

This is a repository copy of *Barriers and facilitators to implementation of a home-based cardiac rehabilitation programme for patients with heart failure in the NHS : a mixed-methods study*.

White Rose Research Online URL for this paper:

<https://eprints.whiterose.ac.uk/189205/>

Version: Published Version

Article:

Daw, Paulina, Wood, Grace E R, Harrison, Alexander orcid.org/0000-0002-2257-6508 et al. (7 more authors) (2022) Barriers and facilitators to implementation of a home-based cardiac rehabilitation programme for patients with heart failure in the NHS : a mixed-methods study. *BMJ Open*. e060221. ISSN 2044-6055

<https://doi.org/10.1136/bmjopen-2021-060221>











Reuse

This article is distributed under the terms of the Creative Commons Attribution-NonCommercial (CC BY-NC) licence. This licence allows you to remix, tweak, and build upon this work non-commercially, and any new works must also acknowledge the authors and be non-commercial. You don't have to license any derivative works on the same terms. More information and the full terms of the licence here: <https://creativecommons.org/licenses/>

Takedown

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.

BMJ Open Barriers and facilitators to implementation of a home-based cardiac rehabilitation programme for patients with heart failure in the NHS: a mixed-methods study

Paulina Daw ¹, Grace E R Wood ¹, Alexander Harrison ²,
Patrick J Doherty ², Jet J C S Veldhuijzen van Zanten ¹,
Hasnain M Dalal ^{3,4}, Rod S Taylor ⁵, Samantha B van Beurden ⁶,
Sinead T J McDonagh ⁷, Colin J Greaves ¹

To cite: Daw P, Wood GER, Harrison A, *et al.* Barriers and facilitators to implementation of a home-based cardiac rehabilitation programme for patients with heart failure in the NHS: a mixed-methods study. *BMJ Open* 2022;**12**:e060221. doi:10.1136/bmjopen-2021-060221

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2021-060221>).

Received 21 December 2021
Accepted 29 June 2022



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to

Paulina Daw;
pxd891@student.bham.ac.uk

ABSTRACT

Objectives This study aimed to identify barriers to, and facilitators of, implementation of the Rehabilitation Enablement in CHronic Heart Failure (REACH-HF) programme within existing cardiac rehabilitation services, and develop and refine the REACH-HF Service Delivery Guide (an implementation guide cocreated with healthcare professionals). REACH-HF is an effective and cost-effective 12-week home-based cardiac rehabilitation programme for patients with heart failure.

Setting/participants In 2019, four early adopter ‘Beacon Sites’ were set up to deliver REACH-HF to 200 patients. In 2020, 5 online REACH-HF training events were attended by 85 healthcare professionals from 45 National Health Service (NHS) teams across the UK and Ireland.

Design Our mixed-methods study used in-depth semi-structured interviews and an online survey. Interviews were conducted with staff trained specifically for the Beacon Site project, identified by opportunity and snowball sampling. The online survey was later offered to subsequent NHS staff who took part in the online REACH-HF training. Normalisation Process Theory was used as a theoretical framework to guide data collection/analysis.

Results Seventeen healthcare professionals working at the Beacon Sites were interviewed and 17 survey responses were received (20% response rate). The identified barriers and enablers included, among many, a lack of resources/commissioning, having interest in heart failure and working closely with the clinical heart failure team. Different implementation contexts (urban/rural), timing (during the COVID-19 pandemic) and factors outside the healthcare team/system (quality of the REACH-HF training) were observed to negatively or positively impact the implementation process.

Conclusions The findings are highly relevant to healthcare professionals involved in planning, delivering and commissioning of cardiac rehabilitation for patients with heart failure. The study’s main output, a refined version of the REACH-HF Service Delivery Guide, can guide the implementation process (eg, designing new care pathways) and provide practical solutions to overcoming

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The mixed-methods used (interviews and survey) allowed triangulation of data, increasing the robustness of the study findings.
- ⇒ The combination of sampling methods (opportunity sampling and snowball sampling) improved representativeness of the study sample.
- ⇒ A validated theoretical framework, Normalisation Process Theory, was used to guide data collection and interpretation.
- ⇒ The framework analysis procedure used both inductive and deductive analysis, preventing the forcing of emerging concepts into the themes of Normalisation Process theory.
- ⇒ The findings may be transferable to other UK home-based cardiac rehabilitation programmes but may not transfer well to healthcare services outside the UK.

common implementation barriers (eg, through early identification of implementation champions).

BACKGROUND

Heart failure and cardiac rehabilitation

Heart failure is a complex, debilitating syndrome with significant health consequences that, due to an ageing population, advances in device and pharmacotherapy, and more widespread adoption of western lifestyle, is on the rise globally.¹ There are approximately 64.3 million people living with heart failure in the world² and one million in the UK.³ Heart failure is associated with high healthcare costs, stemming particularly from hospitalisations⁴ and is a significant global healthcare challenge.¹ Cardiac rehabilitation participation is an important part of heart



failure management, as it has been shown to increase exercise capacity and health-related quality of life, and reduce risk of hospital admission in patients with heart failure.⁴ However, cardiac rehabilitation is greatly underutilised globally.⁵ In Europe, less than 50% of eligible patients receive cardiac rehabilitation; the uptake is particularly low in patients with heart failure (with only 14% receiving it).⁶ Offering alternative models of delivery, such as home-based programmes, can potentially improve the uptake of cardiac rehabilitation among this clinical population by reducing some of the patient-level barriers (eg, dislike of group sessions) and making it more accessible, for example, for patients who are housebound.^{7,8}

Normalisation Process Theory

A lack of theoretical underpinning can lead to a failure in developing a comprehensive understanding of the implementation process,⁹ as well as a failure of introducing evidence-based interventions into clinical practice.¹⁰ The use of implementation models, theories and frameworks in published implementation research studies has increased in the last decade.¹¹ In this study, we used

Normalisation Process Theory (NPT) to help understand the mechanisms of successful implementation.¹² NPT can be used to describe and evaluate different aspects of the implementation process, including barriers to, and facilitators of, implementation. The theory uses four main constructs (coherence, cognitive participation, collective action and reflexive monitoring) and 16 components (see [table 1](#)) to capture the work that healthcare professionals do to implement (or ‘normalise’) a new set of practices. The framework is sensitive to influences at the individual, community, organisational and system levels.¹³

Study aims

This study is part of a larger mixed-methods pragmatic implementation evaluation project.¹⁴ The first aim of the current study was to identify barriers to, and facilitators of, implementation of the Rehabilitation Enablement in CHronic Heart Failure (REACH-HF) programme using two different cohorts of healthcare professionals. The second aim was to develop and refine an implementation manual to inform the future implementation of the REACH-HF programme.

