ESC European Society of Cardiology

European Journal of Cardiovascular Nursing (2023) **22**, 804–813
https://doi.org/10.1093/eurjcn/zvad004

ORIGINAL RESEARCH

Home-based cardiac rehabilitation for people with heart failure and their caregivers: a mixed-methods analysis of the roll out an evidence-based programme in Scotland (SCOT:REACH-HF study)

Carrie Purcell [1]*, Anthony Purvis [2], John GF. Cleland [3], Aynsley Cowie [4], Hasnain M. Dalal [5], Tracy Ibbotson [6], Clare Murphy[7], and Rod S. Taylor [2,3]

[1]Faculty of Wellbeing, Education and Language Studies, The Open University in Scotland, 10 Drumsheugh Gardens, Edinburgh EH3 7QJ, UK; [2]MRC/CSO Social and Public Health Sciences Unit, University of Glasgow, Berkeley Square, 99 Berkeley St, Glasgow G3 7HR, UK; [3]Robertson Centre for Biostatistics, University of Glasgow, Level 11, Boyd Orr Building, University Avenue, Glasgow G12 8QQ, UK; [4]NHS Ayrshire and Arran, University Hospital Crosshouse, Kilmarnock Rd, Crosshouse, Kilmarnock KA2 0BE, UK; [5]Primary Care Research Group, University of Exeter Medical School, St Luke's Campus, Exeter EX1 2LU, UK; [6]General Practice & Primary Care, University of Glasgow, 1 Horselethill Road, Glasgow G12 9LX, UK; and [7]NHS Forth Valley, Forth Valley Royal Hospital, Stirling Road, Larbert FK5 4WR, UK

Received 6 July 2022; revised 29 September 2022; accepted 4 January 2023; published 6 January 2023

Aims

Alternative models of cardiac rehabilitation (CR) are required to improve CR access and uptake. Rehabilitation EnAblement in CHronic Heart Failure (REACH-HF) is a comprehensive home-based rehabilitation and self-management programme, facilitated by trained health professionals, for people with heart failure (HF) and their caregivers. REACH-HF was shown to be clinically effective and cost-effective in a multi-centre randomized trial. The SCOT:REACH-HF study assessed implementation of REACH-HF in routine clinical practice in NHS Scotland.

Methods and results

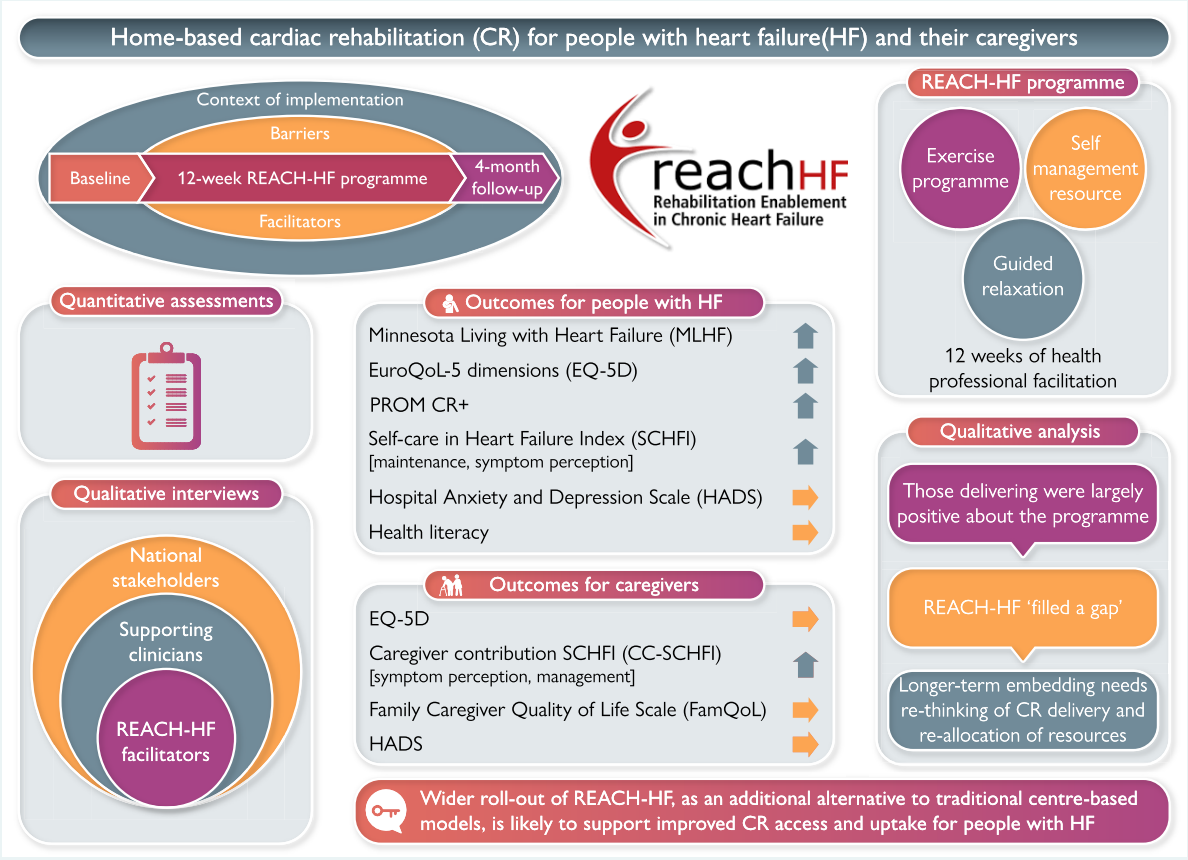
A mixed-method implementation study was conducted across six regional Health Boards. Of 136 people with HF and 56 caregivers recruited, 101 people with HF and 26 caregivers provided 4-month follow-up data, after participating in the 12-week programme. Compared with baseline, REACH-HF participation resulted in substantial gains in the primary outcome of health-related quality of life, as assessed by the Minnesota Living with Heart Failure Questionnaire (mean difference: −9.8, 95% CI: −13.2 to −6.4, $P < 0.001$). Improvements were also seen in secondary outcomes (PROM-CR+; EQ-5D-5L; Self-Care of Heart Failure Index (SCHFI) domains of maintenance and symptom perception; Caregiver Contribution to Self-Care domains of symptom perception and management). Twenty qualitative interviews were conducted with 11 REACH-HF facilitators, five supporting clinicians, and four national stakeholders. Interviewees were largely positive about REACH-HF, considering it to have 'filled a gap' where centre-based CR was not an option. Key issues to support future roll-out were also identified.

