation activities, intervention and factors potentially influencing the implementation were conducted among 51 professionals and 73 patients. User data were extracted from the eRehabilitation applications.

Results: Implementation activities were mostly executed as planned and supplemented with instructional activities. From the professionals trained to deliver the intervention (33 of 51 professionals included in the survey), 25 (75.8%) delivered it. From the 165 patients, 82 (49.7%) received the intervention, with 54 (65.8%) using it. Concerning the mechanisms of impact, professionals and patients were equally satisfied with implementation activities (median score 7.0 (IQR 6.0-7.75) versus 7.0 (6.0-7.5), respectively), but patients were more satisfied with the intervention (8.0 (IQR 7.0-8.0) versus 5.5 (4.0-7.0)). The rating of impact on the implementation showed highest scores for, amongst others, personal guidance by professionals (patients), and the support of ambassadors and time given for training (professionals). Professionals rated the integration into conventional rehabilitation as insufficient. Contextual factors hampered the implementation, including unexpected financial cutbacks and technical setbacks.

Conclusion: Main areas for improvement of the implementation of eRehabilitation appear to be related to healthcare professionals' perceptions on the intervention, actual integration of eRehabilitation into conventional rehabilitation, as well as contextual, mostly technical and organizational, factors.

INTRODUCTION

Over the last decades, the availability and quality of digital health technology in rehabilitation (eRehabilitation) increased [1,2]. eRehabilitation may include various modalities such as online physical or cognitive exercise programs, serious gaming, education or e-consultations [3-6] and has the potential to improve the quality and frequency of rehabilitation therapy [7,8]. A major target population in medical specialist rehabilitation are stroke patients. As the incidence of stroke and survival rates increase in our ageing society [9], eRehabilitation may provide a solution for the growing demand for stroke rehabilitation and healthcare-related costs. Recent systematic reviews concluded that eRehabilitation after stroke might lead to better health-related outcomes [10-12], improved access to care [4], reduced healthcare costs [8] and improved self-management of patients [13]. However, it is hard to draw conclusions about the effectiveness of stroke eRehabilitation in general, since the characteristics of interventions and outcomes measured varied greatly across studies and most studies were not adequately powered [8].

An important observation regarding eRehabilitation is that its usage by patients and healthcare professionals in clinical practice is, despite implementation efforts, generally limited [14]. This finding highlights the need for studies that provide insight into why eRehabilitation interventions work or fail, and in particular how interventions and implementation strategies can be improved [15]. The implementation of eRehabilitation may be influenced not only by the eRehabilitation intervention itself, but also by the implementation strategy and the context in which it is executed, the latter often varying from one intervention, organisation or country to another [15,16]. Therefore, comprehensive, systematic evaluations taking into account all of these aspects are very important [8,15]. The Medical Research Council (MRC) framework is frequently used to structure such comprehensive evaluations of the implementation of interventions [16]. Their results make it possible to better interpret findings of effectiveness studies, and may contribute to the evidence base for recommendations for the design and execution of future implementation projects [17].

Despite the importance of comprehensive process evaluations, to our knowledge, only one process evaluation is published in the field of eRehabilitation after stroke. That study was performed in Uganda, and concerned a mobile phone-supported rehabilitation intervention [18]. Terio et al. investigated the user experiences and contextual factors influencing the implementation. It was concluded that the implementation strategy was partially delivered as planned and that barriers, including technical setbacks, and facilitators, including motivated participants, influenced the implementation. However, that study did not follow the MRC guidelines [19], and did not describe details of the implementation strategy nor evaluated the mechanisms through which the intervention and implementation strategy might have worked.

Recently, an observational effect study was performed, which aimed to evaluate an eRehabilitation intervention, integrated into conventional stroke rehabilitation (Fit After Stroke @Home, Fast@Home, Box 1). As compared to conventional stroke rehabilitation alone, patients treated in the period where the eRehabilitation intervention was offered

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to all admitted stroke patients, showed a greater improvement on the Stroke Impact Scale domains communication, memory, meaningful activities and physical strength, three to six months after admission. However from admission until three months thereafter no statistically significant differences were found [20].

The aim of the current process evaluation was to describe and evaluate the implementation of the Fast@home eRehabilitation intervention in a medical specialist rehabilitation facility. More specific, the objective was to understand what worked and why in the implementation of the Fast@home eRehabilitation intervention into conventional rehabilitation and to identify areas for improvement in future implementations. This was done with the guidance of the MRC framework for 1. describing and evaluating the implementation activities (dose, fidelity, adaptations, reach); 2. exploring mechanisms of impact (patients and healthcare professionals responses and interaction with the intervention and implementation strategy); and 3. identifying contextual factors that influenced the implementation of the eRehabilitation intervention.

METHOD

1. Setting
The Fast@home eRehabilitation intervention was implemented at two locations of a specialized rehabilitation facility in the Netherlands (Basalt The Hague, Basalt Leiden). In the Netherlands, approximately 10% of the stroke patients receive inpatient and/or outpatient rehabilitation treatment. Rehabilitation treatment is provided in accordance to a national guideline [21], delivered by a multidisciplinary team including a rehabilitation physician (RP), physical therapist (PT), occupational therapist (OT), speech therapist, psychologist and social worker. Stroke rehabilitation treatment generally focuses on improving motor, cognitive or psychological function, speech, and/or daily activities and participation. The average duration of treatment varies, from 44 days for inpatient rehabilitation, to 119 days for outpatient rehabilitation [22].

2. Study design
In this mixed methods study, the MRC guidelines for process evaluation of complex interventions were followed [19]. The three domains of evaluation recommended by the guidance were explored, namely implementation, mechanisms of impact, and contextual factors (Figure 1).

Box 1: The Fast@home effect study

Aim: Compare the effects of a multidisciplinary eRehabilitation intervention offered alongside conventional stroke rehabilitation, with conventional stroke rehabilitation.

Design: Pre-test post-test comparison in two rehabilitation centres in the Netherlands (Basalt The Hague and Leiden), with 12 months control period and 12 months intervention period, with both inpatients and outpatients.

Intervention: Fast@home is an eRehabilitation intervention consisting multiple already existing applications;

- physical exercise program, named Physitrack which was used in The Hague (Physitrack Limited, London, Great Britain) and Telerehabilitation, used in Leiden (Roessingh Research & Development, Enschede, Netherlands)
- cognitive exercise program named Braingymmer (Dezzel Media, Almere, Netherlands),
- activity-tracker named Activ8 (Activ8 consumer, 2M Engineering, Valkenswaard, Netherlands)
- psycho education based on the Dutch patients association (www.hersenstiching.nl)

Each patient was offered access to the psycho education. For the patients who would benefit from it, additional applications were offered. In this eRehabilitation intervention, healthcare professionals compiled an exercise program tailored to each patient personal goals and monitored the results and adherence of the patients. Fast@home is a web-based intervention and can be used on each smartphone, laptop, pc or tablet.

Professionals where provided with objective data including time of use in each application, number of attempted and successful repetitions, in order to better support the patient and/or adapt the programme if required.

Methods: Questionnaires at admission (T0), three months (T3) and six months (T6) after admission, and administration of the use of the intervention by the application developers. Primary outcome was the Stroke Impact Scale (SIS), secondary outcomes were health-related quality of life, measured with the EuroQoL-5D (EQ5D) and the 12-item Short-Form Health Survey (SF-12); fatigue, measured with the Fatigue Severity Scale (FSS); Self-management measured with The Patient Activation Measure Shorted form 13 (PAM-13) and participation measured with the Utrecht Scale for Evaluation of Rehabilitation-Participation (USER-P) and the International Physical Activity Questionnaire Short Form (IPAQ-SF).

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Outcome: A positive significant effect was found between three and six months in the SIS domains Communication, Memory, Physical Strength and Meaningful activities. Users of eRehabilitation showed a trend toward greater improvements compared to the whole intervention group including those who did not use eRehabilitation. However, Fast@home did not result in any clinically relevant difference or effect over the entire six-month period.

1. The implementation domain explores which elements of the implementation strategy are actually delivered (dose), how delivery is achieved (fidelity and adaptations) and whether the intended target group comes into contact with the intervention (reach). It covers Objective 1 of this study, i.e. describing the implementation strategy.
2. The mechanisms of impact domain identifies the process through which the intervention and implementation activities produce changes (Objective 2, to explore participants responses and interaction with the intervention).
3. The contextual factor domain explores the contextual elements that positively or negatively affect the implementation and outcomes (Objective 3, to identify contextual factors influencing the implementation).