Table 1 Normalisation Process Theory (NPT)—constructs, components and definitions (based on the NPT Online Toolkit at www.normalizationprocess.org)

Constructs	Components	Definition
Coherence—the sense-making work	Differentiation	Whether the intervention is easy to describe to service providers and whether healthcare professionals can appreciate how it differs or is clearly distinct from current ways of working.
	Communal specification	Whether healthcare professionals have or are able to build a shared understanding of the aims, objectives, and expected outcomes of the proposed intervention.
	Individual specification	Whether individual staff have or are able to make sense of the work—specific tasks and responsibilities the proposed intervention would create for them.
	Internalisation	Whether healthcare professionals have or are able to easily grasp the potential value, benefits and importance of the intervention.
Cognitive participation—the relational work	Initiation	Whether or not key healthcare professionals are able and willing to get others involved in the new practice.
	Enrolment	The capacity and willingness of healthcare professionals to organise themselves in order to collectively contribute to the work involved in the new practice.
	Legitimation	Whether or not healthcare professionals believe it is right for them to be involved, and that they can make a contribution to the implementation work.
	Activation	The capacity and willingness of healthcare professionals to collectively define the actions and procedures needed to keep the new practice going.
Collective action—the operational work	Interactional workability	Whether healthcare professionals are able to enact the intervention and operationalise its components in practice.
	Relational integration	Whether healthcare professionals maintain trust in the intervention and in each other.
	Skill set workability	Whether the work required by the intervention is appropriately allocated to healthcare professionals with the right mix of skills and training to do it.
	Contextual integration	Whether the intervention is supported by the host organisation, management and other stakeholders, protocols, policies and procedures.
Reflexive monitoring—the appraisal work	Systematisation	Whether healthcare professionals can determine how effective and useful the intervention is from the use of formal and/or informal evaluation methods.
	Communal appraisal	Whether, as a result of formal monitoring, healthcare professionals collectively agree about the worth of the effects of the intervention.
	Individual appraisal	Whether individuals involved with (healthcare professionals), or affected by (patients), the intervention, think it is worthwhile.
	Reconfiguration	Whether healthcare professionals or services using the intervention can make changes as a result of individual and communal appraisal.

METHODS AND ANALYSIS

Study design and participants

We conducted in-depth semi-structured interviews and an online survey. To recruit participants for the interviews, we used opportunity sampling—inviting all trained REACH-HF Beacon Site practitioners (n=12) to participate, followed by snowball sampling—the initial interviewees were asked to identify other key staff involved in, or impacting, the implementation process. Participant recruitment continued until saturation in the identified themes was reached. The online survey invitation was sent to all healthcare professionals (n=85) who took part in the REACH-HF remote training.

Greene *et al* suggested five broad reasons for using mixed-methods. These include triangulation (employing different methods leads to verification of results), complementarity (results from one method clarify results from the other), development (results from one method inform the other method), initiation (discovering paradoxes and contradictions that can be used to reframe the research question) and expansion (expanding the breadth of inquiry—using different methods for different inquiry components).¹⁵ In terms of the current study, the rationale for using mixed-methods was a desire to maximise the depth of data through triangulation, to understand different aspects of the implementation process and to identify unexpected factors influencing implementation (expansion). Different methods were employed sequentially with a small overlap between launches—this allowed the project to conclude within the available time frame.

The REACH-HF programme

REACH-HF is a novel cardiac rehabilitation programme for patients with heart failure and their caregivers, designed to be delivered in the patient's home.^{16–20} The 12-week programme was co-designed with patients, caregivers and healthcare professionals; patient preference and acceptability were addressed extensively during the REACH-HF clinical trials and during the process evaluation of one of those trials. The REACH-HF team continues to work with patients, caregivers and healthcare professionals to refine the intervention further and create the best possible match between the intervention and its providers and recipients. The programme's clinical effectiveness (for improving heart failure-related quality of life) was demonstrated in a multicentre UK clinical trial and a decision model-based analysis confirmed its cost-effectiveness.^{21–23} The multicomponent intervention consists of a heart failure manual, a choice of two exercise training programmes (chair-based and walking), a stress management programme, a progress tracker and a family and friends resource. The programme requires facilitation from a healthcare professional (most often a cardiac rehabilitation nurse or physiotherapist) trained to deliver REACH-HF.

Beacon sites

In January 2019, the research team appointed four cardiac rehabilitation services to become early adopter sites (the REACH-HF Beacon Sites) and deliver the REACH-HF programme to a target total of 200 patients between June 2019 and June 2020. The Beacon Site criteria, recruitment and set up processes are described in detail in the published study protocol (see online supplemental appendix 1).¹⁴ Briefly, the Beacon Sites consisted of four well-established cardiac rehabilitation teams from diverse geographical areas (urban and rural) in England and Northern Ireland. Three healthcare professionals from each team attended a 3-day, in-person REACH-HF training course. Prior to their involvement with REACH-HF, the Beacon Sites mainly offered group, centre-based cardiac rehabilitation and one service excluded patients with a primary diagnosis of heart failure. There were no charges to patients enrolled to receive the REACH-HF programme and any additional cost associated with offering home visits, for example, travel costs were covered by the individual sites from their current budgets.

The participating Beacon Sites were given a great amount of autonomy regarding introducing the programme into the service and operationalising its delivery. This included which healthcare professionals to put forward for the training. In fact, some interviewed healthcare professionals volunteered for the training, whereas others were sent to attend. There was no compensation paid to the trained REACH-HF practitioners to participate in the Beacon Site project.

REACH-HF remote training

During the recent COVID-19 crisis, most group, centre-based cardiac rehabilitation programmes (the prevailing mode of delivery prior to the pandemic²⁴) were suspended.²⁵ The challenges to service provision caused by staff redeployment and social distancing and shielding guidance led to a sharp demand for alternative models of delivery,²⁶ including home-based programmes.²⁷ To facilitate this, members of the REACH-HF research team adapted the 3-day face-to-face REACH-HF training into a 2-day remotely delivered format and offered it free-of-charge to interested cardiac rehabilitation teams. A total of 85 healthcare professionals from 45 National Health Service (NHS) organisations and four centres in the Ireland attended the REACH-HF remote training between May 2020 and September 2020.

Data collection and analysis

PD and CJG generated the interview topic guide (see online supplemental appendix 2) using all 16 concepts from the NPT. All interviews were conducted by PD (mainly, prior to the COVID-19 pandemic) via the telephone or face-to-face. Each participant was interviewed once (mainly, at the beginning of the implementation process). We were not able to repeat interviews or conduct focus groups, as stated in the protocol, due to the COVID-19 lockdown restrictions and temporary

redeployment of rehabilitation staff to support pandemic-related healthcare service delivery.¹⁴ Audio recordings of the interviews were transcribed verbatim. The transcripts were redacted to remove any identifiable information and entered into NVivo (V.12) program for analysis.²⁸ The online survey (see online supplemental appendix 3) was based on the interview topic guide with additional questions about the REACH-HF Service Delivery Guide and consisted of a mixture of closed-response and open (qualitative) questions. The survey was conducted using the LimeSurvey online platform.²⁹ Qualitative data from the survey were entered into NVivo for analysis alongside the interview data.

Data analysis was conducted by PD, GERW and CJG following the procedures for framework analysis outlined by Ritchie and Spencer.³⁰ These included: identification of a theoretical framework suitable for the study (NPT), familiarisation with the data, indexing, charting, mapping and interpretation of themes. The analysis initially consisted of two rounds of independent coding of two transcripts by PD and GERW and in-depth discussions of emerging themes, moderated by CJG, between the rounds of coding. The resulting framework was then used to code the remaining data, with variations and extensions of the thematic framework added as new ideas emerged. To avoid forcing themes into a framework, our coding procedure allowed identification of emergent themes that were outside of the NPT; these were included in the study and were given the same weight of evidence in the final interpretation.

An implementation manual, the REACH-HF Service Delivery Guide (see online supplemental appendix 4), was developed following the initial qualitative interviews with NHS staff from the Beacon Sites (n=9). The draft guide was then circulated among one of the healthcare teams for comments and further development and refined following the consecutive interviews with the participating sites. The latest iteration of the Service Delivery Guide also incorporated data from the survey.