Conclusion

Our findings support wider roll-out of REACH-HF as an alternative to centre-based models, to improve CR access and uptake for people with HF.

* Corresponding author. Tel: +44 (0) 7816780911, Email: carrie.purcell@open.ac.uk

Graphical Abstract



Keywords Heart failure • Cardiac rehabilitation • Self-management • Home-based programme • Caregivers • Implementation study

Novelty

- Rehabilitation EnAblement in CHronic Heart Failure (REACH-HF) is a comprehensive home-based rehabilitation and self-care support programme, co-developed with key stakeholders, and drawing on relevant evidence and behaviour change theory.
- The present study uniquely provides a formal mixed-method evaluation of the implementation of REACH-HF, following demonstration of its clinical and cost-effectiveness in a recent randomized controlled trial.
- Our results show that adaptation to REACH-HF necessitated by the COVID-19 pandemic did not appear to reduce the effectiveness of the programme.
- Our findings support wider roll-out of the REACH-HF home-based programme as an alternative to traditional centre-based models of cardiac rehabilitation, which can improve rehabilitation access and uptake for people with HF and their families.

Introduction

Meta-analyses of randomized controlled trials (RCTs) show that participation in cardiac rehabilitation (CR) by people with heart failure (HF) reduces their risk of hospital admission and results in important gains in health-related quality of life (HRQoL).[1,2] Despite these benefits—and national and international clinical guidelines consistently recommending that those living with stable, chronic HF should receive CR—access to and participation in CR remain poor.[3] While barriers to CR access are complex and interacting, they can be summarized as operating at three levels: health systems (e.g. limited funding or facilities); clinicians (e.g. lack of referral); and patients (e.g. issues with transport, convenience, conflicts with return to work).[3–5] Furthermore, some patient groups are at lower likelihood of participating in CR, including older people, those living in greater social deprivation, and people from minority ethnic groups.[5]

A key potential solution to improving CR access is more innovative, diverse models of delivery. The dominant mode of CR since its inception 50 years ago has been centre-based, typically supervised group classes delivered in a hospital outpatient setting, and

focused on exercise training.[6,7] The coronavirus disease-19 (COVID-19) pandemic—and associated challenges of effectively delivering rehabilitation while following guidance on social distancing and shielding—has foregrounded the need to reframe traditional CR delivery. Calls have particularly focused on inclusion of home-based programmes, as well as use of wearable technology, and interactive online or hybrid programmes that combine centre- and home-based modes.[8] With evidence that benefits in patient-reported outcomes in home-based programmes are similar to those seen in centre-based CR,[9] leading medical bodies have advocated for this model.[10] There nevertheless remain questions around the capacity of clinical teams and responsiveness of healthcare systems to more innovative models of CR.

We sought to explore this issue in the case of the Rehabilitation EnAblement in CHronic Heart Failure (REACH-HF) intervention. REACH-HF is a comprehensive home-based rehabilitation and self-care support programme, co-developed with key stakeholders, and based on relevant evidence and behaviour change theory.[11] A multi-centre randomized trial in 216 people with reduced ejection fraction HF (HFrEF), and their informal caregivers, found that, compared with usual care alone, participation in REACH-HF improved disease-specific HRQoL at 12-month follow-up—as measured by the Minnesota Living with Heart Failure Questionnaire (MLHF)—by a mean total score of −5.7 points (95% confidence interval: −10.6 to −0.7).[12] REACH-HF was also found to be a relatively low-cost intervention (sterling £417 per patient), and economic modelling based on the trial results showed it also be highly cost-effective, with an average cost per quality adjusted life-year (QALY) of £1720 per patient.[13]

The SCOT:REACH-HF study was designed to generate understanding of organisational influences that shape implementation of REACH-HF for people living with HFrEF and their caregivers in Scotland, in order to inform potential scaled roll-out. Our specific research questions were: (1) How do 'real-world' patient and caregiver outcomes and REACH-HF costs compare with those seen in the randomised trial? ; and (2) What are the service-level facilitators of and barriers to implementation of REACH-HF?

