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What works and why in the implementation of eRehabilitation after stroke – a process evaluation

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ABSTRACT

Background: Implementation of an eRehabilitation intervention named Fit After Stroke @Home (Fast@home) – including cognitive/physical exercise applications, activity-tracking, psycho-education – after stroke resulted in health-related improvements. This study investigated what worked and why in the implementation.

Methods: Implementation activities (information provision, integration of Fast@home, instruction and motivation) were performed for 14 months and evaluated, using the Medical Research Council framework for process evaluations which consists of three evaluation domains (implementation, mechanisms of impact and contextual factors). Implementation activities were evaluated by field notes/surveys/user data, it's mechanisms of impact by surveys and contextual factors by field notes/interviews among 11 professionals. Surveys were conducted among 51 professionals and 73 patients. User data ($n = 165$ patients) were extracted from the eRehabilitation applications.

Results: Implementation activities were executed as planned. Of the professionals trained to deliver the intervention (33 of 51), 25 (75.8%) delivered it. Of the 165 patients, 82 (49.7%) were registered for Fast@home, with 54 patient (65.8%) using it. Mechanisms of impact showed that 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]), but patients were more satisfied with the intervention (8.0 [IQR 7.0–8.0] versus 5.5 [4.0–7.0]). Guidance by professionals was seen as most impactful for implementation by patients and support of clinical champions and time given for training by professionals. Professionals rated the integration of Fast@home as insufficient. Contextual factors (financial cutbacks and technical setbacks) hampered the implementation.

Conclusion: Main improvements of the implementation of eRehabilitation are related to professionals' perceptions of the intervention, integration of eRehabilitation and contextual factors.

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➤ IMPLICATION FOR REHABILITATION

- To increase the use of eRehabilitation by patients, patients should be supported by their healthcare professional in their first time use and during the rehabilitation process.
- To increase the use of eRehabilitation by healthcare professionals, healthcare professionals should be (1) supported by a clinical champion and (2) provided with sufficient time for learning to work and getting familiar with the eRehabilitation program.
- Integration of eRehabilitation in conventional stroke rehabilitation (optimal blended care) is an important challenge and a prerequisite for the implementation of eRehabilitation in the clinical setting.

Introduction

Over the last decades, the availability and quality of digital health technology in rehabilitation (eRehabilitation) has 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 of eRehabilitation are stroke patients in medical specialist rehabilitation. 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

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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 outcome measures varied greatly across studies and most studies were not adequately powered [8].

Despite great implementation efforts, usage of eRehabilitation by patients and healthcare professionals in clinical practice is generally limited [14]. This finding highlights the need for comprehensive evaluations that provide insight into why the implementation of eRehabilitation interventions work or fail and in particular how implementation strategies can be improved [15]. To structure the comprehensive evaluations of implementation of interventions, the Medical Research Council (MRC) framework is frequently used [16]. The MRC framework includes three domains of evaluation, namely implementation, mechanisms of impact, and contextual factors. The combination of the results of the evaluation of these three domains and the interactions between them make it possible to better interpret the effectiveness of studies in the clinical practise and may contribute to the evidence for the design and execution of implementation projects in everyday routines [17].

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 evaluated the effect of an eRehabilitation intervention, which was integrated into medical specialist stroke rehabilitation (Fit After Stroke @Home, Fast@Home, Box 1) [20]. This effect study showed greater improvement on the Stroke Impact Scale (SIS) domains communication, memory, meaningful activities and physical strength three to six months after admission for those who received conventional rehabilitation including Fast@home (intervention period), compared to those who received only conventional rehabilitation (control period).

Box 1. The Fast@home intervention and effect study.

Intervention:

Fast@home is a web-based eRehabilitation intervention developed to support stroke patients and healthcare professionals during inpatient and outpatient rehabilitation and after discharge. Patients are instructed to use Fast@home five times a week for 30 min, for 16 weeks.