We used the Standards for Reporting Qualitative Research checklist to report the qualitative findings (see online supplemental appendix 5).³¹

Patient and public involvement

The REACH-HF intervention was co-designed with patients, caregivers and healthcare professionals; patient preference and acceptability have been addressed extensively during the REACH-HF clinical trials and process evaluation as detailed in the intervention development paper.²⁰ The focus of the current study was on implementation into routine service delivery, therefore, the research team worked closely with healthcare staff working at the Beacon Sites to discuss the feasibility of the study, selected outcome measures and the burden of participation. Additionally, the first draft of the REACH-HF Service Delivery Guide was shared with staff from one of the Beacon Sites to comment on its content, layout and completeness. All amendments and suggestions made by the staff (during

interviews and when completing the survey) were implemented into the subsequent version of the guide.

RESULTS

Qualitative interviews were conducted between September 2019 and February 2021 with 17 healthcare professionals working at the Beacon Sites (site 1—six interviewees, site 2—six interviewees, site 3—four interviewees and site 4—one interviewee). All except two of the interviews were conducted before the COVID-19 pandemic. The average time between the REACH-HF training (ie, May 2019) and the 15 interviews conducted before the COVID-19 pandemic (ie, before March 2020) was 113 days. We interviewed six cardiac rehabilitation nurses, five physiotherapists/exercise physiologists/exercise instructors, three clinical leads/projects managers, two heart failure nurses and one consultant cardiologist. Of the 17 interviewees, 3 were male. The average management/cardiology/cardiac rehabilitation/heart failure experience of the interviewees who disclosed their employment seniority was 9.5 years.

From a different part of the Beacon Site project, during which we interrogated the routinely collected audit data, we know that cardiac nurses were the main source of referrals with the majority of patients enrolled on the programme following hospitalisation for heart failure.³² Only a fraction of referrals came from primary care pathways (general practitioners, primary care nurses).

The survey invitation was sent to 85 participants on 25 February 2021. The survey was active until 8 April 2021 and the response rate was 20% (15 participants fully completed the survey and two partially completed it). All of the survey responses were gathered following the peak of the COVID-19 pandemic in the UK. Out of the 17 healthcare professionals who took part in the survey study, 7 were physiotherapists, 6 cardiac rehabilitation nurses and 4 heart failure nurses. The majority of respondents rated their knowledge prior to attending the training as 'advanced' in the four domains crucial for delivery of REACH-HF: cardiac rehabilitation—13, heart failure—11, exercise prescription—9 and person-centred communication skills—12. Prior to attending the REACH-HF training, all participants worked for services that offered cardiac rehabilitation to patients with heart failure. Eight healthcare professionals worked for services that offered home-based cardiac rehabilitation to cardiac patients. To preserve the anonymity of both participants and study sites, no other demographic or identifiable information were collected.

Barriers and facilitators to implementation

The study uncovered a wide range of general influences and a smaller number of site-specific factors positively and negatively affecting the implementation of REACH-HF (tables 2 and 3). Most of the identified barriers and facilitators mapped onto the existing NPT constructs. Factors that fell outside of the NPT framework are listed

Table 2 Barriers to implementation of REACH-HF

NPT construct	Barriers
Differentiation	
Communal specification	Confusion about patient criteria
Individual specification	Initial trial-and-error with operationalising the intervention
Internalisation	
Initiation	Lack of implementation plan Lack of champions
Enrolment	Routine of delivering group centre-based programmes Practitioners being away from core cardiac rehabilitation duties/team being stretched Low team morale and lack of enthusiasm for REACH-HF Challenging personal circumstances Poor communication with heart failure team
Legitimation	Initial hesitation about being part of project
Activation	Perception of REACH-HF in its current format as not implementable
Interactional workability	Additional time Additional cost Additional admin
Relational integration	Higher opinion of centre-based provision Negative opinion of REACH-HF resources (DVDs are outdated, technical problems, written resources are too lengthy)
Skill set workability (including REACH-HF practitioner's training)	Disinclination for lone working Disjointed working between cardiac rehabilitation and heart failure teams REACH-HF training not well-pitched to audience
Contextual integration	Lack of time allocation Lack of staff Staff redeployment due to COVID-19 Commissioning structure (lack of commissioning of cardiac rehabilitation for heart failure patients)
Systematisation	Time required for evaluation Task of evaluation lies with management
Communal appraisal	
Individual appraisal	
Reconfiguration	
Non-NPT barriers	
Patient-level factors	Multimorbidity patients (frequent hospitalisations, not stable to exercise, additional time) Engaging with technology (lack of DVD players or internet, not being technologically savvy) Apparent lack of improvement following REACH-HF Expectations and preferences (lack of motivation, preference for group centre-based programmes, dislike of home visits)
Geographical factors	Size and type of patch (large catchment area, transport issues)
NPT, Normalisation Process Theory; REACH-HF, The Rehabilitation EnAblement in CHronic Heart Failure programme.	

in the 'non-NPT barriers and facilitators' sections of each table. Online supplemental appendices 6 and 7 contain extended versions of [tables 2 and 3](#), which include quotes relating to each construct.

Barriers and facilitators related to NPT

Coherence: the sense-making work

There was agreement between participants and across all sites about the purpose and value of the REACH-HF

intervention. An initial process of trial-and-error at the beginning of the implementation process linked with operationalising the intervention, for example, developing delivery and/or administrative procedures, and some minor confusion about patient criteria/eligibility were present at all sites. Site 1 was the only site that had a very clear vision for the intervention from the outset; the targeted delivery of the programme at this site involved

**Table 3** Facilitators to implementation of REACH-HF

NPT construct	Facilitators
Differentiation	Good grasp of difference between REACH-HF and usual service delivery
Communal specification	Good grasp of purpose of REACH-HF
	Agreement that REACH-HF adds value to service
	Initial dissemination of purpose and structure of REACH-HF
	Awareness of service gap
	Clear vision for REACH-HF
Individual specification	Clear procedures and increased efficiency
Internalisation	Good grasp of value of intervention to heart failure population
Initiation	Availability of champions (whole team, organisation, three REACH-HF practitioners, single REACH-HF practitioner)
	Identification of potential referrers/referral streams
Enrolment	Strong endorsement for REACH-HF
	Interest in heart failure
	Effective communication (within cardiac rehabilitation team, between cardiac rehabilitation and heart failure teams)
Legitimation	Feeling positive about involvement
	Feeling positive about challenge of introducing REACH-HF
	Being part of innovative team
Activation	REACH-HF part of service going forward
	Watchful waiting
	Implementing REACH-HF post-COVID-19
Interactional workability	Gaining balanced perspective of time involved in delivery of REACH-HF
	COVID-19 led to changes in service provision
	Good fit with service and with patient
Relational integration	More objective opinion of centre-based programmes
	Positive opinion of REACH-HF resources (written resources are just right, being able to use friends and family resource)
	Trust in intervention and each other
	REACH-HF practitioner's peer support
Skill set workability (including REACH-HF practitioner's training)	Preference for home-visits
	Close working with heart failure team
	Choice of REACH-HF practitioners (self-selection, personal attributes, training more than one individual, experiences of working with multimorbidity patients)
	Skills combination (cardiac rehabilitation, physiotherapy/exercise physiology and heart failure)
	Improvements to REACH-HF training (making it more practical, more emphasis on exercise component, input from previous implementers, shorter modular online training, having more in-depth pretraining reading around self-management approach, recommending pretraining course—the BACPR heart failure exercise or activity training course)
Contextual integration	Protected time
	Management team is proactive (securing additional funding, redesigning service, offering flexible rehabilitation)
	Commissioning structure (being block contractor)
	Support from management
Systematisation	Planned, formal evaluation (by management)
	Reflective, informal evaluation (by REACH-HF practitioners)
Communal appraisal	Developing more balanced view of intervention and implementation process
Individual appraisal	Job satisfaction
	Continuous professional development
	Positive feedback from patients