Methods

Design and setting

We employed a mixed-method, single arm, pre–post design, collecting both quantitative and qualitative data, and drawing on UK Medical Research Council (MRC) guidance on evaluation of complex interventions.[14,15]

CR services in six (of a total of 14) NHS Scotland regional Health Boards were included as early adopter sites: NHS Ayrshire and Arran; NHS Lanarkshire; NHS Forth Valley; and NHS Highland, Orkney, and Shetland (the latter three were combined due to small patient numbers). NHS Greater Glasgow and Clyde sponsored the study, and the West of Scotland Research Ethics Service (20/WS/0038) gave ethical approval. Written informed consent was obtained from all participants.

Study population

Using existing CR referral pathways, sites recruited people who had a confirmed diagnosis of HFrEF.[14] At study entry, the person with HF was asked to nominate a friend or family member to participate as a 'caregiver' (that is, a spouse, relative, or friend who typically provided them with unpaid support).

REACH-HF intervention

A detailed account of the REACH-HF intervention has been described elsewhere,[11] and intervention components are summarised in *Figure 1*. As SCOT:REACH-HF was conducted during COVID-19 pandemic restrictions, several adaptations to the REACH-HF model were necessary to enable intervention delivery. These included: switching from a three-day in-person facilitator training course to a two-day online format that included a combination of pre-recorded and live presentations, and interactive sessions, hosted on Zoom; intervention adaptation to allow fully remote delivery (namely telephone or online facilitation), if face-to-face contact with the facilitator in the home or clinic was not possible. All adaptations were made in collaboration with the central REACH-HF team and our patient and public involvement group. Participants with HF continued to receive 'usual' medical care, according to local and national guidelines.

Data collection

Three categories of data were collected: (a) participant (patient and caregiver) reported outcomes at baseline (pre-intervention) and four-month follow-up (post-12-week facilitated intervention period) [RQ1]; (b) economic data to allow quantification of the cost of the REACH-HF intervention to NHS Scotland [RQ1]; and (c) interviews with REACH-HF facilitators, supporting teams, and key stakeholders [RQ2]. COVID-19 restrictions also had implications for data collection: as participants completed questionnaires by post, or online via a secure web portal (rather than at clinic as initially planned).[7] It was also not possible to assess exercise capacity (incremental shuttle walk test), since lockdown measures meant participants were largely unable to attend, and services were unable to hold, research visits in a clinical setting.

Outcomes for people with HF

Sociodemographic and medical history data were collected by clinical teams from medical notes and from people with HF via self-complete questionnaires. Our primary outcome was disease-specific HRQoL [Minnesota Living with Heart Failure questionnaire (MLHF)].[16] Secondary outcomes included the following: CR-specific HRQoL (modified PROM-CR+),[17] generic HRQoL (EQ-5D-5L),[18] psychological well-being [Hospital Anxiety and Depression Scale (HADS)],[19] HF self-management [Self-Care in Heart Failure Index (SCHFI)],[20] and health literacy [selected sub-scales of the Health Literacy Questionnaire (HLQ)].[21] Serious adverse events (SAEs) were recorded and assessed for relatedness to the intervention. Adverse events were regarded as 'serious' if they resulted in death, were life threatening, or required hospitalization.

Outcomes for caregivers

Generic HRQoL (EQ-5D-5L), caregiver-specific HRQoL (Family Caregiver Quality of Life Scale),[22] caregiver contribution to HF self-management (CC-SCHFI),[23] psychological well-being (HADS), and caregiver burden [Caregiver Burden Questionnaire for Heart Failure (CBQ-HF)].[24] Self-reported demographic data were also collected from caregivers at baseline.

Economic data

To allow costs analysis, key implementation data were collated, including costs of training facilitators, REACH-HF consumables (such as REACH-HF manuals, DVDs), and facilitator time spent on delivering the 12-week intervention. Training coordinators (Heart Manual Department, NHS Lothian) provided teaching faculty, administration, and material costs (including REACH-HF manuals). Facilitator time was captured via self-completion logs recording the number, duration, and format (home/phone call/clinic) of every participant contact. Unit costs were applied for staff time using standard national sources.[25]

Interviews

All trained facilitators were invited to take part in a qualitative interview focused on organizational-level barriers to and facilitators of implementation. Further purposive sampling recruited supporting team members (senior clinicians) and, to provide high-level contextual data, interviews were also conducted with four key stakeholders. Normalization Process Theory (NPT)[26] was used as a theoretical framework to guide data production (full analysis applying NPT will be presented in a subsequent publication). All interviews were conducted by telephone, audio-recorded, transcribed verbatim and pseudonymized for analysis.