Fast@home consisted of the following already existing (commercially available) eRehabilitation applications:

- physical exercise program, offered by Telerevalidatie (Roessingh Research & Development, Enschede, the Netherlands, www.telerevalidatie.nl, used in Basalt Leiden) or Physitrack (Physitrack Ltd, London, UK, www.physitrack.com, used in Basalt Den Haag). Exercises for all parts of the body were available and aimed to improve strength, balance, coordination, mobility, stability, speech or aerobic capacity. The exercises were explained by videos within the physical exercise programme. A tailored day-to-day schedule for each participating patient could be compiled by the treating physical and/or occupational therapist including a selection of one or more exercises.
- cognitive exercise program named Braingymmer (Dezzel Media, Almere, Netherlands). Every day, each patient could perform three exercises of 300 s, on the domains concentration, logic, perception, memory and velocity.
- physical activity-tracker (Activ8 consumer, 2M Engineering, Valkenswaard, the Netherlands, www.activ8all.com). This tracker was worn inside a pocket of jeans and measured the time spent on laying, sitting, standing, walking, cycling or running, in min. Data could be uploaded with a personal login and viewed in the dashboard of Fast@home.
- psycho-education. This psycho-education was based on the information given by the Dutch patient association (www.hersenstichting.nl) and included information about stroke, consequences of stroke and stories of other patients and informal caregiver. Pictograms were used to increase ease of use and understanding.

Each patient was offered access to the psycho-education. For the patients who would benefit from it, other applications were offered. In this, 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.

Effect study:

Aim: Compare the effects of Fast@home offered alongside conventional stroke rehabilitation, with conventional stroke rehabilitation.

Design: Number of attempted: 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 inpatient and outpatient.

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)

Outcome: effect Fast@home: 54 of the 165 patients in the intervention period used the intervention. A positive significant effect was found between three and six months in the SIS domains Communication, Memory, Hand function, Physical Strength and Meaningful activities. Users of eRehabilitation showed a trend towards 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.

The aim of the current process evaluation was to understand what worked and why in the implementation of the Fast@home intervention and to identify areas for improvement in future implementations. This was done with the guidance of the MRC framework by (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

Context

The Fast@home intervention was implemented at two locations of a specialized rehabilitation facility in the Netherlands (Basalt The Hague and 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 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].

Research design

In this mixed methods study, the MRC guidelines for process evaluation of complex interventions were followed [19] consisting of following three domains (Figure 1):

1. *The implementation domain* explores which elements of the implementation strategy are actually delivered (dose), how the 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 (i.e., 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 (i.e., 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 Centre. All participants gave written informed consent.

The intervention and implementation strategy

Details about the Fast@home intervention and the preceding effect study are summarized in Box 1. For more details, see the previously published effect study [20].

The implementation strategy included activities in the following four domains: Information provision, Integration, Instruction & support and Motivation. In preceding focus group and survey studies [23,24], barriers and facilitators in the implementation of eRehabilitation were identified. The implementation strategy was developed to target those barriers and facilitators. The implementation activities targeted almost all healthcare professionals working in the stroke teams, with a specific focus on the RPs, PTs and OTs who are primarily involved in delivering Fast@home 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.

The activities of the implementation strategy started three months before the use of Fast@home and continued during the year that Fast@home intervention was delivered as part of the conventional stroke rehabilitation (i.e., the intervention period).

Information provision

All potential end-users (patients, informal caregivers, healthcare professionals) were informed about the availability and potential advantages of 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.).