Continued

Table 3 Continued

NPT construct	Facilitators
Reconfiguration	Fully home-based programme
	Fully remote delivery during COVID-19 pandemic
	Smoother enrolment onto programme
	Reduced home visits
	Home/centre hybrid
	Group centre-based programme
	Inspiration for better service delivery in general
	Amendments to REACH-HF resources (careful wording, simplified version of exercises, online resources)
	Non-NPT facilitators
Patient-level factors	Simplified version of exercises
	Overcoming technological issues
	Expectations and preferences (preference for, and motivation to, take part in home-based programme, being housebound)
Geographical factors	Size and type of patch (small catchment area, availability of transport)
.BACPR, British Association for Cardiovascular Prevention and Rehabilitation; NPT, Normalisation Process Theory; REACH-HF, The Rehabilitation EnAblement in CHronic Heart Failure programme.	

offering it to patients who would not otherwise have been able to attend traditional/centre-based cardiac rehabilitation. Effective dissemination of the purpose and value of the REACH-HF programme among the wider team was an important part of the sense-making work at all Beacon Sites and a task of REACH-HF practitioners following the initial training.

Cognitive participation: the relational work

There were significant differences between the sites in terms of what or who was driving the implementation process forward. The identified champions included the organisation itself (site 2), a single practitioner (site 4) all trained REACH-HF practitioners (site 3) and the whole team (site 1). Participants were unanimous that an early identification of potential referrers, most often heart failure nurses, was an important pre-requisite for programme delivery—this was achieved easily at site 1 due to a close proximity between the cardiac rehabilitation and heart failure teams. A strategy for improving the relational work, highlighted by all participants, was effective communication within the cardiac rehabilitation team and between the cardiac rehabilitation team and the heart failure team.

Low team morale (also exacerbated by challenging personal circumstances) and a lack of enthusiasm for the intervention were identified at site 2 and site 4, respectively. On the other hand, participants at sites 1 and 3 expressed feeling positive about their involvement in the implementation of REACH-HF. Being part of an innovative team and enjoying the implementation challenges were particularly evident at site 1.

Another noteworthy difference between the sites was how NHS staff perceived the future of the REACH-HF intervention in their service. At site 1, there was a strong hope that REACH-HF would be part of the service going

forward. At site 3, we observed a pattern of watchful waiting (a process of working out if REACH-HF can fit within the service delivery and whether it is sustainable). At site 2, there was a strong perception of the intervention in its current format not being implementable (mainly, linked with a large catchment area served by this service). Staff at site 4, were looking forward to re-engaging with the innovation post-COVID-19.

Collective action: the operational work

Interviewees were in agreement that operationalising REACH-HF into a service required additional time (eg, travelling and with patients) and additional cost (eg, the REACH-HF manuals and travel fares). Additional administrative tasks were identified at site 2 only; these were specific to the unique way staff working at site 2 were enrolling patients onto the programme, which included posting out the REACH-HF manual prior to the initial assessment.

Collective action can be positively or negatively influenced by the healthcare professionals' opinions of the innovation. We did not notice any patterns in the data or site-level differences relating to the REACH-HF resources; on occasions, what one person suggested as a negative, was a positive for another person. For example, some healthcare professionals enjoyed using the progress tracker and believed it allowed them to engage in a more meaningful way in goal setting and goal tracking during treatment, whereas others found the progress tracker to be a surplus part of the treatment. We identified the strongest collective endorsement for the intervention at site 1. A practical way of improving collective action (increasing the trust in the intervention and in each other) was to introduce regular (most often monthly) REACH-HF peer support/supervision sessions—these were spontaneously introduced and implemented by staff working at sites 1

and 3 and involved discussing implementation and/or clinical challenges linked with introducing REACH-HF programme into routine service delivery. The sessions were not supervised by the REACH-HF trainers or researchers.

Additionally, two 90-min videoconferencing peer supervision sessions were available to all REACH-HF trained facilitators. These were provided as part of the REACH-HF training package and chaired by the REACH-HF trainers and researchers. The purpose of those virtual meetings was to help embed the learning from the initial training and troubleshoot any implementation problems. The REACH-HF practitioners from three Beacon Sites were available to take part in the first peer support session in December 2019 and only one team participated in the second session in February 2021.

Two operational barriers relating to the availability of resources were consistent between the sites—a lack of sufficient time to implement REACH-HF and being understaffed. A lack of commissioning structure for cardiac rehabilitation for heart failure patients (in general, not just for the REACH-HF programme) was a barrier particular to site 2, whereas at site 1, the specific type of commissioning arrangement (being a block contractor) was identified as a facilitator, as it allowed more flexibility in how the service is delivered. Managers can positively impact barriers related to collective action by providing support to the implementers and being proactive—securing additional funding, redesigning the service and offering a flexible cardiac rehabilitation provision. The latter was done by adjusting the length of centre-based cardiac rehabilitation (typically 12 weeks) so it was tailored to patient needs and lifestyle (not all patients will require the full length of a set centre-based programme), which will free up REACH-HF practitioners to offer home-based rehabilitation to more complex heart failure patients.

Reflexive monitoring: the appraisal work

Within each site, various evaluation procedures were used to conduct the appraisal work. These ranged from ad hoc informal reflection by REACH-HF practitioners to formal, planned approaches using both patient-level and service-level data. Individual and communal appraisal (two important aspects of reflexive monitoring) resulted in a more balanced view of the intervention and the implementation process. For example, an acknowledgement that the time required to deliver the programme was overestimated at the beginning of the implementation process (the reduction in time needed was also linked with increased efficiency in delivery) or, that in time, it will be possible to secure referral pathways through developing links with heart failure nurses. Positive feedback from patients and increased job satisfaction were frequently quoted by the REACH-HF practitioners when commenting on appraisal of the programme.

Different levels of reconfiguration of the REACH-HF programme were suggested by the interviewees. These

ranged from a fully home-based programme (suggested by participants at site 1) to a home-based/centre-based hybrid (at site 3) or adapting REACH-HF into a group centre-based programme (at site 2). At site 1, the programme was delivered fully remotely during the COVID-19 pandemic, using phone contacts and video consultations to facilitate the intervention. A more detailed overview of the barriers and facilitators relating to each of the 16 NPT components (which were subsumed within the four over-arching themes described above) can be found in online supplemental appendix 8.

Barriers and facilitators not related to NPT

Patient-level factors

Patient-level factors related to multimorbidity, issues with technology, and patient expectations and preferences. Interviewees were in agreement that patients with multimorbidity sometimes struggled to engage with the intervention due to frequent hospitalisations and not being stable or well enough to exercise. The impact of multimorbidity on patients' abilities to complete the programme was particularly evident at site 1, which targeted patients who were housebound and would not otherwise be able to engage in centre-based cardiac rehabilitation programmes. Many patients treated at this site were unable to attend baseline and end-of-treatment assessments at the clinic and/or had periods of no exercise. The availability of a smaller paper-based set of exercises was a suggested facilitator for managing more complex patients.

Some patients were unable to engage with the chair-based exercise programme due to not having access to a DVD player or the internet. Patients who were less technologically savvy (particularly older patients) needed additional support from staff to access the chair-based exercises. Managers and staff working at site 1 took steps to overcome technological challenges by purchasing and lending DVD players to patients who did not have them. Staff also helped to address technical challenges by inputting the chair-based exercises weblink into patients' devices during assessments or follow-up appointments.