The study was approved by the Medical Ethics Review Committee (protocol P18.038) of the Leiden University Medical Center and all participants gave written informed consent.

3. Implementation strategy

The implementation strategy used in this study was developed to target barriers and facilitators in the implementation of the eRehabilitation intervention, as identified in preceding focus group and survey studies [23,24]. The implementation strategy included activities that focused on the following four domains: Information provision, Integration, Instruction & support and Motivation. The implementation activities targeted almost all healthcare professionals working in stroke teams within the two rehabilitation facilities, with a specific focus on the RPs, PTs and OTs who are primarily involved in delivering eRehabilitation to the patients. Several activities also targeted patients and their informal caregivers. An overview of the activities of the implementation strategy is given in Table 1.
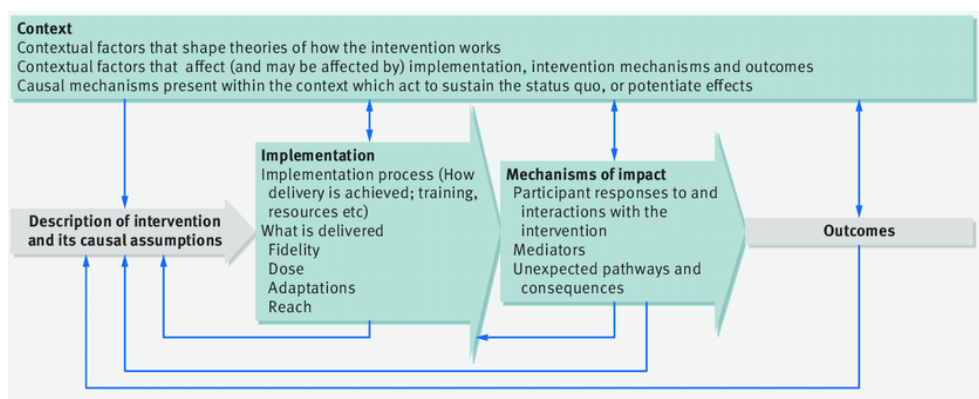

Figure 1. MRC framework for evaluations of the implementation processes [16]

An overview of the timing of the phases of the Fast@home project is given in Figure 2. First, before the control period, focus group and survey studies identified expected barriers and facilitators regarding the delivery and use of eRehabilitation among patients, informal caregivers and healthcare professionals (December 2016 – June 2016). Second, during the control period, patients received conventional rehabilitation without eRehabilitation (May 2016 – April 2017) and simultaneously, the intervention and implementation strategy were designed (July 2017 – February 2017), based on the results of the preceding studies. During the last three months of the control period, healthcare professionals were already informed about the eRehabilitation intervention, but without the possibility to use it. During the intervention period (May 2017- April 2018) the eRehabilitation intervention was integrated into conventional stroke rehabilitation and data for the current process evaluation were collected. During the whole intervention period, implementation activities were performed (March 2017 – April 2018).

Table 1. Implementation strategy of the Fast@home eRehabilitation intervention

Element of strategy; Aim of element	Description	Timing	Frequency	Pat	Prof
Information provision; Informing end-users about the existence and potentials of eR	- News items via internal & external communication	3 months before until start of inter-vention	Variable, ± once per month	x	x
	- Presentation about potential eRehabilitation		Once	.	x
	- Promotional activities (banners, flyers, treats, etc.)		Continuous	x	x
Integration; Actions for integrating eRehabilitation into the conventional rehabilitation process	- Discuss benefits of applications for the patient during multidisciplinary team conferences	Start until end of interven-tion	Continuous	.	x
	- Login credentials in electronic patient registries		Continuous	.	x
	- Administering patient email address		Continuous	x	.
	- Email with login credential send to patient		Continuous	x	
	- Use of eRehabilitation discussed during consultation with PT, OT or RP		Continuous	x	x
Instruction & support; Increase ease of use and offering support in case of problems	- Joined instruction for RP, OT, PT (2 hours)	Start until end of interven-tion	Once per prof	.	x
	- Helpdesk by telephone and email		Continuous	x	x
	- Students available for support		Continuous	x	x
	- Ambassador* available for support (2 h/week)		Continuous	.	x
	- Manuals for patients and professional		Continuous	x	x
	- Information folder for each patient		Continuous	x	
Motivation; Keeping end-users involved and motivated	- Recurrent presentation about use and potential of eRehabilitation	Start until end of interven-tion	Once per 4 months	.	x
	- Motivation from management**		Continuous	.	x
	- Video with patient using eRehabilitation		Once	.	x
	- Promotional activities (banners, flyers, treats, etc.)		Continuous	x	x

Pat; patients, Prof; healthcare professionals, eR; eRehabilitation, RP; rehabilitation physicians, PT; physical therapist, OT; occupational therapist, *Ambassador; physical therapist with extra time and knowledge to support colleagues; **Management; executive board, managers and rehabilitation physicians

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3.1 Information provision

All potential end-users (patients and their informal caregivers if applicable and healthcare professionals) were informed about the availability and potential advantages of the eRehabilitation intervention Fast@home, prior to the start of the intervention period and by means of internal and external communication, presentations and promotion materials (banners, flyers, etc.).

3.2 Integration

For the integration of the intervention within regular care, the conventional stroke rehabilitation process was first described. Next, a meeting was organized with representatives of the different professionals involved in each step of this rehabilitation process (e.g. OT/PT, RP, nurse, administrative assistant). In that meeting, the integration of the intervention into conventional stroke rehabilitation was discussed. The results were included in practical guidelines for each location, that prescribed in detail which actions should be taken by whom within each phase of the rehabilitation process.

3.3 Instruction & support

RPs, PTs and OTs who were directly involved in the rehabilitation of stroke patients were instructed in the delivery of the eRehabilitation intervention and the developed practical guidelines. This was done during joined instruction sessions (3 sessions, 2 hours per session, one session per healthcare professional) prior to the start of the intervention period of the effect study. Other stroke team professionals (i.e., psychologist, social worker, etc.) were informed during presentations and via internal communication. During the intervention period, support was given to healthcare professionals and patients by a helpdesk (both telephone and email), manuals and specifically trained movement technology students. For the healthcare professionals, additional support was provided by an ambassador. This ambassador was a PT who was skilled in and motivated for the delivery of eRehabilitation. Each ambassador (one per rehabilitation facility) was available for two hours per week to support colleagues in using the eRehabilitation intervention and to pass on questions and feedback to the research team.

Figure 2. Timing of the investigation of barriers and facilitators (23,24), the development of an implementation strategy and an eRehabilitation intervention, the implementation period and evaluation by the current process evaluation. In light blue the effect study with a control and intervention period.

3.4 Motivation

During the intervention period, all users were motivated by presentations, support from their managers and a video of a patient while using Fast@home.

4. Participants and data collection

Data collection methods for each domain of the MRC framework are summarized in Table 2. Both quantitative and qualitative data were collected using a mixed-methods approach. For the evaluation of the implementation (Objective 1), data were collected using field notes, a survey among patients and a survey among healthcare professionals and user data of the Fast@home eRehabilitation intervention. To explore the mechanism of impact (Objective 2), data from the aforementioned surveys were used. For identification of the contextual factors (Objective 3), data were collected using individual in-depth interviews with healthcare professionals and field notes.

All stroke patients admitted during the intervention period of the effect study could receive the Fast@home intervention, which was decided by the treating healthcare professional (see box 1 as well). Patients admitted during this period could participate in the effect study and/or the process evaluation. All healthcare professionals that provided stroke rehabilitation during the intervention period were invited to participate in this process evaluation.