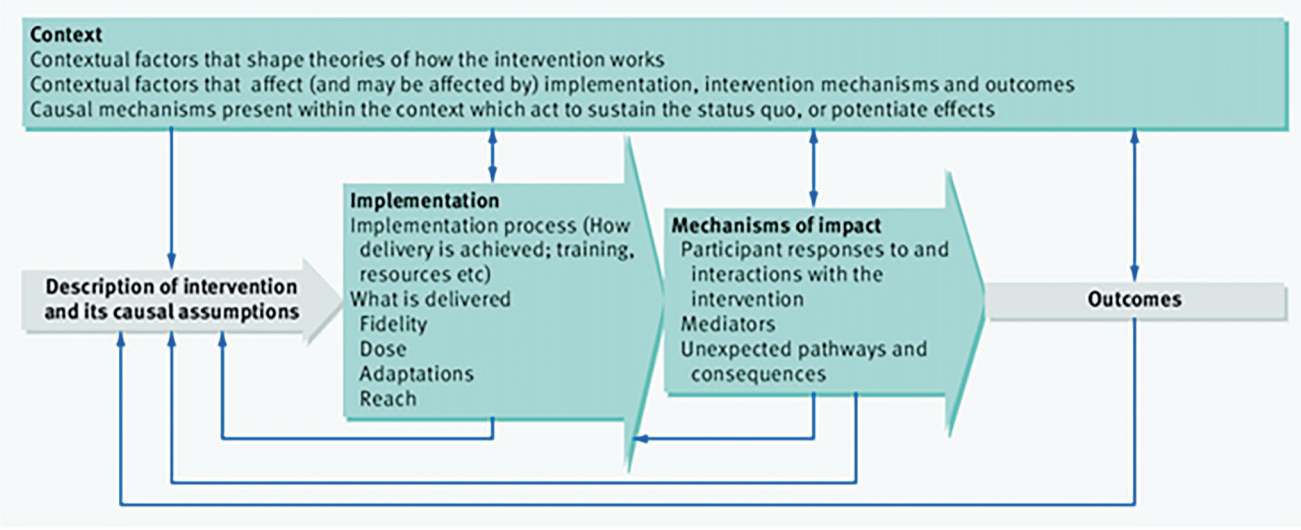

Figure 1. MRC framework for evaluations of the implementation processes. Reproduced from Ref. [16] and not adapted (CC BY 4.0).

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 intervention	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 intervention	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 h)	Start until end of intervention	Once per prof	.	x
	- Helpdesk by telephone and email		Continuous	x	x
	- Students available for support		Continuous	x	x
	- Clinical champion[a] 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 intervention	Once per 4 months	.	x
	- Motivation from management[b]		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.
[a]Clinical champion: physical therapist with extra time and knowledge to support colleagues.
[b]Management: executive board, managers and rehabilitation physicians.

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

Domain MRC: Aim	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),
3. *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.

Integration

For the integration of the intervention within conventional rehabilitation, the conventional rehabilitation process was described step by step. 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). During that meeting, the required adaptation for the integration of Fast@home into conventional stroke rehabilitation was discussed. The results were included in practical guidelines, describing which actions should be taken by whom within each phase of the rehabilitation process.

Instruction & support

Before the start of the intervention period, RPs, PTs and OTs who were directly involved in the rehabilitation of stroke patients were instructed in the use and delivery of Fast@home. This was done during joined instruction sessions (3 h per session) prior to the start of the intervention period. Other stroke professionals (i.e., psychologist, social worker, etc.) were informed during presentations and *via* internal communication.

During the intervention period, support was given to the RPs, PTs, OTs 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 a clinical champion. This clinical champion was a PT who was skilled in and motivated for the delivery of eRehabilitation. Each clinical champion (one per rehabilitation facility) was available for 2 h per week to support colleagues in using the eRehabilitation intervention and to pass on questions and feedback to the research team.

Motivation

During the intervention period, actions to support user engagement and to motivate users were executed, including presentations about Fast@home, arranging support for the use of Fast@home from their managers and showing them the added value of Fast@home for patients by a video of a patient using Fast@home.

Participants and data collection

Data collection of this mixed methods study are summarized in Table 2.

1. For the evaluation of the implementation (objective 1), data were collected using field notes, surveys among patients and healthcare professionals and user data of the Fast@home intervention.
2. To explore the mechanism of impact (objective 2), data from the aforementioned surveys were used.
3. For identification of the contextual factors (objective 3), data were collected using individual in-depth interviews with healthcare professionals and field notes.

Patients admitted during the intervention period could participate in the effect study [20] and/or the process evaluation separately. All healthcare professionals that provided stroke rehabilitation during the intervention period were invited to participate in this process evaluation.

In-depth interviews

In-depth interviews concerned the barriers and facilitators for the delivery of Fast@home. 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, integration) with Fast@home?", "Why did you (not) deliver Fast@home?" and "How can we improve your experience?"

All OTs and PTs instructed in the delivery of Fast@home and still working for the rehabilitation facility ($n = 35$) were invited to participate in the in-depth interviews. We continued interviews with OTs and PTs until data saturation was reached (i.e., no novel concepts emerged during three consecutive interviews [25]). The duration of the in-depth interviews varied from 20 to 40 min and were conducted by two researchers (SH, BB).

Field notes

During the implementation, field notes were made by the primary researcher and the clinical champions. These field notes concerned contextual factors influencing the implementation, perceptions of users and number of healthcare professionals attending instructional activities. Field notes were tagged with date and location where the field note was taken.

Surveys

Separate surveys were developed for the patients and for the healthcare professionals. 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.