Patient expectations and preferences also played an important part in the implementation process as they could hinder it (eg, a lack of motivation, dislike of home visits and preference for group-based programmes) or facilitate it (eg, motivation to engage with home-based programmes and a preference for receiving the intervention at home).

Geographical factors

A large catchment area for a cardiac rehabilitation service (over a vast rural sprawl) was reported as a significant barrier to implementation by all interviewees at site 2. Whereas at site 1, a more contained catchment area (in a dense urban environment) with good transport links facilitated implementation. This additional non-NPT factor is somewhat related to the NPT component of 'contextual integration', but as it extends beyond the organisational

focus of this construct's definition, we placed it outside of the framework.

Survey data

Following the REACH-HF remote training, and at the time of completing the survey (approximate median time—34 weeks), six (35%) healthcare professionals had delivered the REACH-HF programme. The barriers to implementation identified in the survey data were mostly consistent with barriers identified in the interview data. These included commitment to delivering traditional cardiac rehabilitation programmes (and a consequential lack of capacity to deliver alternative programmes), a lack of commissioning and funding/resources/capacity, and patients not taking up the offer or not having access to a DVD player/the internet to support the implementation of REACH-HF. Three additional barriers were identified in the survey: a lack of an implementation plan, a lack of champions in the service and staff redeployment due to COVID-19. The survey also uncovered a more nuanced impact of the COVID-19 pandemic. The forced changes to the delivery of cardiac rehabilitation during the COVID-19 pandemic were seen as a facilitator—some services embraced new technologies to enable more remote ways of delivering cardiac rehabilitation. However, in some services, the patient recruitment process was hindered by the redeployment of staff due to COVID-19. One participant also noted that the positive impact of COVID-19 on the team's capacity to offer alternative models of delivery was reversed as the service returned to its usual way of operating (ie, offering mainly centre-based programmes). The facilitators to implementation identified in the survey were closely aligned to those identified in the interviews.

The majority of survey participants (n=14, 82%) had read the REACH-HF Service Delivery Guide, which was included with the survey invitation. Of these, eight (57%) strongly agreed that it would be useful to have access to this implementation manual at the beginning of setting up the REACH-HF programme. Seven (50%) participants agreed that the length of the guide was just right and the same number agreed that the guide was easy to use.

Data from the survey, the successive interviews and feedback from one Beacon Site were used to refine the latest version of the REACH-HF Service Delivery Guide (see online supplemental appendix 4). The key changes included adapting phraseology throughout the document to suit the intended audience, improving/clarifying terminology used in the patient criteria and selection tool, adapting formatting of clinical pathways and adding modifications required to deliver the programme remotely, for example, during the COVID-19 pandemic.

Dynamic interactions between different components

Analysis of the data identified numerous interactions between the barriers and facilitators described above; several of those interactions are depicted in [figure 1](#), the full matrix of the identified interactions can be found

in online supplemental appendix 9. These interactions occurred both within and between NPT domains. The implementation process was also (positively or negatively) influenced by external factors, beyond the healthcare team. These included the COVID-19 pandemic and the resulting restrictions on personal movement and interaction. Factors relating to the innovation itself (eg, the REACH-HF resources) and to the REACH-HF training also played an important role in the implementation process.

We identified several distinct types of interaction between the model's components:

- ▶ Simple associations (denoted by a plain line in the diagram).
- ▶ Positive impact, when one component positively impacts another (green arrowed line).
- ▶ Negative impact, when one component negatively impacts another (red arrowed line).

An example of a simple association was feeling positive about the challenge of implementing REACH-HF and being part of an innovative team. An example of a positive impact interaction was having an interest in heart failure which led to a strong endorsement for REACH-HF. Another example was securing additional funding and thereby reducing the barrier of staff shortages. An example of a negative impact interaction was that shortcomings of the REACH-HF training led to a period of trial-and-error at the beginning of the implementation process.

Many of the interactions between different components followed a typical trajectory (ie, they were in some sense expected/predictable), for example, effective communication between healthcare professionals strengthened multidisciplinary working, and effective dissemination of the purpose/structure of REACH-HF dispelled confusion about patient criteria. However, there were also some unexpected interactions where an apparent facilitator also had a negative impact on implementation. One example of this was that having a clear recruitment target for the intervention at site 1 (offering it to patients who would not otherwise be able to attend centre-based programmes) led to an increase in patient-level barriers as multimorbid patients tended to be less technologically literate as their younger counterparts. Another example, was where a strong organisational push to implement the innovation (an organisation as the main champion) resulted in the team's hesitation/resistance to roll out REACH-HF at site 2. Lastly, a positive reconfiguration at site 2 (posting out manuals before the assessment session) led to patients starting the programme in a timely manner, but also increased the amount of administrative cost and burden placed on the team.

Although we were unable to repeat qualitative interviews, during the conducted in-depth interviews healthcare professionals reflected on temporal changes to their attitude to, and perception of, the work required to deliver the intervention. It is important to note that most identified barriers reduced with time and practice.

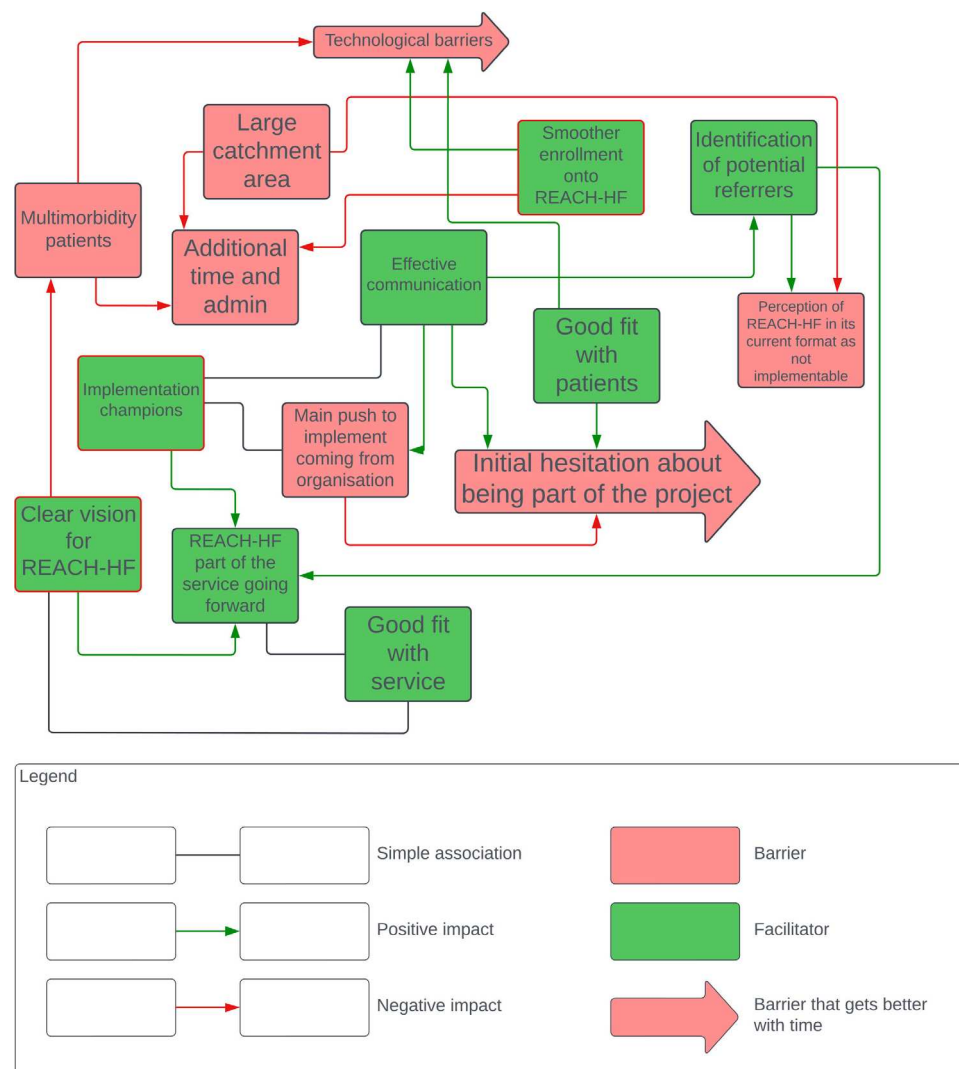


Figure 1 Dynamic interactions between model's components. REACH-HF, The Rehabilitation EnAblement in CHronic Heart Failure programme.