Table 2. Sources and data collection methods in the three domains of the MRC framework

Aim	Content; measurement outcome	Data collection method
1. Implementation; How the implementation is delivered		
1.1 Fidelity	Whether the intervention was delivered as intended; n participants at (online) instruction, n presentations, etc.	Field notes (Ql)
1.2 Adaptations	Changes in implementation strategy	Field notes (Ql)
1.3 Dose	The quantity of intervention implemented; n participants noticed elements of implementation	Survey patients and professionals (Qt)
1.4 Reach	Whether the intended audience comes into contact with the intervention; n participants using Fast@home	Survey patients and professionals (Qt), user data of patients (Qt)
2. Mechanism of impact; Responses of participants	Satisfaction about implementation (information provision, motivation, instruction & support, integration) and eRehabilitation/Fast@home	Survey patients and professionals (Qt),
F3. Context; factors associated with use	Factors influencing the implementation and perceived impact of eRehabilitation	Interviews professionals and field notes (Ql)

Qt; quantitative data, Ql; qualitative data

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4. 1 In-depth interviews

All OTs and PTs who were instructed in the delivery of the eRehabilitation intervention and still worked in one of the rehabilitation facilities after the end of the intervention period (n=35) were invited to participate in the in-depth interviews regarding the delivery and barriers and facilitators for the delivery of the eRehabilitation intervention. RPs were not invited because in practice only PTs and OTs delivered the eRehabilitation intervention. RPs were only involved in the prescription of the intervention to stroke patients. We continued interviews with OTs and PTs until data saturation was reached. Data saturation was reached when no novel concepts emerged during three consecutive interviews [26]. The interview guide was based on the results of the preceding focus group study and survey study [23,24]. Questions included were: 'What is your experience (feasibility, added value compared to conventional methods, integration) with the eRehabilitation intervention?', 'Why did you (not) deliver the eRehabilitation intervention?' and 'How can we improve your experience with eRehabilitation?' Prompts (i.e. the content, ease of use, lay-out and accessibility) were included to encourage the participants to reflect on possible improvements. The duration of the in-depth interviews varied from 20 to 40 minutes and were conducted by two researchers (SH, BB).

4.2 Field notes

Throughout the implementation and intervention period of the effect study, field notes were made by the primary researcher and the Fast@home-ambassadors. These field notes concerned contextual factors influencing the implementation, perceptions of users of the intervention and number of healthcare professionals attending instructional activities. Field notes were tagged with date and rehabilitation facility location where the field note was taken.

4.3 Surveys

Two separate surveys were developed, one for patients and one for healthcare professionals. This was done by two researchers involved in the development and execution of the implementation strategy (BB, LvB). The surveys included questions concerning the previously identified barriers and facilitators [23,24] and the activities of the implementation strategy. Both surveys were pilot tested on readability, content and length by two patients and five professionals (SH, SB, JM, IK, AM).

The survey for the patients included baseline characteristics (gender and age) and questions regarding the possession of digital technology including smartphone, laptop, tablet, PC (yes/no). The survey also included questions to evaluate whether patients received (yes/no) and used (yes/no) the eRehabilitation intervention. If patients had not used the intervention at all, the survey was ended. If patients had used the eRehabilitation intervention, they were asked to complete the following items: use of the five applications that were part of the eRehabilitation intervention (5 items, yes/no), satisfaction about these five applications if used (5 items, range 0-10), awareness of the implementation activities (7 items, yes/no), the contribution of those activities to the use of the eRehabilitation intervention (range 0-10), the perceived barriers/facilitators in the context (7 items, range 0-10), satisfaction with the implementation in general and the eRehabilitation intervention in general (range 0-10),

willingness to use Fast@home and eRehabilitation in the future (both yes/no), and whether patients performed exercises prescribed in the eRehabilitation intervention without login in (yes/no).

The survey for the healthcare professionals included the following items: professional discipline, delivery of the five applications that were part of the eRehabilitation intervention (5 items, yes/no), satisfaction about these five applications if delivered (5 items, range 0-10), awareness of implementation activities (9 items, yes/no), the contribution of these activities to the delivery of eRehabilitation (range 0-10), perceived barriers/facilitators in the context (11 items, range 0-10), satisfaction with the implementation in general and the eRehabilitation intervention in general (range 0-10), and willingness to deliver the Fast@home intervention and eRehabilitation in the future (both yes/no).

The patient survey was sent out in May 2019 to 210 patients admitted during the intervention period of the effect study (both patients who participated and patients who did not participate in the effect study), by email (n=160) and on paper (n=50) if no email address was available. Reminders were sent after two and four weeks. Thereafter, non-responders were phoned by the research team (maximum two times). If a patient responded to the phone call, the survey was administered by telephone if the patients was willing to complete it in that way. The survey for healthcare professionals (all member of the multidisciplinary team, n=80) was conducted in January 2019, individually during the weekly team conferences, to include as many as possible responders. To those who were not present at the team meetings, a personal email was sent to ask them to participate in the survey.

4.4 User data

The inclusion of patients in the effect study was done in cooperation with the ongoing, observational study Stroke Cohort Outcomes of REhabilitation (SCORE; Dutch Trial Register no. 4293 [22,25]). Inclusion criteria for patients were: being 18 years or older and time since first or recurrent stroke less than six months. Exclusion criteria were severe psychiatric conditions, inability to communicate in Dutch, concurrent acquired brain injury and/or drug or alcohol abuse. For patients included in the intervention group of the effect study, it was recorded whether they received and used the eRehabilitation intervention. For each patient who used the intervention, the number of exercises performed in the individual applications of the intervention were recorded, and how long the intervention was used (days between the first and last exercise). Details about this data collection are published elsewhere [20].

5. Data analyses

5.1 In-depth interviews and field notes

In-depth interviews were audio-taped and transcribed in full. Both in-depth interviews and field notes were analysed with initial line-by-line open coding. The codes were discussed between the two researchers (BB and LvBV) and categorized according to the levels of the implementation model of Grol and Wensing; i.e. the innovation, the organisational context, the individual patient, the individual professional, the financial context and the social context [27].

5.2 Survey and user data

Survey and user data were described using means and standard deviations (SD), median and inter quartile ranges (IQR), or numbers and percentages. Participants who completed <90% of the survey were excluded. Analyses were performed using Statistical Packages for the Social Sciences (IBM SPSS 25.0 for Windows). STARI guidelines were used for adequate data collection, analyses and reporting [28].

RESULTS

Participant response & characteristics

In-depth interviews

Of the 35 healthcare professionals invited, 11 participated (response rate 31.4%). Three of them were male (27.2%), three were OT and eight were PT.

Surveys

Of the 210 patients who were included in the intervention period of the effect study, 65 were not eligible to participate in the survey; four were deceased, of four there was no valid email or post address available and 57 patients refused participation. So finally, 145 patients were invited for the current process evaluation, of whom 73 participated (response rate 50.4%), with a mean age of 62.9 (SD 13.2) years, 43 males (58.9%) and the majority (n=68, 93.2%) possessing one or more digital devices to use eRehabilitation. Of the 73 patients who participated, 41 (56.1%) were offered the eRehabilitation intervention and 22 of those 41 patients (53.7%) actually used it.

In total, 80 healthcare professionals were invited and 51 participated in the survey (response rate 63.8%); 14 OTs (27.5%), 12 PTs (23.5%), 7 RPs (13.7%), 5 speech therapists (9.8%), 4 psychologists (7.8%), 3 social workers (5.8%) and 6 others (11.7%). Forty-six healthcare professionals who were instructed in the delivery of eRehabilitation (i.e. PT, OT, RP) were invited to participate in the survey, of whom 33 participated (response rate 73,9%), and 25 (73,5%) delivered Fast@home.

User data

165 patients were included in the effect study (details about the inclusion of participants will be published elsewhere [20]. Mean age of those patients was 62.6 (SD 10.5) years, and 103 (62.8%) were male. Of those 165 patients, 82 (49.7%) received Fast@home and 54 (65.9%, 32.7% of total group) used it.

Implementation

The implementation of the eRehabilitation intervention was evaluated regarding the following aspects of the MRC framework: fidelity, adaptations, dose and reach of the implementation strategy.

Fidelity

The implementation activities in the domains Information provision, Motivation and Instruction & support (Table 1) were delivered as planned. However, from the field notes it appeared that regarding the domain 'integration' only one out of the three teams in Basalt The Hague discussed the delivery of eRehabilitation during all weekly multidisciplinary team conferences. Furthermore, it appeared that in the second half of the implementation period promotional activities (banners, flyers, etc.) were less frequently prepared and disseminated by the research team than the intended frequency of once per month.