The survey for the patients included gender, age and questions regarding the possession of digital technology including smartphone, laptop, tablet, PC (yes/no). The survey also included questions whether patients received an account (yes/no) and used Fast@home (yes/no). If patients did not used Fast@home, the survey was ended. If patients used Fast@home, they were asked to complete the following items: use of the five applications that were part of Fast@home (five items, yes/no), satisfaction about these applications if used (five items, range 0–10), awareness of the implementation activities (seven items, yes/no), the contribution of those activities to the use of Fast@home (range 0–10), the perceived barriers/facilitators in the context (seven items, range 0–10), satisfaction with the implementation in general and the Fast@home 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 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 Fast@home 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 Fast@home (range 0–10), perceived barriers/facilitators in the context (11 items, range 0–10), satisfaction with the implementation in general and Fast@home 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 (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. If a patient responded to the call, the survey was administered by telephone if possible. 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. For those not present at the team meetings, a personal email was sent to ask them to participate in the survey.

User data

For patients included in the intervention group of the effect study ($n = 165$), it was recorded whether they received and used Fast@home. For each patient who used Fast@home, 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].

Data analyses

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 and categorized according to the levels of the implementation model of Grol; i.e., the innovation, the organizational context, the individual patient, the individual professional, the financial context and the social context [26].

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 [27].

Results

Participant characteristics

Figure 2 shows the data gathering methods among patients and professionals, and displays the response rate for each method.

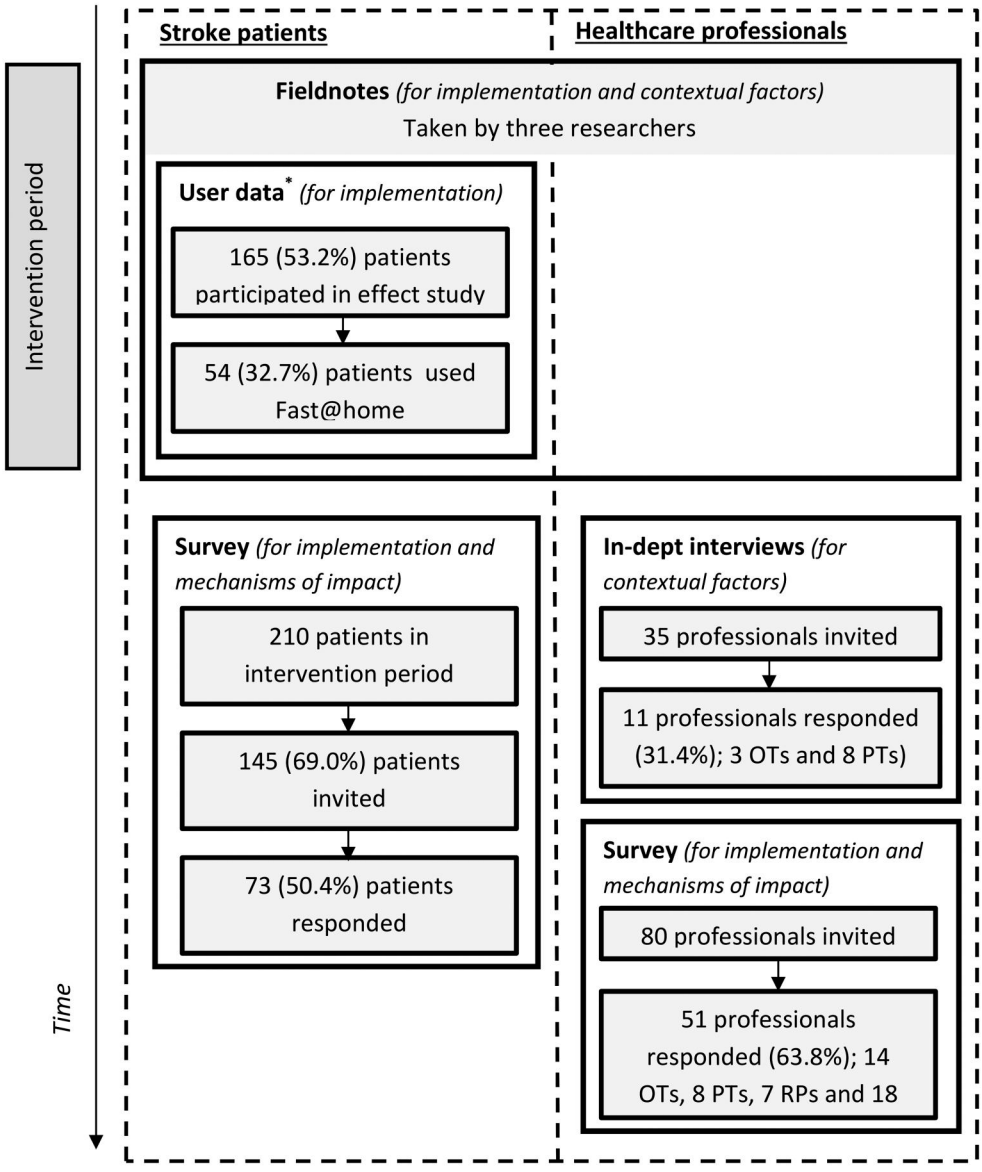

Figure 2. Data collection methods among patients and professionals including response rate and domains of the MRC framework for which the data are gathered.