For example, initial trial-and-error was mostly replaced with new systems and efficiency. Other barriers subsided following evaluation when, for example, healthcare professionals developed a more realistic view of the time required to deliver REACH-HF and allocated resources accordingly. We did not observe any weakening in the relevance of facilitating factors over time.

DISCUSSION

Principal findings

We believe this to be the first study to investigate the implementation of a home-based cardiac rehabilitation programme in a variety of contexts (pre and during the COVID-19 pandemic). We identified a complex matrix of general and site-specific barriers and facilitators to implementation that interact and change over time. These influences occur on different levels: individual clinician (eg, having an interest in heart failure, a lack of enthusiasm for the intervention), the community of practice (eg, close working with the heart failure team), organisational

(eg, availability of resources, a good fit between the intervention and the service) and the wider systems (eg, a lack of commissioning of cardiac rehabilitation for patients with heart failure). The most pronounced variations between the Beacon Sites included main drivers behind the innovation (ie, who instigated and was driving the implementation forward), varying levels of enthusiasm for delivering REACH-HF, perceived sustainability of delivery and the level of adaptation of the intervention.

The meaning of the study: possible explanations and implications for clinicians and policy-makers

The complexity³³ and adaptability³⁴ of modern healthcare systems is well-documented and widely accepted within the realm of implementation science and our study undeniably captured the complex and dynamic nature of the implementation process. By understanding the backdrop of barriers and facilitators affecting implementation, we were able to make recommendations for future implementers and for further development of the intervention and its training course (figure 2). For example, the study

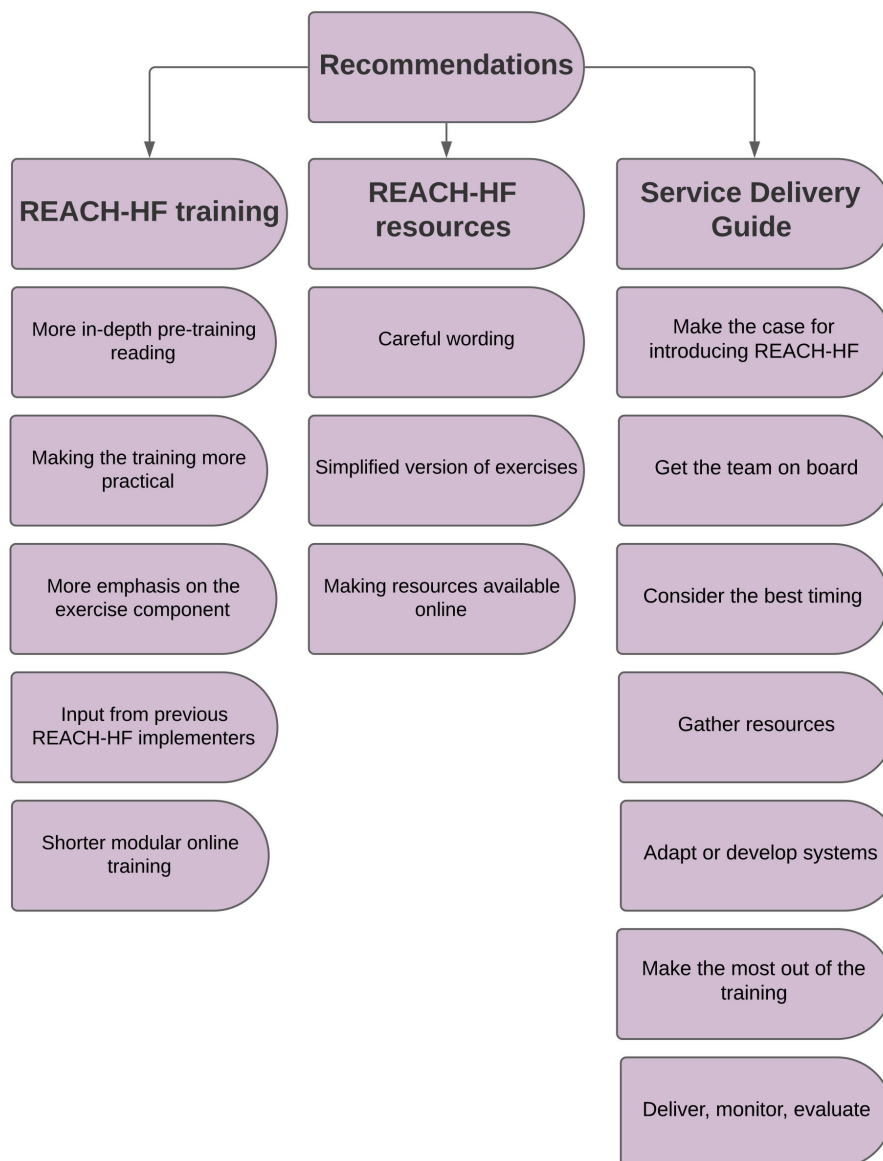


Figure 2 Recommendations for further intervention and training development, and future implementers. REACH-HF, The Rehabilitation EnAblement in CHronic Heart Failure programme.

highlighted the importance of choosing the best timing when introducing REACH-HF into a service or of a careful selection of staff to train in the intervention delivery. We also used the data to expand and refine the REACH-HF Service Delivery Guide, for example, by considering practicalities of introducing remote delivery. Some of the recommendations from the current study have been already put into action. For example, early adopters are now involved in delivering the REACH-HF training and the REACH-HF research team is in the process of digitising the healthcare professional training³⁵ and the intervention,³⁶ as well as adapting it for use in Denmark.³⁷ The study is of high clinical relevance, as it can provide healthcare professionals responsible for planning, delivering and commissioning of cardiac rehabilitation services valuable insight into the implementation process, as well as a pragmatic implementation manual. It is hoped that these tools/recommendations will guide the ongoing

introduction of the REACH-HF programme into NHS and other healthcare settings, as well as promoting its sustained delivery.

The majority of identified barriers and facilitators to implementation of the REACH-HF programme are consistent with the wider implementation science literature on generic factors which can positively or negatively affect the implementation of new innovations.^{38 39} The study provides a worked model of assessing implementation that can be used as an example in future implementation evaluation projects of different healthcare innovations.