Adaptations

Table 3 shows activities that were executed in addition to the planned implementation activities, as recorded in the field notes. These activities were performed when the delivery of the eRehabilitation intervention fell behind. It included, amongst others, 1) extra instructional sessions for PTs and OTs, and the provision of more time for PTs and OTs to get familiar with the delivery of eRehabilitation and 2) instruction for all members of the multidisciplinary teams other than RPs, PTs or OTs (i.e. speech therapist, psychologist, social workers, movement agogist, nurses); all healthcare professionals were offered an eLearning about Fast@home, and for the movement agogist and nurses the ambassador introduced Fast@home face-to-face. The aim of the extra training for PTs and OTs was to increase confidence of PTs and OTs in delivering the eRehabilitation intervention. The extra instruction for all healthcare professionals aimed to fulfil their need to increase knowledge about the eRehabilitation intervention. Moreover, nurses and movement agogists were trained in response to PTs' and OTs' observation that they had insufficient time during regular consultations to support patients to start using the intervention.

Table 3. Adaptations made to implementation strategy, as reported in field notes

	Target group	
Domain	**Pat.**	**Prof.**
Motivation		
Extra presentations, one for each multidisciplinary stroke team	.	x
Instruction & support		
Extra instruction time (0.5-2 hours) for physical therapists and occupational therapists	.	x
Extra support from helpdesk (pro-actively offering support)	.	x
Other disciplines (nurses, movement agogist, social workers) instructed in using eRehabilitation	.	x
Integration		
Nurses playing an active role in encouraging patient to use eRehabilitation	x	x
Movement agogist supporting patients in the first time use of eRehabilitation	x	x

Pat; patients, Prof; healthcare professionals

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Table 4: Dose of the implementation, based on survey with patient and healthcare professionals using Fast@home, n patients/healthcare professionals noticed activities of the implementation strategy, in n (%)

Domain	Patients (n=22)	Healthcare professionals* (n=25)
Information provision		
Presentations	.	21 (84.0%)
Promotional activities	18 (81.8%)	22 (88.0%)
Integration		
Email with login credentials	15 (68.2%)	.
eRehabilitation discussed with OT/PT	20 (90.9%)	.
eRehabilitation discussed with RP	14 (63.6%)	.
Instruction & support		
Information folder for patient	16 (72.7%)	20 (80.0%)
Helpdesk (telephone and email)	11 (50.0%)	19 (76.0%)
Manual for patients and professionals	10 (45.5%)	18 (72.0%)
Ambassador	.	19 (76.0%)
ELearning	.	15 (60.0%)
Students available for support	.	14 (56.0%)
Motivation		
Video with patient using Fast@home	.	12 (48.0%)

* Only occupational therapist (OT), physical therapist (PT) and rehabilitation physician (RP)

Dose

Table 4 shows the awareness of the implementation activities (dose) as reported in the surveys by patients and healthcare professionals. On average, each activity of the implementation strategy was noticed by 60.7% (range 45.5%-90.9%) of the 22 patients using eRehabilitation, and 71.1% (range 48%-88%) of the 25 healthcare professionals delivering eRehabilitation. Of all implementation activities, patients who used eRehabilitation most frequently noticed the integration activity 'discussing the use of the eRehabilitation intervention with the PT/OT' (n= 90.9%); healthcare professionals reported that they most frequently noticed the 'promotional activities like banners, flyers, internal and external communication' (n= 88%).

In the field notes it was reported that of the 47 (95.9%) out of 49 healthcare professionals who were invited for the instructional session (RPs, OTs and PTs only) did attend.

Table 5: Reach of patients; use of applications within Fast@home by patients, based on the user data

Use of eRehabilitation (total/used)	Cognitive exercises (n=165/20)	Physical exercises (TR, n=65/20)	Physical exercises (PhT, n=100/16)	Activity-tracker (n=165/15)
Number of exercises, median (IQR, min-max)	14 (2-37, 1-308)	9.5 (4-23, 1-66)	9.5 (3-51, 1-548)	4 (1-15, 1-110)
Period of use, mean days (median, IQR)	26 (9.5-150.5)	25 (16.5-62.5)	9 (1-21)	-*

TR; Telerehabilitation, used in Leiden, PhT; Physitrack, used in The Hague, * Information for Activ8 not available
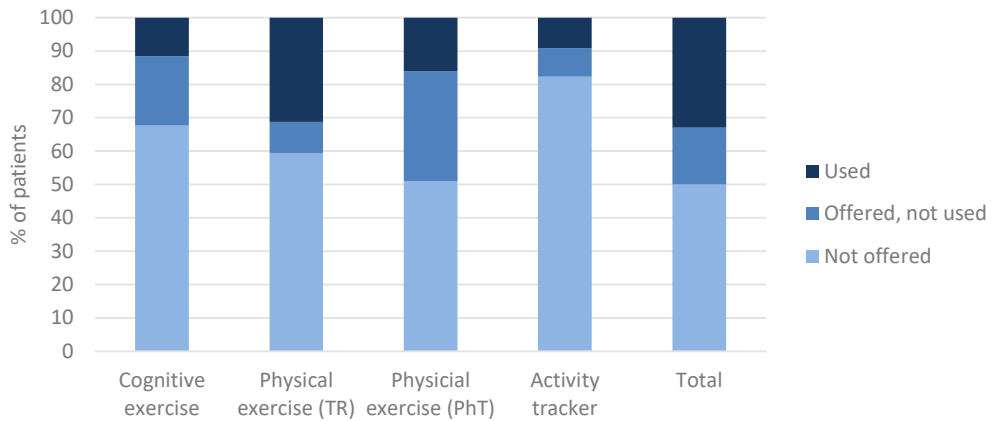
Figure 3. Reach of patients, by the number of patients receiving and using Fast@home. TR; Telerehabilitation, PhT; Physitrack

Reach

Figure 3 shows that 50% (n=82) of the 165 patients with an account for the eRehabilitation intervention had access to at least one application. Subsequently, 65.6% of those who received the intervention (n=54, 29 in The Hague and 25 in Leiden) actually used of one or more of those applications. The cognitive exercise application was used by 20 (24.4%) patients, the physical exercise application Telerehabilitation (Leiden only) by 20 of the 25 patients (80.0%), Physitrack (the Hague only) by 16 of the 29 patients (55.1%) and the activity-tracker by 15 (18.2%) patients.

In Table 5, the median use of the applications is shown, also based on the user data. The cognitive exercise application was most frequently used (median 14 exercise sessions, IQR 2-37) and for the longest period (median number of days 26, IQR 9.5-150.5). The number of exercises performed with the two physical exercise applications were comparable (Telerehabilitation; median 9.5 exercise sessions, IQR 4-23; Physitrack; median 9.5 exercises sessions, IQR 3-51). However, Telerehabilitation was used on average for 25 days (IQR 16.5-62.5) and Physitrack for 9 days (IQR 1-21). The data of the activity-tracker was on average uploaded four times (IQR 1-15). The majority of the patients participating in the survey (n=19, 86.5%) reported that they performed exercises prescribed in the eRehabilitation intervention without logging on since they know the exercises by heart.

Figure 4 shows that 8 of the 14 OTs (57.1%), 12 of the 12 PTs (100%) and 5 of the 7 RPs (71.4%) reported to have delivered at least one application of the eRehabilitation intervention (i.e. physical exercise program, cognitive exercise program or activity-tracker). Since additional instruction was offered to the remaining disciplines, also 2 of the 5 (40%) speech therapists delivered the eRehabilitation intervention, as well as 2 of the 6 (33%) other disciplines (a dietician and movement agogist).
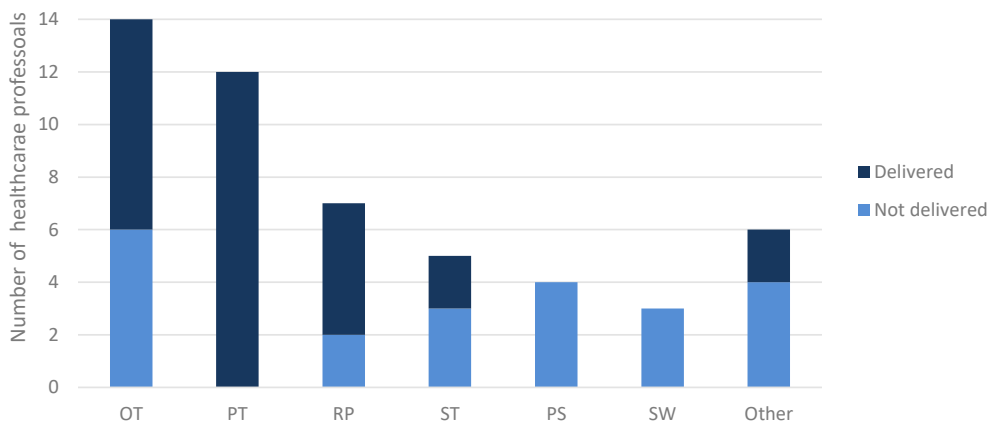
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Figure 4. Reach of professionals, by the number of professionals that delivered Fast@home to stroke patients OT; occupational therapist, PT; physical therapist, RP; rehabilitation physician, ST; speech therapist, PS; psychologist, SW; social worker

Mechanisms of impact

The mechanisms of impact are defined as the extent to which the implementation activities contributed to the delivery and use of the eRehabilitation intervention. The results that describe the mechanisms of impact are shown in Table 6, as measured with the surveys among patients and healthcare professionals.