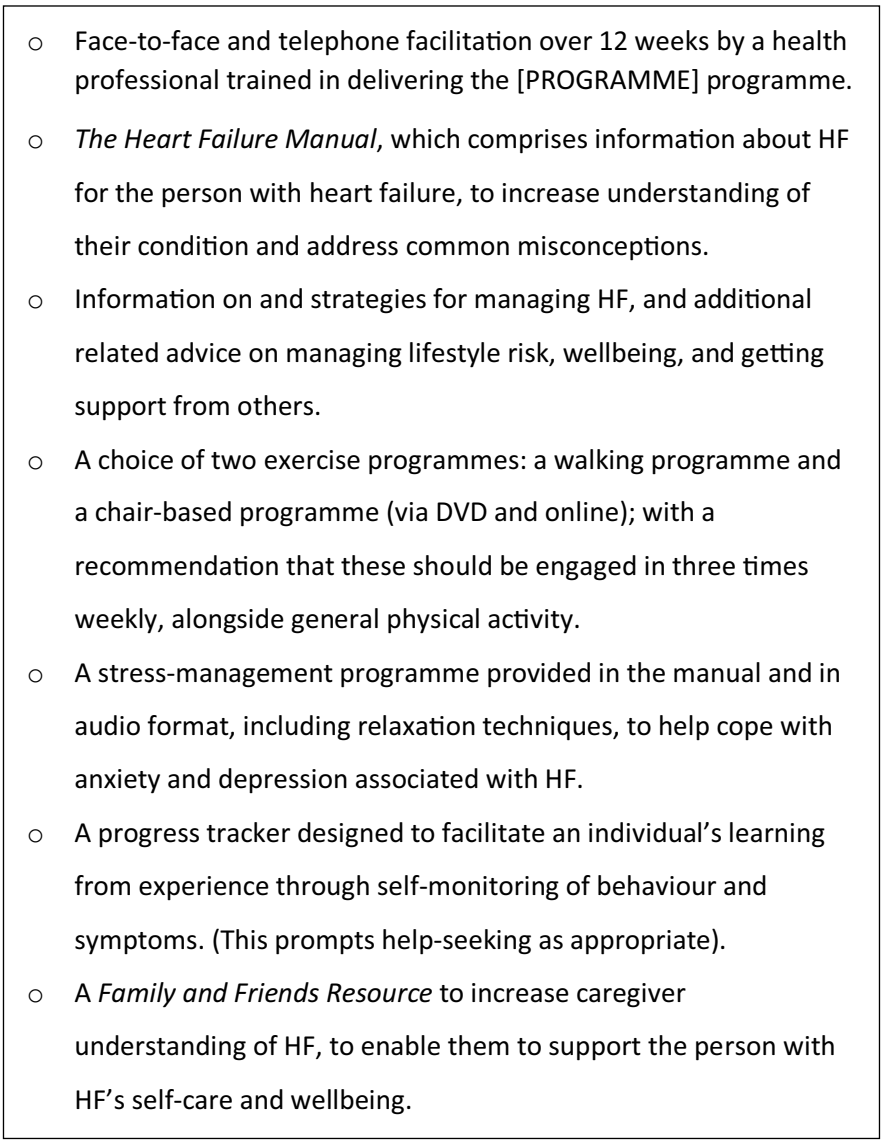


Figure 1 Summary of REACH-HF programme components. Face-to-face and telephone facilitation over 12 weeks by a health professional trained in delivering the REACH-HF programme. *The Heart Failure Manual*, which comprises information about HF for the person with heart failure, to increase understanding of their condition and address common misconceptions. Information on and strategies for managing HF, and additional related advice on managing lifestyle risk, well-being, and getting support from others. A choice of two exercise programmes: a walking programme and a chair-based programme (via DVD and online); with a recommendation that these should be engaged in three times weekly, alongside general physical activity. A stress-management programme provided in the manual and in audio format, including relaxation techniques, to help cope with anxiety and depression associated with HF. A progress tracker designed to facilitate an individual's learning from experience through self-monitoring of behaviour and symptoms. (This prompts help-seeking as appropriate). A *Family and Friends Resource* to increase caregiver understanding of HF, to enable them to support the person with HF's self-care and well-being.

Data analysis

Pre-specified statistical and qualitative analysis plans were developed and finalized prior to commencing data analysis.

Participant-reported outcomes

We estimated that we needed to enrol 130 people with HF to detect a pre–post change [based on MLHF total score standard deviation of 24 points, within-patient pre–post correlation ($r = 0.72$), and attrition rate of $\leq$10% as seen in the randomized trial].[12] Patient and caregiver outcomes at baseline and 4-month follow-up are reported descriptively. The focus of inferential analysis was a within-participant paired comparison of outcomes at baseline and 4 months, for those who completed follow-up. Differences are reported as mean differences, 95% confidence intervals, and *P*-values ($P \leq 0.05$ indicating statistical significance). We examined whether there were differences in characteristics and outcomes of participants who did not complete follow-up. Sensitivity analysis was undertaken to assess any

impact where follow-up was completed outwith ±1-month window around the 4-month follow-up. Statistical analysis was conducted by AP using R [R Core Team (2017), R Foundation for Statistical Computing, Vienna, Austria].

Economic analysis

An average REACH-HF programme cost per patient was calculated by totalling costs of delivering training and facilitator time and dividing that figure by the total number of people with HF who started on the REACH-HF programme during the study. Costs are reported in pounds sterling (£) for 2021.

Qualitative interviews

Analysis was undertaken by CP using NVivo 12 software [QSR International Pty Ltd. (2020), Melbourne, Australia] to facilitate data management and taking an approach informed by the Framework method.[27] Combining inductive and deductive elements, a coding framework was developed based on relevant literature, learning from the REACH-HF randomized trial,[12] and on the key research questions, while also allowing for emergence of unanticipated issues. Following an initial categorizing stage, a further interpretive stage explored commonalities, differences, and comparison across sites. This facilitated understanding of contextual factors shaping implementation and development of potential explanations for aspects of our quantitative results.