In-depth interviews

Of the 35 healthcare professionals invited, 11 participated (response rate 31.4%), including 3 OTs and 8 PTs. Three of them were males (27.2%).

Surveys

Of the 210 patients included in the intervention period, 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 process evaluation, of whom 73 participated (response rate 50.4%), 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. Of the 73 patients that participated, 41 (56.1%) were offered the eRehabilitation intervention and 22 of those 41 patients (53.7%) actually used it.

Of the 80 healthcare professionals invited, 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%). If only the disciplines who were instructed in the delivery of Fast@home (i.e., PT, OT, RP) were included, 46 healthcare professionals were invited, 33 participated (response rate 73.9%), of whom 25 (73.5%) delivered Fast@home.

User data

165 patients were included in the effect study, mean age 62.6 (SD 10.5) years, and 103 (62.8%) were male. Detailed description of the patients included in the effect study can be find elsewhere (20).

Evaluation of the implementation (objective 1)

The implementation of Fast@home was evaluated regarding the following aspects of the MRC framework: fidelity, adaptations, dose and reach.

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 Fast@home during all weekly multidisciplinary team conferences. Furthermore, it appeared that during the second half of the intervention period, promotional activities (banners, flyers, etc.) were less frequently prepared and disseminated 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 Fast@home 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 intervention. The aim of this training was to increase confidence of PTs and OTs in delivering Fast@home.
2. instruction for all members of the multidisciplinary teams other than RPs, PTs or OTs; i.e., speech therapist, psychologist, social workers, movement agogist (i.e., a therapist specialized in sport and physical activity for people with a disability) and nurses. All healthcare professionals were offered an eLearning about Fast@home, aiming to fulfil their needs for increased knowledge about Fast@home. In addition, the nurses and movement agogist received a face-to-face introduction in Fast@home by the clinical champion. This was done in response to the observation that PTs' and OTs' had insufficient time during regular consultations to support patients to start using the intervention. After the introduction in Fast@home, the nurses and movement agogist supported the first time use after the additional training.

Dose

Table 4 shows the awareness of the implementation activities (dose). The field notes showed that 47 (95.9%) out of 49 invited RPs, OTs and PTs attended the instructional session for the Fast@home intervention. The survey data showed that each activity of the implementation strategy was noticed by 60.7% (range 45.5%–90.9%) of the 22 patients that actually used Fast@home, and 71.1% (range 48%-88%) of the 25 healthcare professionals that actually delivered Fast@home. Of all implementation activities, patients most frequently noticed the integration activity "discussing the use of Fast@home 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" ($n = 88\%$).

Reach

Figure 3 shows that 50% ($n = 82$) of the 165 patients with an account in Fast@home had access to at least one application. Subsequently, 65.6% of those patients actually used one or more of those applications ($n = 54$, 29 in The Hague and 25 in Leiden). The cognitive exercise application was used by 20 of the 54 (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 of the 54 (18.2%) patients.

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 h) 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.

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[a] ($n = 25$)
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%)
Clinical champion	.	19 (76.0%)
eLearning	.	15 (60.0%)
Students available for support	.	14 (56.0%)
Motivation		
Video with patient using Fast@home	.	12 (48.0%)

[a]Only occupational therapist (OT), physical therapist (PT) and rehabilitation physician (RP).