Interaction with implementation strategy

The satisfaction regarding the implementation activities of healthcare professionals (n=25) and patients (n=22) who respectively delivered and used the eRehabilitation intervention was comparable (median 7.0 (IQR 6.0-7.5) and 7.0 (IQR 6.0-7.75)). Healthcare professionals reported that the support of the ambassadors (domain instruction & support, median 7.0, IQR 6.0-8.0) and the time they were given to learn how to deliver intervention (domain integration, median 7.0, IQR 6.0-8.0) had the greatest impact of all implementation activities. On the contrary, activities in the domain integration hampered the delivery of the eRehabilitation intervention, according to healthcare professionals. This included insufficient integration of Fast@home into conventional stroke rehabilitation (median 4.0, IQR 2.0- 6.0) and insufficient time to apply eRehabilitation in daily rehabilitation practice including the discussion of benefits, explaining how to use the eRehabilitation intervention and to adapt the exercises in the physical exercise applications if needed (median 5.0, IQR 3.0-7.0). Multiple activities of the implementation strategy facilitated the use of the eRehabilitation intervention according to patients. For patients, the implementation activity with the highest impact was individual guidance by PTs and OTs (domain integration, median 7.0, IQR 7.0-8.0),

Table 6. Mechanisms of impact. Interaction with the implementation strategy and intervention, based on survey with patient and healthcare professionals using the eRehabilitation intervention

	Satisfaction/agree	
	Patient (n=22)	Professionals* (n=25)
Interaction with the implementation		
Overall satisfaction about implementation strategy activities (0-10), median (IQR)	7.0 (6.0-7.75)	7.0 (6.0-7.5)
Satisfaction about implementation strategy activities (0-10), median (IQR)		
Information provision; Presentation	.	6.0 (5.5-7.0)
Information provision; Promotional activities	6.0 (6.0-7.0)	7.0 (5.75-7.25)
Integration; Fast@home discussed with OT/PT (personal guidance)	7.0 (7.0-8.0)	.
Integration; Fast@home discussed with RP (personal guidance)	7.0 (5.75-7.25)	.
Integration; Email with login credentials	6.0 (5.0-7.0)	.
Instruction & support; Joint education	.	7.0 (6.25-8.0)
Instruction & support; Sufficient time to learn how to use		7.0 (6.0-7.0)
Instruction & support; Helpdesk (telephone and email)	6.0 (6.0-8.0)	6.0 (5.0-7.0)
Instruction & support; Manual	7.0 (6.0-7.25)	6.5 (5.0-7.25)
Instruction & support; Information folder	6.0 (4.5-7.75)	7.0 (5.0-7.75)
Instruction & support; Ambassador	.	7.0 (6.0-8.0)
Instruction & support; ELearning	.	6.0 (4.0-7.0)
Instruction & support; Students available for support	.	6.0 (3.75-8.0)
Motivation; Sufficiently supported by the Executive Board	.	6.0 (5.0-7.0)
Motivation; Sufficiently supported by managers	.	6.0 (5.0-7.0)
Motivation; Sufficiently supported by rehabilitation physicians	.	6.0 (4.75-8.0)
Barriers/facilitators in the implementation (0-10; disagree-agree), median (IQR)		
I had sufficient time to use eRehabilitation	.	5.0 (3.0-7.0)
Is sufficiently integrated into the conventional rehabilitation	.	4.0 (2.0-6.0)
Interaction with the intervention		
Overall satisfaction about the Fast@home intervention (0-10), median (IQR)	8.0 (7.0-8.0)	5.5 (4.0-7.0)
Satisfaction about applications within Fast@home (0-10), median (IQR)		
Psycho education	7.0 (7.0-8.0)	7.0 (6.0-7.0)
Activity-tracker	8.0 (6.0-8.0)	6.0 (3.0-8.0)
Physical exercise application (Telerehabilitaion)	7.0 (6.0-8.0)	7.0 (7.0-8.0)
Physical exercise application (Physitrack)	7.0 (6.0-8.0)	7.0 (5.75-8.0)
Cognitive exercise application	7.0 (6.0-8.0)	6.0 (3.0-8.0)
Barriers/facilitators related to the intervention (0-10; disagree-agree), median (IQR)		
Contributed to recovery of the patient	7.0 (5.75-8.0)	6.5 (5.0-7.0)
Has added value for my work as professional	.	6.0 (4.5-7.0)
Is applicable in addition to convention therapy	7.0 (6.0-8.0)	6.0 (3.0-8.0)
Is feasible despite disabilities after stroke	7.0 (2.5-10.0)	5.0 (4.0-7.0)
Is user-friendly	7.0 (6.0-7.25)	5.0 (3.0-7.0)
Recommend future use, n (%)		
Recommend Fast@home to others	20 (90.0%)	14 (56%)
Use Fast@home in the future	19 (86.4%)	.
Use eRehabilitation in the future	.	22 (88%)

* Only occupational therapist (OT), physical therapist (PT) and rehabilitation physician (RP)

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Interaction with the intervention

Healthcare professionals who delivered the eRehabilitation intervention reported to be less satisfied with the Fast@home intervention as a whole than patients who used the eRehabilitation intervention (median 5.5 (IQR 4.0-7.0) and 8.0 (IQR 7.0-8.0) respectively). However, healthcare professionals reported to be satisfied about the physical exercise applications (Telerehabilitation median 7.0, IQR 7.0-8.0 and Physitrack median 7.0, IQR 5.57-8.0) and the psycho education (median 7.0, IQR 6.0-7.0), but less about the activity-tracker and the cognitive exercise application (both median 6.0, IQR 3.0-8.0). Patients were relatively satisfied about all five applications in Fast@home; psycho education (median 7.0, IQR 7.0-8.0), two physical exercise application (Telerehabilitation median 7.0, IQR 6.0-8.0; Physitrack median 7.0, IQR 6.0-8.0), cognitive exercise application (median 7.0, IQR 6.0-8.0)) and the activity-tracker (median 8.0, IQR 6.0-8.0). Furthermore, patients reported that the feasibility of the eRehabilitation intervention was high, despite stroke-related impairments (median 7.0, IQR 2.5-10.0), healthcare professionals were more negative (median 5.0, IQR 4.0-7.0). The same difference between patients and healthcare professionals was found concerning the user-friendliness of the eRehabilitation intervention (professional median 5.0 (IQR 3.0-7.0), patient median 7.9 (IQR 6.0-7.25)).

Of the 25 healthcare professionals, 14 (56.0%) would recommend Fast@home to others and 22 (88.0%) wanted to deliver eRehabilitation in the future. When accounted for all responses of healthcare professionals (also those who did not deliver eRehabilitation), a similar proportion of 88.0% (n=45) was found regarding the wish to deliver eRehabilitation in the future. In total, 20 of the 22 (90.9%) patients taking part in survey and used the eRehabilitation intervention would recommend Fast@home to others and 19 (86.4%) were planning to keep using eRehabilitation in the future.

Contextual factors

Table 7 shows the contextual factors influencing the implementation of eRehabilitation, based on the in-depth interviews with 11 healthcare professionals and field notes taken during the intervention period.

Six factors concerned the innovation, of which four reported both as barrier and facilitator and two reported only as barrier. These factors included eRehabilitation being evidence-based (barrier and facilitator), the content of exercise applications being useful to attain the specific rehabilitation goals of the individual patients (barrier and facilitator) and the number of patients per healthcare professional being too small to deliver eRehabilitation regularly and efficiently (barrier only).