Public and patient involvement

A patient and public involvement (PPI) group of 14 patients and caregivers, chaired by TI, was established to provide direction to the research team. The group met remotely on five occasions over the study duration and its activities included: review of all participant-facing documents; advice on recruitment strategies; review of outcome and interview data; and guidance on dissemination plans.

Results

Study recruitment and sample

Between 4th March and 22nd October 2021, a total of 136 HF people with HF and 56 caregivers were recruited (221 eligible people having been initially approached about participating in the study). Of these, 124 patients and 46 caregivers (91% and 82%, respectively, of those initially consenting) provided baseline data. One hundred and one patients and 26 caregivers (81% and 57%, respectively, of those completing baseline assessment) completed 4-month follow-up at the end of the 12-week programme (see *Figure 2* and Supplementary material online, *File A*).

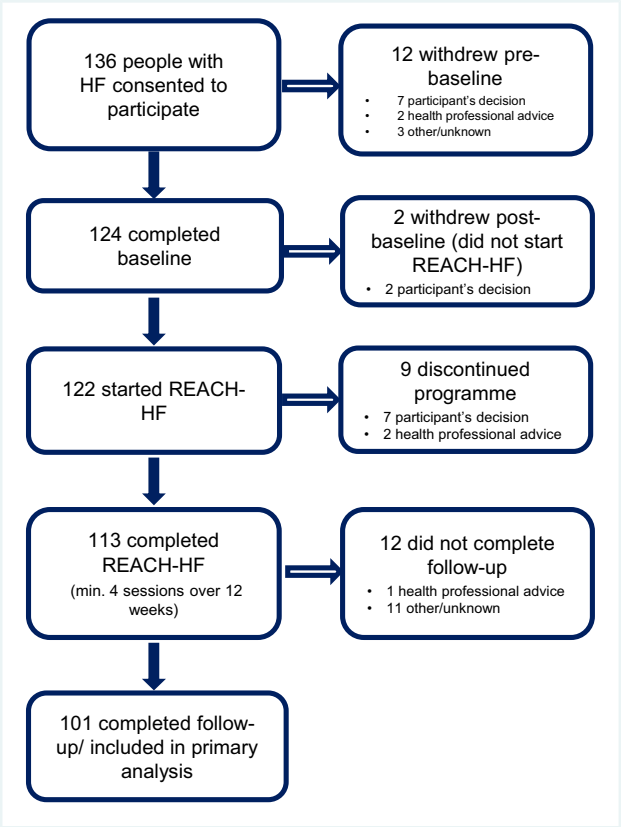


Figure 2 People with HF flow through study.

Participant baseline characteristics

Most participants with HF were men (72%), NYHA Class II–III (94%), with a mean age of 68 years, and left ventricular ejection fraction of 31% (see *Table 1*). Comorbidities included atrial fibrillation (48%), hypertension (48%), and myocardial infarction (34%). Pharmacological therapy for HF included angiotensin-converting enzyme (ACE) inhibitor (36%), aldosterone receptor antagonist (MRA) (69%), beta blockers (90%), angiotensin receptor II blocker neprilysin inhibitor (ARNI) (57%), sodium–glucose co-transporter 2 (SGLT-2) inhibitor (42%), and loop diuretics (69%). Caregivers were typically the spouse/partner (65%), predominantly women (76%), with a mean age of 62 years (see Supplementary material online, *File B*). All participants were of white ethnicity.

REACH-HF delivery

Facilitator logs of REACH-HF contacts were returned for 104 participants. Patients had a median of five contacts with their facilitator, with a median total contact time of 4 hours and 50 min. There was evidence of some variation in contacts across study sites (see Supplementary material online, *File C*). Only two sites were able to provide any home-based face-to-face REACH-HF contacts, with face-to-face contacts in other sites taking place at clinic.

Outcomes for people with HF

At 4-month follow-up, MLHF total scores improved compared with baseline [mean within-group difference of −9.8 (95% CI: −13.2 to −6.4, $P < 0.0001$, *Table 2*)], with 62 of 98 participants (63%) having a change that met the minimally important clinical difference of ≥5 points (). *Figure 3* shows a negative relationship between individual patients' total MLHF baseline scores and the magnitude of reduction in pre–post MLHF scores (Pearson's correlation coefficient, −0.40, $P < 0.0001$). That is to say, participants with the poorest HRQoL at baseline experienced the largest HRQoL gains with REACH-HF. Although there was some variation in the average magnitude of the improvement in in total MLHF scores across the four study sites, after adjustment for patient baseline MLHF score, these across-site differences were not found to be statistically significant ($P = 0.40$, data not presented). Both physical and emotional MLHF component scores improved. A sensitivity analysis limited to those 74 patients who were assessed within the ±1-month window at follow-up showed a similar inference in pre–post comparisons of MLHF total scores (−10.5, 95% CI: −14.1 to −6.9, *P*-value < 0.0001).