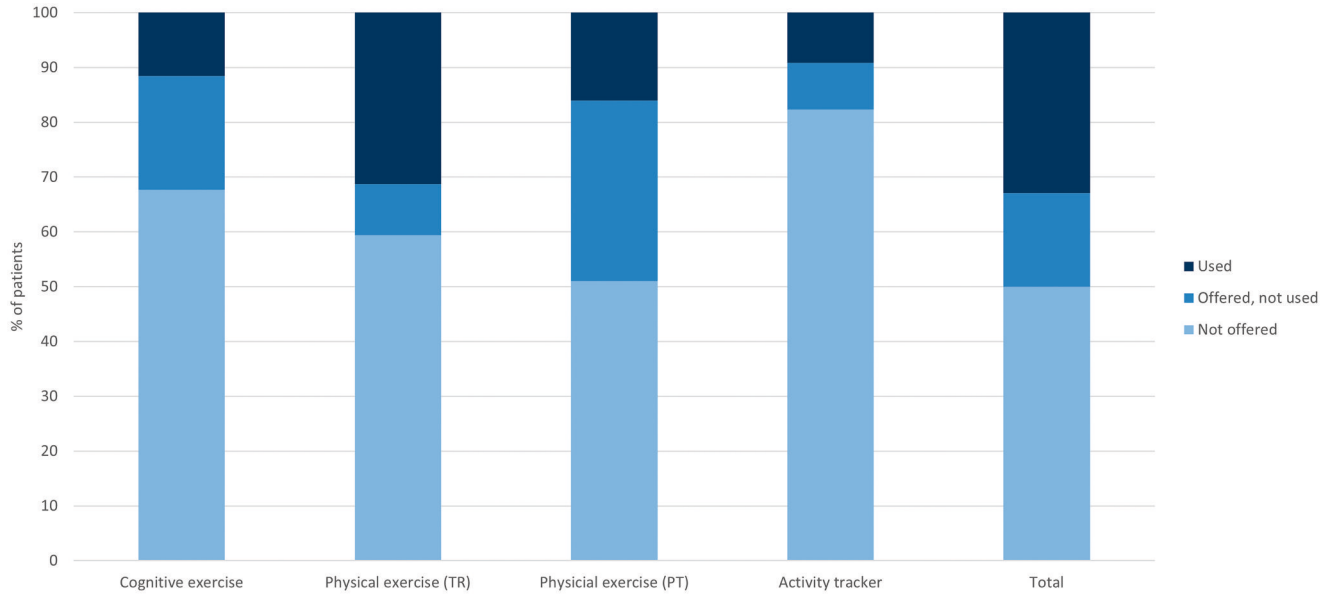

Figure 3. Reach of patients, by the number of patients receiving and using Fast@home.
TR: Telerehabilitation; PT: Physitrack.

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 (PT, $n = 100/16$)	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)	–[a]

TR: Telerehabilitation, used in Leiden; PT: Physitrack, used in The Hague; IQR: inter quartile range.
[a]Information for Activ8 not available.