Twelve factors, mostly barriers, were identified concerning the organisational context. These factors included insufficient integration of the eRehabilitation intervention into conventional stroke rehabilitation, resulting in healthcare professionals forgetting to deliver eRehabilitation. Insufficient time was also reported, both to learn how to deliver the eRehabilitation intervention and to deliver the eRehabilitation intervention in conventional stroke rehabilitation. Especially 'playing time', in which healthcare professionals can get acquainted with the new intervention was reported as important. Financial cutbacks during the intervention period resulted in less time for the healthcare professionals to properly

incorporate eRehabilitation into their daily routine. Moreover, stroke patients were no longer merely admitted to stroke units, therefore some patients were treated by healthcare professionals who were not instructed how to deliver Fast@home. Another important barrier was the experience of technical setbacks including problems delivering the intervention on an Apple device and uploading data from the activity-tracker. A facilitator at the level of the organisational context was the presence of the ambassadors.

Four factors were identified at the level of the individual patient and three factors at the level of the individual healthcare professional. For both the patients and healthcare professionals, skills and knowledge about how to use and deliver the eRehabilitation intervention were reported as sufficient (facilitator) as well as insufficient (barrier). According to the professionals, insight in daily activities and exercises activities is an important reason for patients to start using the eRehabilitation intervention. For healthcare professionals a motivation to deliver eRehabilitation is that it facilitates the cooperation between PTs and OTs and multidisciplinary work. According to the healthcare professionals, a reason for patients not to use eRehabilitation was that there is no added value of logging in if the patient knew the exercises by heart. The motivation to deliver eRehabilitation for the healthcare professionals was hampered by the feeling of doing double work by prescribing exercises in one of the exercise applications and reporting in the treatment plans.

Concerning the social context, two factors were identified hampering the implementation of the eRehabilitation intervention: the beliefs of the healthcare professional about the effectiveness of eRehabilitation, and the relatively low priority for the implementation of eRehabilitation among managers and RPs.

DISCUSSION

This process evaluation aimed to understand what worked and why in the implementation of an eRehabilitation intervention integrated into conventional rehabilitation for stroke patients, and to identify areas of improvement for future implementations. The implementation strategy was mostly executed as planned and supplemented with additional instructional activities, resulting in the delivery of intervention by three-quarters of the healthcare professionals and in actual usage by two-thirds of the patients who received it. Regarding the mechanisms of impact, it was found that professionals and patients were equally satisfied with the implementation activities, but patients were more satisfied with the intervention. The implementation activities with the highest impact were, amongst others, personal guidance by PTs, OTs and RPs (for the patients) and the support of ambassadors, joint education and time given for learning to deliver eRehabilitation (for the healthcare professionals). However, at the end, professionals reported that eRehabilitation was insufficiently integrated into conventional rehabilitation, despite all implementation activities. Contextual factors that hampered the implementation, including unexpected financial cutbacks, technical setbacks and low priority of the implementation of eRehabilitation among managers and RPs.

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Table 7. Contextual factors influencing the implementation, reported in interviews with professionals and field notes, categorized among the levels of Grol

Factor	Sub-factor	B,F	Quote interviews	Field notes
Feasibility	Helpdesk function	B,F	SH (F); 'I think there was a lot of support for us [therapists] in using eRehabilitation. For example, a helpdesk that was reasonably accessible.' AO (B): No, it [the use of eRehabilitation] was complicated because things didn't work or patients did not have login credentials.'	.
Attractiveness	Ease of use	B,F	SB (B); 'Less clicks and actions would improve the ease of use of the eRehabilitation intervention. It must be simpler.' BM (F): 'For the patients I thought it [the eRehabilitation intervention] was convenient, it is very clear how you go through to use the different applications."	.
	Content of eRehabilitation	B,F	MB (B); 'It is better to learn explicitly instead of learning implicitly, so the exercises needs to have something functional. For example, get up from the chair instead of making squats. Now, there are only implicit exercises available.' LH (F); 'There are plenty of options for different exercises within the eRehabilitation intervention. That makes me happy.'	Request from healthcare professional for task-oriented arm/hand exercises, which are not standard but can be developed.
Advantage of use	Innovation offering advantage	B,F	EP (F); 'We have less and less time for treatment per patient. This [Fast@home] is particularly a very good solution to compensate for that problem.' SH (B); 'Since there is some doubt about the added value of this eRehabilitation intervention compared to the conventional treatment, they are not willing to make the investment to learn working with the eRehabilitation intervention.'	A healthcare professional mentioned that patients ask for Fast@home during treatment. Patient see the added value and want to try it.
	Proven effects	B	IS; 'Especially for Braingymmer [cognitive training], it is actually not scientifically proven that that would help.'	In Leiden, professionals are not keen on using the cognitive exercise program because of the lack of scientific evidence.
Applicability	Few patient suitable for eR	B	BM; 'There are times that you use eRehabilitation a lot, but sometimes there a periods in which you are working with patients for whom it is not feasible to use it in their rehabilitation. In those periods, you use it just too little to keep up your skills regarding the use of the eRehabilitation intervention in rehabilitation.'	"Speech therapist and social workers are trained in the use of FAST@HOME and are enthusiastic, but currently they do not see patient to practice it with".
Organisation of care	Conflict with other projects	B	BM; 'We are now very busy with the entire CARAS arm-hand training. Immediately, you notice that FAST@HOME shows a decrease in use because there is limited time to implement new things in addition to the already busy schedules.'	.
	Ambassador useful	F	EW; 'The ambassador does a great job. She sends regular emails and she makes sure there is very frequent time to work with eRehabilitation. So in that sense it is really facilitated and supported.'	Ambassadors help colleagues with first time use of intervention and report that this is helpful.
	Problems administering accounts	B	AO; 'There were problems with the patient administered in Fast@home. It turned out the patient was not registered in Fast@home, which should be done automatically at the start.'	.
Resources	Hardware	B	ET; 'We do not have a computer in our department where patients can use Fast@ home.'	Healthcare professional reporting: "Also, not all patients have their own device."

Innovation

Organisational context (1)

Organisational context (2)

Factor	Sub-factor	B,F	Quote interviews	Field notes
	Software	B	BM; *'Here in the clinical departments there were sometimes complaints about the falling internet connections, which caused problems in using eRehabilitation for patients.'*	Due to an update of the internet firewall, exercises of Braingymmer are not accessible anymore. The Activ8 [activity-tracker] accidentally ended up in the washing machine, and now the activity data is lost.
Time	Time to learn	B	ET; *'I think the recommendation for future projects would be to make sure you have instruction at the beginning, but also 'playing time'. That healthcare professionals can get to know the eRehabilitation program.'*	A healthcare professional was positive but felt that she did not yet master the program, she said she felt insecure. She would like to have 2 hours each week for 5 weeks to learn how to work with eRehabilitation.
	Time to use	B	SH; *'Everyone already has a full schedule and extra something [the use of eRehabilitation] is added. Therapists simply do not have the time to also tailor an exercise program for each patient.'*	Healthcare professionals are willing to try to discuss Fast@home more during conventional therapy, but indicates that there is already little time for each patient.
Changes context and conventional rehabilitation	Financial cutbacks	B	.	This week [December 2017] major budget cuts were announced including redundancy, which gives a noticeable changed in atmosphere within the organization in The Hague.
	Increasing patient related time	B	.	Financial situation is less positive than expected. Guidelines are published to increase production, resulting in less time for additional activities [like innovation projects].
	Patient admitted to all units	B	.	To occupy as many beds as possible, stroke patients are now admitted in all units, including units not instructed in the use of eRehabilitation.
Implementation in conventional care	Implementation in usual rehabilitation	B, F	SB; *'I think it [the use of the eRehabilitation intervention] is not implemented enough in our conventional rehabilitation processes. I forget to use it, because it is something new and you don't get reminders during team meetings.'*	Movement agogist are instructed in the use of eRehabilitation. They are motivated to support patients during their first time use and unburden healthcare professional who had to do this during therapy time.
	Temporary, flex worker	B	ET; *'I set up an exercise program for a patient. I didn't evaluate whether she used it or not, it wasn't for one of my patients.'*	In the summer months, there are several flex workers to compensate for healthcare professional on holiday. Must they be instructed, for e.g. via e-learning?