Pre–post improvements ($P \leq 0.05$) were also observed for the EQ-5D-5L; SCHFI self-care maintenance and symptom perception subscales; HLQ 'actively managing my health' sub-scale; and all PROM-CR + sub-scales. Non-significant improvement ($P > 0.05$) was seen in: the

Table 1 Baseline characteristics of recruited people with HF, *n*(%) unless otherwise stated

	n = 124
Demographics	
Age (years)—mean (SD)	68 (12.4)
Gender	
Female	34 (27%)
Male	90 (73%)
Other	0
BMI (kg/m^2)—mean (SD)	29.4 (7)
Ethnicity	
White (any)	124 (100%)
Any other	0
Partnership status[a]	
Married or civil partnership	76 (60%)
Divorced	19 (15%)
Widowed	18 (15%)
Single (never married)	7 (6%)
Live alone	44 (36%)
Smoking status	
Never	42 (34%)
In the past	68 (55%)
Current	14 (11%)
Employment status	
Employed/self-employed	23 (19%)
Unemployed	11 (4%)
Retired	85 (69%)
Full-time parent/carer	0
Student	0
Other	5 (4%)
Education[b]	
Post-minimum school leaving age	59 (48%)
Degree or equivalent	54 (44%)
Scottish Index of Multiple Deprivation Quintile	
1 (most deprived)	24 (19%)
2	28 (23%)
3	33 (27%)
4	24 (19%)
5 (least deprived)	15 (12%)
Medical history	
Ejection fraction (%)—mean (SD)	31% (8.1)
Cause of heart failure	
Ischaemic	54 (44%)
Non-ischaemic	49 (40%)
Unknown	21 (17%)
New York Heart Association (NYHA) class	
Class I	7 (6%)
Class II	66 (53%)
Class III	51 (41%)
Class IV	0
Comorbidities, past or present	
Angina pectoris	33 (27%)
Arthritis (osteo or rheumatoid)	23 (19%)
Asthma	15 (12%)
Atrial fibrillation or atrial flutter	60 (48%)
Cardiac arrest with resuscitation	7 (6%)
Cerebrovascular disease	6 (5%)
Chronic back pain	9 (7%)
Chronic renal impairment	18 (15%)
Depression	13 (11%)
Diabetes[c]	15 (15%)
Hypertension	60 (48%)
Myocardial infarction	42 (34%)
Osteoporosis	3 (3%)
Stroke	12 (10%)
Valvular heart disease	17 (14%)
Cardiac surgery/devices	
Coronary artery bypass graft (CAGB)	11 (9%)
Coronary angioplasty (with or without stent)	35 (28%)
Implantable cardioverter defibrillator (ICD)	10 (8%)
Cardiac synchronization therapy device (CRT)	9 (7%)
Combined CRT/ICD device	2 (2%)
Heart transplant	0
Pacemaker	5 (4%)
Pharmacological therapy	
Angiotensin-converting enzyme inhibitor (ACE)	44 (36%)
Aldosterone receptor antagonist (MRA)	85 (69%)
Angiotensin II receptor blockers (ARB)	13 (11%)
Angiotensin Receptor-Neprilysin Inhibitor (ARNI)	71 (57%)
Anti-coagulant	60 (48%)
Beta blocker	112 (90%)
Digoxin	20 (16%)
Ivabradine	5 (4%)
Loop diuretic	85 (69%)
Nitrate	23 (19%)
Sodium–glucose co-transporter 2 (SGLT-2) inhibitor	52 (42%)
Thiazide diuretic	0

[a]Two particpants with missing data
[b]One participant with missing data
[c]23 participants with missing data

SCHFI self-care management sub-scale; three HLQ sub-scales ('feeling understood and supported by healthcare providers', 'ability to actively engage with healthcare providers', 'understand health information enough to know what do to'); or in the HADS depression and anxiety sub-scales.

Table 2 Patient baseline and 4-month outcome scores

	Baseline *n*, Mean (SD)	4-months *n*, Mean (SD)	Within-group baseline vs. 4-month difference Mean (95% CI), *P*-value
Primary outcome			
MLHF			
Total score	124, 44.5 (23.9)	98, 32.8 (23.1)	−9.8 (−13.2, -6.4), < 0.001
Physical dimension score	124, 21.6 (11.4	100, 15.9 (11.1)	−5.07 (−6.7, −3.4), < 0.0001
Emotional dimension score	124, 11.6 (7.8)	98, 8.7 (7.0)	−2.4 (−3.5, −1.3), < 0.0001
Secondary outcomes			
EQ-5D-5L			
Visual analogue score (VAS)	124, 58.3 (21.4)	99, 67.2 (18.2)	8.3 (4.8, 11.8), < 0.0001
Utility score	122, 0.59 (0.24)	100, 0.67 (0.22)	0.06 (0.03, 0.1), < 0.001
SCHFI			
Maintenance	124, 57.4 (14.1)	99, 65.6 (14.1)	7.4 (4.7, 10.2), < 0.0001
Symptom perception	123, 48.2 (16.6)	99, 53.6 (15.3)	5.1 (1.9, 8.3), < 0.05
Management	122, 34.3 (17.2)	97, 37.2 (17.7)	2.8 (−1.0, 6.6), 0.14
HLQ			
Feeling understood and supported by healthcare providers	124, 3.4 (0.6)	101, 3.5 (0.6)	0.1 (−0.1, 0.2), 0.33
Actively managing my health	124, 2.9 (0.6)	101, 3.2 (0.6)	0.3 (0.1, 0.4), < 0.0001
Social support for health	124, 3.3 (0.6)	101, 3.4 (0.5)	0.1 (−0.1, 0.2), 0.40
Ability to actively engage with healthcare providers	124, 4 (0.8)	101, 4.1 (0.7)	0.1 (−0.1, 0.2), 0.25
Understand health information enough to know what do to	124, 4.2 (0.6)	101, 4.2 (0.6)	−0.002 (−0.1, 0.1), 0.96
HADS			
HADS anxiety	124, 6.7 (4.3)	100, 5.8 (4.4)	−0.6 (−1.2, 0.1), 0.07
HADS depression	124, 6.7 (4.2)	100, 5.8 (4.0)	−0.5 (−1.1, 0.2), 0.14
PROM- CR			
Total physical impact	123, 24.2 (9.2)	100, 19.2 (9.4)	−4.6 (−6.3, −2.9), < 0.0001
Total social impact	123, 13 (6.9)	101, 10.0 (6.1)	−2.6 (−3.9, −1.4), < 0.0001
Overall health and well-being	123, 6 (2.0)	99, 6.7 (1.9)	0.65 (0.3, 1.0), < 0.001
Overall physical well-being	123, 5.6 (2.0)	100, 6.5 (1.9)	0.79 (0.45, 1.12), < 0.0001
Overall social well-being	121, 6.0 (2.4)	101, 6.6 (2.1)	0.39 (−0.02, 0.8), 0.065
Overall emotional well-being	123, 5.8 (2.3	100, 6.8 (2.1)	0.68 (0.3, 1.1), < 0.001
Total impact of care	124, 19.8 (4.7)	100, 21.1 (3.6)	0.85 (−0.1, 1.8), 0.070