REACH-HF service delivery guide

Following the initial interviews conducted for this study, and in collaboration with staff working at one Beacon Site, we created the REACH-HF Service Delivery Guide (see online supplemental appendix 4). This implementation manual is designed to support healthcare teams wishing



to add the REACH-HF programme to their cardiac rehabilitation service. The 18-page guide describes pragmatic solutions to overcoming implementation challenges encountered at the Beacon Sites and is designed to be used in conjunction with the REACH-HF Facilitator Training Pack. The guide can be used to help 'make the case' for introducing REACH-HF into a service, which is an important part of the implementation process. It also outlines the necessary practical steps for adding REACH-HF into a service, such as, equipment required, deciding the best timing for implementation, gathering resources and designing new care pathways. The guide highlights the importance of evaluation and lists some of the adaptations to delivery that took place at the Beacon Sites, including adaptations for fully remote delivery during the COVID-19 pandemic. The guide is publicly available through the National Institute for Health and Care Excellence Shared Learning Database.⁴⁰

Strengths and limitations of the study

The main strength of the study is that it goes beyond the identification of barriers and facilitators to implementation to provide practical guidance for cardiac rehabilitation teams interested in offering the REACH-HF programme to their patients. Additionally, using two methods of data collection, at different time points and with different cohorts of participants, allowed data triangulation and enriched our understanding of the implementation process in different contexts and under different circumstances. Involving professionals from a large number of healthcare teams and using two sampling methods increased the representativeness of the study sample and relevance of the study's results. However, as in any relatively small scale study there is a possibility of a selection bias affecting the findings. Therefore, the results of the current study need to be interpreted taking into account the participant sample they were uncovered within.

The study has sound theoretical underpinnings in the form of the NPT, however, to avoid forcing emerging concepts into the pre-existing NPT components, we used a combined deductive/inductive analytic approach. There are two main limitations to the study. The first one is a deviation from the study protocol—due to the COVID-19 pandemic, we were not able to repeat the interviews later during the implementation process or to conduct focus groups. It is unclear if deviation from the protocol impacted the outcomes of the study. The second limitation of the study is its likely poor transferability/relevance outside of the UK healthcare system. The REACH-HF intervention was designed in collaboration with UK-based patients and healthcare professionals working in the NHS. Therefore, in its current format, the intervention is most compatible within the UK implementation context, for example, it requires a patient to have access to a DVD player or the internet. This poor transferability is particularly evident in low-income countries, where, due to small healthcare budgets, developing affordable models for the

delivery of cardiac rehabilitation for heart failure patients is a priority.

Qualitative research, particularly with low participant numbers, is susceptible to response bias. In the case of our study, the interviewed healthcare professionals may have worried that their feedback would be seen by their employer or co-workers which could have led to socially desirable responses. To manage this dynamic and minimise the occurrence of the response bias, the interviewer had an exclusive research relationship with the interviewees and tried to promote honest responding. Interviewees were made aware during the informed consent procedure and at the beginning of the interview that their responses would be anonymised and their service location protected.

Unanswered questions and future research

The study was the first attempt to understand the process of implementation of the REACH-HF programme into routine service delivery. Further implementation data relating to different healthcare contexts are needed. In this regard, data are currently being gathered in the SCOT REACH-HF project involving six health boards in Scotland.⁴¹ The growing knowledge of the implementation process in different contexts could be further expanded by exploring interactions between the innovation and the implementation context, for example, by investigating the 'plasticity of intervention components' (the adaptability of the intervention) and the 'elasticity of contexts' (rigidity/flexibility of the implementation environment).⁴²

Conclusions

This study identified a wide range of barriers to, and facilitators of, implementation of the home-based REACH-HF cardiac rehabilitation programme across the UK. The study highlighted many interactions between different components of the model, including reductions in barriers over time, as well as interactions with the intervention itself and the quality of training. The main output of the study is a pragmatic implementation guide—the REACH-HF Service Delivery Guide, which the study confirmed to be a useful tool for cardiac rehabilitation services wishing to include the REACH-HF programme in their service provision.

Author affiliations

¹School of Sport, Exercise & Rehabilitation Sciences, University of Birmingham, Birmingham, UK

²Health Sciences, University of York, York, UK

³Royal Cornwall Hospital, University of Exeter Medical School, Truro, UK

⁴Primary Care Research Group, University of Exeter Medical School, Exeter, UK

⁵MRC/CSO Social and Public Health Sciences Unit & Robertson Centre for Biostatistics, University of Glasgow, Institute of Health and Well Being, Glasgow, UK

⁶College of Medicine and Health, University of Exeter, Exeter, UK

⁷Primary Care Research Group, College of Medicine and Health, University of Exeter, Exeter, UK

Acknowledgements We thank all NHS staff who are working at the Beacon Sites and staff who participated in the online survey for providing invaluable insight for the study.

Contributors All authors (bar GERW) contributed to the idea for the study and protocol development. HMD was instrumental in setting up the Beacon Sites. SBvB led the set up and recruitment process. STJM was overseeing the day-to-day management of the Beacon Sites. PD secured all relevant ethical approvals for the project, prepared all study documentation and acquired the data. PD, GERW and CJG analysed the data. CJG, JJCSvVZ, HMD, RST, PD and AH provided project supervision and oversight. PD drafted the manuscript. All authors provided critical revision of the manuscript for important intellectual content and approved the final draft for submission. The guarantor for the study was the University of Birmingham.

Funding This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors. PD's time is funded by a PhD studentship from the University of Birmingham.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval The study (IRAS 261723) has received ethics approval from the South Central (Hampshire B) Research Ethics Committee (19/SC/0304).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. The datasets analysed during the current study are available from the corresponding author on reasonable request.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Paulina Daw <http://orcid.org/0000-0002-0942-3953>
 Grace E R Wood <http://orcid.org/0000-0003-2622-2501>
 Alexander Harrison <http://orcid.org/0000-0002-2257-6508>
 Patrick J Doherty <http://orcid.org/0000-0002-1887-0237>
 Jet J C S Veldhuijzen van Zanten <http://orcid.org/0000-0001-8422-9512>
 Hasnain M Dalal <http://orcid.org/0000-0002-7316-7544>
 Rod S Taylor <http://orcid.org/0000-0002-3043-6011>
 Samantha B van Beurden <http://orcid.org/0000-0001-7848-2159>
 Sinead T J McDonagh <http://orcid.org/0000-0002-0283-3095>
 Colin J Greaves <http://orcid.org/0000-0003-4425-2691>