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Table 7 continued

Factor	Sub-factor	B,F	Quote interviews	Field notes
Individual patient				
ICT-skills		B,F	BM (B): 'For the older patients who do not have a feeling with computers, I will not use Fast@home, it is so unfamiliar for them that it is not going to work.' CB (F): 'To be honest, patients have been using computers for 15 years now. I had a 70-year-old patient with a smartphone, so I think it will be become less an issue.'	.
Motivation to change		B,F	EP (B): 'Patients don't really use the videos. They only see which exercise they have to do and think 'I have to make a squat', for example, and then they will do that, instead of always watching the videos.' AO (F): 'I think that the concept of registering and tracking activity and exercise, is very attractive, and also patients are interested in it. They appreciate it as well.'	.
Individual professional				
Knowledge		B,F	EP (F): 'Patients are very enthusiastic, they realize that they can do more independently. I think that people are also well informed about how to do this.' SH (B): 'Patients do not use it because they do not understand how to use it.'	.
Patient characteristics		B	LH: 'Very often patients starting [with rehabilitation therapy] have limited mental capacity and get easily over stimulated.'	A healthcare professional mentioned: "My patients are too old or do not have a laptop or something."
Motivation to change		B,F	EP (B): 'I think that healthcare professionals have the feeling of doing double work at the beginning. They already report an exercise in the electronic patient registries, and then they also have to prepare the exercise in the eRehabilitation program.' IS (F): 'I think that the multidisciplinary team is aware of using eRehabilitation, so occupational therapist and physical therapist can cooperate together really easy.'	.
Knowledge		B,F	**SB (F):** 'And for example, healthcare professionals have now made a step-by-step plan containing a really clear overview of all the steps to set up an exercise program, and I have the idea that this gives a bit of insight and an extra manual to keep the overview.' **SB (B):** 'After the joined instruction at the start, I felt insecure working with it.'	A healthcare professional mentioned: "I got all flyers on my desk, but the person who brought them said that other worlds knew what to do with them. I don't"
Skill		B	AO: 'Logging in with my credentials, it was a terrible hassle. It will be my age as well.'	.
Social context				
Culture in team		B	ET: 'At a certain point I stopped doing that [motivating colleagues to use Fast@home], if I don't hear anyone anymore.'	Managers say Fast@home has become a goal in itself, as many patients as possible in the study and not so much improvement in care.
Leadership	No priority management	B	ET: 'It all depends on time and, indeed, also on priority. But it [the use of eRehabilitation] has no priority now. You can't change a lot unless the managers say 'we have to do this'.'	The board says Fast@home needs to be used by default, but the professional feel they did not have the opportunity to really invest time and don't master the program.

B; barrier, F; facilitator

The current process evaluation enabled us to identify what worked and why, and thus to reflect on how the implementation may have influenced outcomes and to highlight lessons for future implementation. Previous implementation studies only investigated potential barriers and facilitators for the implementation of eRehabilitation [29-31] or the feasibility or acceptability when implemented [32-34]. Below, areas of improvement for future implementations will be discussed for each of the three domains of the MRC framework.

Regarding the implementation strategy, on first sight the use of the eRehabilitation intervention by patients may seem quite low. A usage rate of 66% among those who received the intervention is, however, in line with previously published studies that reported proportions of patients using eRehabilitation interventions at least once (66-100%, [35-39]). The number of days that the intervention was used (median 19 days) was higher than found in a previous study that reported a median of 5 days [40]. Moreover, in the design of the Fast@home study, all patients admitted to conventional stroke rehabilitation were assumed to be eligible for eRehabilitation. This has probably resulted in a number of patients included in this study who were actually not able to use eRehabilitation. This could well be a reason for healthcare professionals not to offer the intervention to some patients, thereby increasing the percentage of non-users of the total group of patients. Therefore, it is important to gain insights in and better define which patients would be eligible and who would benefit most from eRehabilitation [8].

Regarding the mechanisms of impact, the delivery and use of the eRehabilitation intervention could probably have been improved as we succeeded 1) to integrate the eRehabilitation better in the conventional rehabilitation and 2) to increase the healthcare professionals' satisfaction with the eRehabilitation intervention. To enhance the integration, additional instructions and time to get familiar with the delivery of the eRehabilitation were offered to PTs and OTs, as well as to the whole multidisciplinary team. As a consequence of the involvement of the whole multidisciplinary team, the workload of PTs and OTs delivering the eRehabilitation intervention to patients was reduced and better manageable. Previous literature showed that starting to use an eRehabilitation intervention by patients required the support of a healthcare professions for on average 41 minutes [40]. This support is found to be the most important for patients, in this study and before [32]. However, despite the implementation activities, healthcare professionals were still not satisfied about the integration. Previously, it is already indicated that proper integration of eRehabilitation might be the largest challenge in the maturation of eRehabilitation [6,41] and that successful integration of eRehabilitation in conventional rehabilitation can probably only be achieved when all parts of the conventional rehabilitation are redesigned [6]. To increase healthcare professionals' satisfaction, it is important to address healthcare professionals' lack of belief in the effectiveness of some of the applications within the eRehabilitation intervention. According to the healthcare professionals, the effectiveness of some of the applications within the eRehabilitation intervention was questionable, which influenced their motivation to deliver the eRehabilitation intervention. This confirms findings from previous literature, in which was stated that belief in the effectiveness of an eRehabilitation intervention is crucial for successful delivery [23].

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With respect to contextual factors, a prompt and better response to some observations in the present study could also have led to better results. In our study it appeared that healthcare professionals experienced additional barriers during the intervention period as to the ones they expected on beforehand. These included financial cutbacks that forced healthcare professionals to focus on production instead of novelties like eRehabilitation, low priority given to the delivery of the intervention by managers and rehabilitation physicians, and technical setbacks that made it more difficult for healthcare professionals to deliver the eRehabilitation intervention. This latter barrier was also found in previous studies [6,18], and thus it is an important point of attention for future implementation initiatives.

Based on all of the abovementioned findings, it is recommended for future eRehabilitation initiatives to increase delivery of eRehabilitation by healthcare professionals. This can be achieved by sufficient integration in conventional rehabilitation, increased satisfaction with the intervention and resolve barriers in the context. Therefore, it is important to redesign conventional rehabilitation in such a way that the interventions become an indispensable part of the rehabilitation process. For example, by setting treatment goals for patients that can only be met and measured using eRehabilitation. Such a redesign of the rehabilitation process should be done in co-creation with patients, healthcare professionals and the research team [36]. Moreover, the results indicate that a flexible approach towards the implementation process is needed to be able to give a better response to unexpected barriers for the implementation, such as unexpected financial cutbacks. Regarding the research methodology, we recommend to use techniques developed by experts in action research, which allow adaptation of the intervention and implementation strategy to counteract unexpected barriers [19].

Although this study provides some new insights in the implementation process of eRehabilitation in stoke care, some limitations should be discussed. First, this study focussed on the users of the eRehabilitation intervention more than on non-users. Thus, insight into non-users perceptions of why eRehabilitation was not used and what would have motivated them is limited. Second, the majority (86.5%) of patients reported to use the eRehabilitation intervention without logging in since they knew the exercises by heart. This underlines the challenges of accurately measuring the use of eRehabilitation applications. In our case, the actual use of the eRehabilitation intervention may probably have been higher than reported. Future effect studies and process evaluations should be able to monitor the usage of eRehabilitation interventions better, by giving the patients more incentives to log in to the eRehabilitation applications. Third, the delivery of eRehabilitation intervention by healthcare professionals as part of the conventional rehabilitation was voluntary, resulting in some OTs/PTs barely providing the eRehabilitation intervention to patients. Although there may have been good reasons for this, such as patients being non-eligible for the intervention, making eRehabilitation a fixed part of the conventional rehabilitation would maybe have resolved possible ignorance.

CONCLUSION

In conclusion, the main areas for improvement of an implementation process of eRehabilitation appear to be related to the perceptions of healthcare professionals on the intervention, the actual integration of eRehabilitation in conventional rehabilitation, as well as contextual, mostly technical and organizational, factors.

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References

1. Galea MD. Telemedicine in Rehabilitation. Phys Med Rehabil Clin N Am 2019;30:473-483.

2. Brochard S, Robertson J, Medee B, Remy-Neris O. What's new in new technologies for upper extremity rehabilitation? Curr Opin Neurol 2010;23:683-687.

3. Chen Y, Abel KT, Janecek JT, Chen Y, Zheng K, Cramer SC. Home-based technologies for stroke rehabilitation: A systematic review. Int J Med Inform 2019;123:11-22.