n, number of patients

There was no significant difference ($P > 0.05$) in the demographics, medical history, or baseline outcome scores of withdrawals compared with those who completed follow-up, with the exception that people with HF who withdrew were less likely to report having a degree or equivalent education (30% vs. 44%), less likely to have received ACE inhibitors (43% vs. 69%) and reported higher depression scores (mean HADS-D 8.6 vs. 6.3).

Four participants experienced SAEs in the 4-month follow-up period, all of which comprised hospital admissions (for lethargy, epistaxis, chest pain/dyspnoea, and pacemaker removal). All SAEs were reported to the project management and advisory groups. None were judged to be REACH-HF related. There were no deaths during the study.

Outcomes for caregivers

Although there was a trend to benefit for several caregiver outcomes (see Supplementary material online, *File D*), this was only statistically significant for the CC-SCHFI management and symptom perception subscores. Caregivers who withdrew compared to those with complete follow-up were more likely to be male (50% vs. 4%) and reported higher levels of depression (mean HADS-D 6.5 vs.3.5).

REACH-HF costs

Including facilitator training, REACH-HF material costs, and average facilitator total REACH-HF delivery time, the average cost for delivery of the REACH-HF intervention was estimated at £397.22 per patient (see *Table 3*).

Qualitative interviews

Semi-structured interviews were conducted with 11 trained REACH-HF facilitators (three cardiac physiotherapists, three HF and five cardiology specialist nurses), five supporting senior clinicians (three consultant/lead cardiology nurses, two consultant cardiologists), and four national stakeholders (with clinical backgrounds and current strategic national roles relating to policy, service delivery and workforce