REFERENCES

- Savarese G, Lund LH. Global public health burden of heart failure. *Card Fail Rev* 2017;3:7–11.
- Groenewegen A, Rutten FH, Mosterd A, *et al*. Epidemiology of heart failure. *Eur J Heart Fail* 2020;22:1342–56.
- Dalal HM, Taylor RS, Wingham J, *et al*. A facilitated home-based cardiac rehabilitation intervention for people with heart failure and their caregivers: a research programme including the REACH-HF RCT. *Programme Grants Appl Res* 2021;9:1–100.
- Long L, Mordi IR, Bridges C, *et al*. Exercise-based cardiac rehabilitation for adults with heart failure. 2019;2019.
- Turk-Adawi K, Supervia M, Lopez-Jimenez F, *et al*. Cardiac rehabilitation availability and density around the globe. *EClinicalMedicine* 2019;13:31–45.
- Bjarnason-Wehrens B, McGee H, Zwisler A-D, *et al*. Cardiac rehabilitation in Europe: results from the European cardiac rehabilitation inventory survey. *Eur J Cardiovasc Prev Rehabil* 2010;17:410–8.
- Dalal HM, Wingham J, Palmer J, *et al*. Why do so few patients with heart failure participate in cardiac rehabilitation? A cross-sectional survey from England, Wales and Northern Ireland. *BMJ Open* 2012;2:e000787.
- Golwala H, Pandey A, Ju C, *et al*. Temporal trends and factors associated with cardiac rehabilitation referral among patients hospitalized with heart failure: findings from get with the Guidelines-Heart failure registry. *J Am Coll Cardiol* 2015;66:917–26.
- Eccles M, Grimshaw J, Walker A, *et al*. Changing the behavior of healthcare professionals: the use of theory in promoting the uptake of research findings. *J Clin Epidemiol* 2005;58:107–12.
- Sales A, Smith J, Curran G, *et al*. Models, strategies, and tools. theory in implementing evidence-based findings into health care practice. *J Gen Intern Med* 2006;21:43–9.
- Nilsen P. Making sense of implementation theories, models and frameworks. *Implement Sci* 2015;10:53.
- May C, Finch T. Implementing, embedding, and integrating practices: an outline of normalization process theory. *Sociology* 2009;43:535–54.
- Tabak RG, Khoong EC, Chambers DA, *et al*. Bridging research and practice: models for dissemination and implementation research. *Am J Prev Med* 2012;43:337–50.
- Daw P, van Beurden SB, Greaves C, *et al*. Getting evidence into clinical practice: protocol for evaluation of the implementation of a home-based cardiac rehabilitation programme for patients with heart failure. *BMJ Open* 2020;10:e036137.
- Greene JC, Caracelli VJ, Graham WF. Toward a conceptual framework for mixed-method evaluation designs. *Educ Eval Policy Anal* 1989;11:255–74.
- Taylor RS, Hayward C, Eyre V, *et al*. Clinical effectiveness and cost-effectiveness of the rehabilitation enablement in chronic heart failure (REACH-HF) facilitated self-care rehabilitation intervention in heart failure patients and caregivers: rationale and protocol for a multicentre randomised controlled trial. *BMJ Open* 2015;5:e009994.
- Eyre V, Lang CC, Smith K, *et al*. Rehabilitation enablement in chronic heart Failure—a facilitated self-care rehabilitation intervention in patients with heart failure with preserved ejection fraction (REACH-HFpEF) and their caregivers: rationale and protocol for a single-centre pilot randomised controlled trial. *BMJ Open* 2016;6:e012853.
- Lang CC, Smith K, Wingham J, *et al*. A randomised controlled trial of a facilitated home-based rehabilitation intervention in patients with heart failure with preserved ejection fraction and their caregivers: the REACH-HFpEF pilot study. *BMJ Open* 2018;8:e019649.
- Wingham J, Frost J, Britten N, *et al*. Caregiver outcomes of the REACH-HF multicentre randomized controlled trial of home-based rehabilitation for heart failure with reduced ejection fraction. *Eur J Cardiovasc Nurs* 2019;18:611–20.
- Greaves CJ, Wingham J, Deighan C, *et al*. Optimising self-care support for people with heart failure and their caregivers: development of the rehabilitation enablement in chronic heart failure (REACH-HF) intervention using intervention mapping. *Pilot Feasibility Stud* 2016;2:37.
- Dalal HM, Taylor RS, Jolly K, *et al*. The effects and costs of home-based rehabilitation for heart failure with reduced ejection fraction: the REACH-HF multicentre randomized controlled trial. *Eur J Prev Cardiol* 2019;26:262–72.
- Taylor RS, Sadler S, Dalal HM, *et al*. The cost effectiveness of REACH-HF and home-based cardiac rehabilitation compared with the usual medical care for heart failure with reduced ejection fraction: a decision model-based analysis. *Eur J Prev Cardiol* 2019;26:1252–61.
- Frost J, Wingham J, Britten N, *et al*. Home-based rehabilitation for heart failure with reduced ejection fraction: mixed methods process evaluation of the REACH-HF multicentre randomised controlled trial. *BMJ Open* 2019;9:e026039.
- Anderson L, Sharp GA, Norton RJ, *et al*. Home-based versus centre-based cardiac rehabilitation. *Cochrane Database Syst Rev* 2017;6:CD007130.
- Besnier F, Gayda M, Nigam A, *et al*. Cardiac rehabilitation during quarantine in COVID-19 pandemic: challenges for center-based programs. *Arch Phys Med Rehabil* 2020;101:1835–8.
- O'Doherty AF, Humphreys H, Dawkes S, *et al*. How has technology been used to deliver cardiac rehabilitation during the COVID-19 pandemic? an international cross-sectional survey of healthcare professionals conducted by the BACPR. *BMJ Open* 2021;11:e046051.



- 27 The British Heart Foundation. Cardiac rehabilitation at home: a quick guide for healthcare professionals, 2021. Available: <https://www.bhf.org.uk/for-professionals/healthcare-professionals/coronavirus-covid-19/cardiac-rehabilitation-at-home-guide-for-professionals>
- 28 QSR International Pty Ltd. NVivo qualitative data analysis software, version 12 2018.
- 29 Limesurvey GmbH. LimeSurvey: an open source survey tool/ LimeSurvey GmbH, Hamburg, Germany, 2021. Available: <http://www.limesurvey.org>
- 30 Ritchie J, Spencer L. Qualitative data analysis for applied policy research by Jane Ritchie and Liz Spencer. In: Bryman A, Burgess RG, eds. *Analysing qualitative data*. London: Routledge, 1994: 173–94.
- 31 O'Brien BC, Harris IB, Beckman TJ, et al. Standards for reporting qualitative research: a synthesis of recommendations. *Acad Med* 2014;89:1245–51.
- 32 Daw P, Harrison A, Doherty PJ, et al. A pragmatic effectiveness-implementation study comparing trial evidence with routinely collected outcome data for patients receiving the REACH-HF home-based cardiac rehabilitation programme. *BMC Cardiovasc Disord* 2022;22:270.
- 33 Best A, Greenhalgh T, Lewis S, et al. Large-system transformation in health care: a realist review. *Milbank Q* 2012;90:421–56.
- 34 Zimmerman B, Lindberg C, Plsek P. *Edgewise: insights from complexity science for health care leaders*. Irving, TX: Veterans Health Administration, 1998.
- 35 National Institute for Health Research. How our journey through NIHR funding has improved care for people with heart failure, 2021. Available: <https://www.nihr.ac.uk/blog/how-our-journey-through-nihr-funding-has-improved-care-for-people-with-heart-failure/28394>
- 36 Rehabilitation Enablement in Chronic Heart Failure. D REACH-HF: digital rehabilitation enablement in chronic heart failure, 2021. Available: <https://blogs.exeter.ac.uk/reach-hf/d-reach-hf-digital-rehabilitation-enablement-in-chronic-heart-failure/>
- 37 University of Glasgow, Institute of Health & Wellbeing. How best to enable access to rehabilitation for people with heart failure and their families in these challenging times? 2021. Available: https://www.gla.ac.uk/researchinstitutes/healthwellbeing/news/hawkeye2018onwards/june2021/headline_794004_en.html
- 38 Geerligs L, Rankin NM, Shepherd HL, et al. Hospital-based interventions: a systematic review of staff-reported barriers and facilitators to implementation processes. *Implement Sci* 2018;13:36.
- 39 National Institute for Health and Care Excellence. How to change practice: understand, identify and overcome barriers to change, 2007. Available: <https://www.nice.org.uk/media/default/about/what-we-do/into-practice/support-for-service-improvement-and-audit/how-to-change-practice-barriers-to-change.pdf>
- 40 National Institute for Health and Care Excellence. COVID-19 ready rehabilitation for heart failure: REACH-HF can deliver, 2021. Available: <https://www.nice.org.uk/sharedlearning/covid-19-ready-rehabilitation-for-heart-failure-reach-hf-can-deliver>
- 41 Purcell C, Daw P, Kerr C, et al. Protocol for an implementation study of an evidence-based home cardiac rehabilitation programme for people with heart failure and their caregivers in Scotland (SCOT:REACH-HF). *BMJ Open* 2020;10:e040771.
- 42 May CR, Johnson M, Finch T. Implementation, context and complexity. *Implement Sci* 2016;11:141.