4. Laver KE, Schoene D, Crotty M, George S, Lannin NA, Sherrington C. Telerehabilitation services for stroke. Cochrane Database Syst Rev 2013;16:CD010255.

5. Webster D, Celik O. Systematic review of Kinect applications in elderly care and stroke rehabilitation. Journal of neuroengineering and rehabilitation, 2014;11:108.

6. Schwamm, L. H., Chumbler, N., Brown, E., Fonarow, G.C., Berube D, Nystrom K, Lacktman N. Recommendations for the Implementation of Telehealth in Cardiovascular and Stroke Care: A Policy Statement From the American Heart Association. Circulation 2017;135:24-44.

7. Krpic A, Savanovic A, Cikajlo I. Telerehabilitation: remote multimedia-supported assistance and mobile monitoring of balance training outcomes can facilitate the clinical staff's effort. Int J Rehabil Res 2013;36:162-171.

8. Laver KE, Adey-Wakeling Z, Crotty M, Lannin NA, George S, Sherrington C. Telerehabilitation services for stroke. Cochrane Database Syst Rev 2020;1: CD010255.

9. Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2197-2223.

10. Corbetta D, Sirtori V, Moja L, Gatti R. Constraint-induced movement therapy in stroke patients: systematic review and meta-analysis. Eur J Phys Rehabil Med. 2010;46:537-544.

11. Johansson T, Wild C. Telerehabilitation in stroke care--a systematic review. J Telemed Telecare 2011;17:1-6.

12. Sarfo FS, Ulasavets U, Opare-Sem OK, Ovbiagele B. Tele-Rehabilitation after Stroke: An Updated Systematic Review of the Literature. J Stroke Cerebrovasc Dis 2018;27:2306-2318.

13. Nam HS, Park E, Heo JH. Facilitating Stroke Management using Modern Information Technology. J Stroke 2013;15:135-143.

14. Standing C, Standing S, McDermott M, Gururajan R, Kiani Mavi R. The paradoxes of telehealth: a review of the literature 2000–2015. Systems Research and Behavioral Science 2018;35:90-101.

15. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M, et al. Developing and evaluating complex interventions: the new Medical Research Council guidance. Int J Nurse Stud 2013;50:587-592.

16. Moore GF, Audrey S, Barker M, Bond L, Bonell C, Hardeman W, et al. Process evaluation of complex interventions: Medical Research Council guidance. BMJ 2015;350.

17. Moore G, Audrey S, Barker M, Bond L, Bonell C, Cooper C, et al. Process evaluation in complex public health intervention studies: the need for guidance. J Epidemiol Community Health 2014;68:101-102.

18. Terio M, Eriksson G, Kamwesiga JT, Guidetti S. What's in it for me? A process evaluation of the implementation of a mobile phone-supported intervention after stroke in Uganda. BMC Public Health 2019;19.

19. UK Medical Research Council (MRC) guidance. Process evaluation of complex interventions. 2017; Available at: https://mrc.ukri.org/documents/pdf/process-evaluation-of-complex-interventions, 2020.

20. Brouns B, van Bodegom-Vos L, de Kloet AJ, Tamminga SJ, Volker G, Berger MAM, et al. The effectiveness of a comprehensive eRehabilitation intervention alongside conventional stroke rehabilitation; A pre-test post-test comparison. J Rehabil Med 2021;53: 0016

21. Limburg M, Tuut MK. CBO guideline 'Stroke' (revision) Dutch Institute for Healthcare Improvement. Ned Tijdschr Geneeskd 2000;144:1058-1062.

22. Groeneveld IF, Goossens PH, van Meijeren-Pont W, Arwert HJ, Meesters JJL, Rambaran Mishre AD, et al. Value-Based Stroke Rehabilitation: Feasibility and Results of Patient-Reported Outcome Measures in the First Year After Stroke. J Stroke Cerebrovasc Dis 2019;28:499-512.

23. Brouns B, Meesters JJL, Wentink MM, de Kloet AJ, Arwert HJ, Boyce L, et al. Factors associated with willingness to use eRehabilitation after stroke: A cross-sectional study among patients, informal caregivers and healthcare professionals. J Rehabil Med 2019;51:665-674.

24. Brouns B, Meesters JJL, Wentink MM, de Kloet AJ, Arwert HJ, Vliet Vlieland TPM, et al. Why the uptake of eRehabilitation programs in stroke care is so difficult-a focus group study in the Netherlands. Implement Sci 2018;13:133-018-0827-5.

25. Groeneveld IF, Meesters JJ, Arwert HJ, Roux-Otter N, Ribbers GM, van Bennekom CA, et al. Practice variation in the structure of stroke rehabilitation in four rehabilitation centres in the Netherlands. J Rehabil Med 2016;48:287-292.

26. Francis JJ, Johnston M, Robertson C, Glidewell L, Entwistle V, Eccles MP, et al. What is an adequate sample size? Operationalising data saturation for theory-based interview studies. Psychol Health 2010;25:1229-1245.

27. Grol R, Wensing M. What drives change? Barriers to and incentives for achieving evidence-based practice. Med J Aust 2004;180:57-60.

28. Pinnock H, Barwick M, Carpenter CR, Eldridge S, Grandes G, Griffiths CJ, et al. Standards for Reporting Implementation Studies (StaRI) Statement. BMJ 2017;356:i6795.

29. Lutz BJ, Chumbler NR, Roland K. Care coordination/home-telehealth for veterans with stroke and their caregivers: addressing an unmet need. Top Stroke Rehabil 2007;14:32-42.

30. Davoody N, Hagglund M. Care Professionals' Perceived Usefulness of eHealth for Post-Discharge Stroke Patients. Stud Health Technol Inform 2016;228:589-93.

31. Hochstenbach-Waelen A, Seelen HA. Embracing change: practical and theoretical considerations for successful implementation of technology assisting upper limb training in stroke. J Neuroeng Rehabil 2012;9:52-64.

32. White J, Janssen H, Jordan L, Pollack M. Tablet technology during stroke recovery: a survivor's perspective. Disabil Rehabil 2015;37:1186-1192.

33. Caughlin S, Mehta S, Corriveau H, Eng JJ, Eskes G, Kairy D, et al. Implementing Telerehabilitation After Stroke: Lessons Learned from Canadian Trials. Telemed J E Health 2019;26:710-719.

34. Szturm T, Imran Z, Pooyania S, Kanitkar A, Mahana B. Evaluation of a Game Based Tele Rehabilitation Platform for In-Home Therapy of Hand-Arm Function Post Stroke: Feasibility Study. PM R 2020:10.1002/pmrj.12354.

6

35. Smith GC, Egbert N, Dellman-Jenkins M, Nanna K, Palmieri PA. Reducing depression in stroke survivors and their informal caregivers: a randomized clinical trial of a Web-based intervention. Rehabil Psychol 2012;57:196-206.

36. Karasu AU, Batur EB, Karatas GK. Effectiveness of Wii-based rehabilitation in stroke: A randomized controlled study. J Rehabil Med 2018;50:406-412.

37. Choi YH, Ku J, Lim H, Kim YH, Paik NJ. Mobile game-based virtual reality rehabilitation program for upper limb dysfunction after ischemic stroke. Restor Neurol Neurosci 2016;34:455-463.

38. Chen J, Jin W, Dong WS, Jin Y, Qiao FL, Zhou YF, et al. Effects of Home-based Telesupervising Rehabilitation on Physical Function for Stroke Survivors with Hemiplegia: A Randomized Controlled Trial. Am J Phys Med Rehabil 2017;96:152-60.

39. van den Berg M, Crotty MP, Liu E, Killington M, Kwakkel GP, van Wegen E. Early Supported Discharge by Caregiver-Mediated Exercises and e-Health Support After Stroke: A Proof-of-Concept Trial. Stroke 2016;47:1885-1892.

40. Pugliese M, Ramsay T, Shamloul R, Mallet K, Zakutney L, Corbett D, et al. RecoverNow: A mobile tablet-based therapy platform for early stroke rehabilitation. PLoS One 2019;14:e0210725.

41. Blacquiere D, Lindsay MP, Foley N, Taralson C, Alcock S, Balg C, et al. Canadian Stroke Best Practice Recommendations: Telestroke Best Practice Guidelines Update 2017. Int J Stroke 2017;12:886-895.