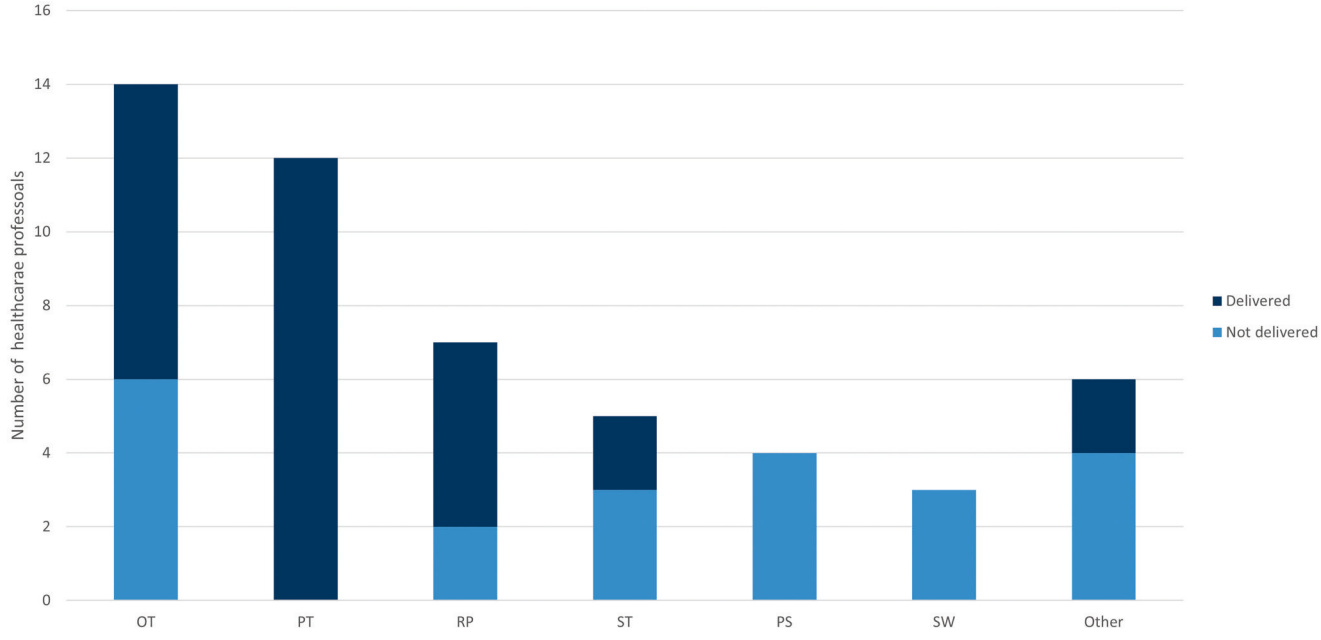

Figure 4. Reach of professionals, by the number of professionals that delivered Fast@home to stroke patients.
OT: occupational therapist; PT: physical therapist; RP: rehabilitation physician; ST: speech therapist; PS: psychologist; SW: social worker.

In Table 5, the median frequency of 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

Table 6. Mechanisms of impact.

	Satisfaction/agree	
	Patient ($n = 22$)	Professionals[a] ($n = 25$)
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; Clinical champion	.	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)	4.0 (5.5–7.0)
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%)

Interaction with the implementation strategy and intervention, based on survey with patient and healthcare professionals using the eRehabilitation intervention.
[a]Only occupational therapist (OT), physical therapist (PT) and rehabilitation physician (RP).

performed exercises prescribed in the Fast@home 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%) delivered at least one application of the Fast@home intervention. Since additional instruction was offered to the remaining disciplines, also two of the five (40%) speech therapists delivered the Fast@home intervention, as well as two of the six (33%) other disciplines (a dietician and movement agogist).

Exploring mechanisms of impact (objective 2)

The mechanisms of impact are defined as the extent to which the implementation activities contributed to the delivery and use of the Fast@home intervention. The results that describe the mechanisms of impact are shown in Table 6, as measured with the surveys among patients who used ($n = 25$) and healthcare professionals who delivered ($n = 22$) the Fast@home intervention.

Interaction with implementation strategy

The satisfaction regarding the implementation activities of healthcare professionals and patients 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 clinical champion (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 Fast@home, 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 Fast@home in daily rehabilitation (median 5.0, IQR 3.0–7.0).

Multiple activities of the implementation strategy facilitated the use of Fast@home according to 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).

Interaction with the intervention

Healthcare professionals reported to be less satisfied about the use of Fast@home in general than patients (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),the psycho-education (median 7.0, IQR 7.0–8.0), and the activity-tracker (median 6.0, IQR 3.0–8.0). Patients were also satisfied about the two physical exercise application (Telerehabilitation and Physitrack [median 7.0, IQR 6.0–8.0]), the 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 Fast@home was high, despite stroke-related impairments (median 7.0, IQR 2.5–10.0). Healthcare professionals were more negative about the feasibility (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 would recommend Fast@home to others and 19 (86.4%) were planning to keep using eRehabilitation in the future.

Identifying influencing contextual factors (objective 3)

Table 7 shows the contextual factors influencing the implementation of Fast@home, based on the in-depth interviews with 11 healthcare professionals and field notes, reported according to the five levels of the implementation model of Grol.

Six influencing factors concerned the Fast@home intervention (innovation), of which four reported both as barrier and facilitator and two reported only as barrier. These factors included Fast@home 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 Fast@home regularly and efficiently (barrier only).

Twelve factors, mostly barriers, were identified concerning the organizational context. These factors included insufficient integration of the Fast@home intervention into conventional stroke rehabilitation, resulting in healthcare professionals forgetting it. Insufficient time was also reported, both to learn how to deliver Fast@home and to deliver it 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 Fast@home 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 were 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 organizational context was the presence of the clinical champion.

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 Fast@home were reported as sufficient (facilitator) and insufficient (barrier). According to the professionals, insight in daily activities and exercises activities is an important reason for patients to start using Fast@home. For healthcare professionals a motivation to deliver eRehabilitation is that it facilitates the cooperation between PTs and OTs. According to the healthcare professionals, a reason for patients not to use Fast@home was that there is no added value of logging in, if the patient knew the exercises by heart. The motivation to deliver Fast@home for the healthcare professionals was hampered by the feeling of doing double work by prescribing exercises in one of the exercise applications and the local administration.

Concerning the social context, two factors were identified hampering the implementation of the Fast@home intervention: the belief of healthcare professionals in 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 Fast@home by three-quarter 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 Fast@home intervention. The implementation activities with the highest perceived impact were personal guidance by PTs, OTs and RPs (for the patients) and the support of clinical champion, instruction and time given for learning to deliver Fast@home (for the healthcare professionals). However, professionals reported that Fast@home was insufficiently integrated into conventional rehabilitation. Contextual factors that hampered the implementation, including unexpected financial cutbacks and technical setbacks .

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 [28–30] or the feasibility or acceptability when implemented [31–33]. 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 Fast@home 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 (66%–100%) [34–38]. 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 five days [39]. 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 it, 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].

Table 7. Contextual factors influencing the implementation, reported in interviews with professionals and field notes, reported to the five levels of the implementation model of GroI.

	Factor	Sub-factor	B,F	Quote interviews	Field notes
Innovation	Feasibility	Helpdesk function	B,F	SH (F): "*I think there were a lot of support for us [therapists] in using the eRehabilitation intervention. 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 more useful to allow people 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 a times that you use the eRehabilitation intervention 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 use it with".
Organizational context	Organization 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 clinical champion 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*".	*Clinical champion* helps 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*	–

(*continued*)

Table 7. Continued.

	Factor	Sub-factor	B,F	Quote interviews	Field notes
				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".
		Software	B	BM: *"Here in the clinical departments there were sometimes complaints about the failing internet connections, which caused problems in using eRehabilitation for patients".*	Due to an update of the internet firewall of the network in The Hague 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, they feel insecure. She would like to have 2 h each week for 5 weeks to learn how to work with eRehabilitation.
		Time to use	B	SH: "E*veryone 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.
Organizational context	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 processess. 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* eLearning?
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*	

(*continued*)

Table 7. Continued.

	Factor	Sub-factor	B,F	Quote interviews	Field notes
				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*".	
	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*".	An healthcare professional mentioned: "My patients are too old or do not have a laptop or something".
Individual professional	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*".	An 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 says 'we have to do this'*".	The board say 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.

Regarding the mechanisms of impact, the delivery and use of the Fast@home intervention could probably have been improved as we succeeded (1) to integrate it better in the conventional rehabilitation and (2) to increase the healthcare professionals' satisfaction with the intervention. To enhance the integration, additional instructions and time to get familiar with the Fast@home were offered to the whole multidisciplinary team. As a consequence of the involvement of the whole multidisciplinary team, the workload of PTs and OTs delivering the Fast@home 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 min [39]. This support is found to be the most important for patients, in this study and before [33]. Previously, it is already indicated that proper integration of eRehabilitation might be the largest challenge in the maturation

of eRehabilitation [5,40] and that successful integration of eRehabilitation in conventional rehabilitation can probably only be achieved when all parts of the conventional rehabilitation are redesigned [5]. Second, to increase healthcare professionals' satisfaction, it is important to address healthcare professionals' belief in the effectiveness of some of the applications within the Fast@home intervention. According to the healthcare professionals, the effectiveness of some of the applications in Fast@home was questionable, which influenced their motivation to deliver it. 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].

With respect to contextual factors, a prompt and better response to some observations in the present study could 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 forehand. 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 technical setbacks. This latter barrier was also found in previous studies [5,18], 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 eRehabilitation becomes 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, our results indicate that a flexible approach towards the implementation process is needed to give a better response to unexpected barriers, such as unexpected financial cutbacks.

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 Fast@home intervention more than on non-users. Thus, insight into non-users perceptions of why Fast@home was not used and what would have motivated them is limited. Second, the majority (86.5%) of patients reported to use Fast@home 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 Fast@home may probably have been higher than reported. Third, the delivery of Fast@home 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, making eRehabilitation a fixed part of the conventional rehabilitation would maybe have resolved possible ignorance.

Conclusion

In conclusion, the main areas for improvement of the implementation of eRehabilitation appear to be related to the perceptions of healthcare professionals that the intervention was not effective, the insufficient integration of eRehabilitation in conventional rehabilitation, as well as to contextual, mostly technical and organizational, barriers that hampered the implementation. Unexpected financial cutbacks and other organizational issues can have a large impact on implementation and should not be underestimated and actions to counter the negative consequences should be taken swiftly.

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Data availability statement

The datasets supporting the conclusions of this article are available from the corresponding author on reasonable request.

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