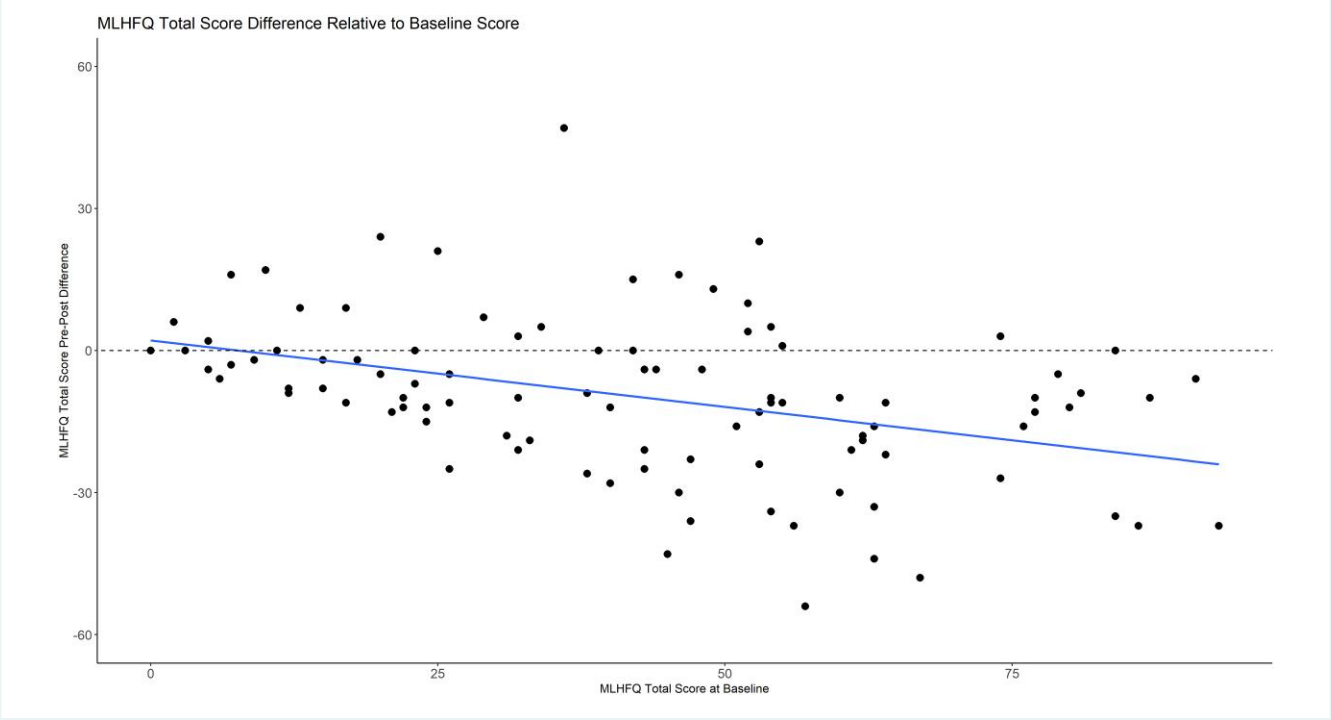


Figure 3 MLHFQ total score difference relative to baseline score.

Table 3 Assessment of costs of REACH-HF

Component	Total cost	Cost per patient in 2021£s[a]
2-day online REACH-HF facilitator training	£3918.20[b]	£32.22
REACH-HF manual & support materials		£40.00
REACH-HF facilitator delivery time[c]		£325.00
Overall cost		£397.22

[a]Based on 122 people with heart failure receiving REACH_HF
[b]Training costs: teaching faculty of 11.5 h of clinical psychologist (@band 9: £140/hr) + 13.0 h of nurse (@band 9: £137/hr) + 8 h of administrative support (@£65.90/hr)
[c]Based on median total contact time/patient of 180mins + non-contact time/patient of 80mins (@band 8 nurse: £75/hr) over 12-weeks of delivery.

development). Analysis highlighted general views on REACH-HF, and key barriers to and facilitators of implementation. The narrative summary of these themes presented below is supported by illustrative quotes in Supplementary material online, *File E*.

General views on REACH-HF

Interviewees were broadly positive about the programme, with around half expressing fully positive views, and half describing positive views mixed with some reservations or negative experiences. Facilitators highlighted the 'educational' benefit to their own practice, and perceived value for patients who were otherwise being 'missed'. Less positive experiences predominantly related to the pandemic context and associated work pressures; familiarity with their work role; and reservations about capacity when already under-resourced services returned to 'normal'.

Barriers to implementation

The online facilitator training was viewed as adequate while no alternative was possible, but most said the online format reduced opportunities for interaction and network-building to support future implementation and that face-to-face was preferable. The time required for one-to-one facilitation—vs. group CR, which had been the norm in all services—was seen as a potential barrier. While not insurmountable, this was presented as requiring a shift in thinking and reallocation of resources. There was also a general view that HF nurses' already challenging caseload was further strained by the pandemic, meaning they may not be best placed to deliver the programme.

The programme's suitability was perceived as uncertain for some patients, particularly those with a longer history of HF, and younger participants (some of whom reportedly found the exercise programmes insufficiently challenging). Interviewees expressed concerns with 'targeting the right patients', and timing introduction of the programme appropriately. Technological constraints included lack of access to DVD players and limited confidence using the internet. Some described an initial view of the programme as 'all exercise', as opposed to the broader goal of self-management. Some interviewees felt this may have acted as a barrier to recruitment and indicated that it took some time to grasp REACH-HF's 'actual purpose'.

Facilitators of implementation

Factors appearing to aid implementation included support and collaboration; familiarity with self-management; and perceptions of the programme's value and fit.

Clear lines of support and opportunities for collaboration within and across HF and CR teams were described alongside positive experiences of implementation. Familiarity with existing self-management

programmes was noted by several interviewees as having supported their adaptation to REACH-HF; while, conversely, the facilitators who described the most negative experience of implementation also described negative experiences with other self-management programmes. Having at least some face-to-face interaction with patients was also commonly described as highly valuable to facilitators and beneficial to patients.

Perceptions of the programme's fit with service's ethos appeared to support implementation. The programme was seen as valuable because it was viewed as an opportunity both for individual professional and broader service development, which would in turn benefit patients. Perceptions of REACH-HF as offering value for money and adding value to existing practice were especially evident at two sites that had already committed to continuing with the programme at the time of the interviews.

'Background noise'

The COVID-19 pandemic had created 'huge upheaval' across sites prior to and during implementation. Interviewees expressed frustration at its impact on CR services, and concerns around the pandemic's impact on their patients. Because no services were functioning as 'normal', some found it challenging to say exactly how REACH-HF might fit into routine practice. However, it was felt that REACH-HF had 'filled a gap' for patients unable to participate in centre-based CR, and the pandemic was seen by some as an opportunity to re-imagine both CR and HF care.

Discussion

The SCOT:REACH-HF study assessed implementation of the REACH-HF home-based CR programme in routine clinical practice across NHS Scotland. Our findings demonstrate that participation in REACH-HF resulted in substantial gains in HRQoL as assessed by patient-reported disease-specific (MLHF), CR-specific (PROM-CR+), and generic (EQ-5D-5L) measures—and in HF self-care management. The pattern and magnitude of gains in patient-reported outcomes in SCOT:REACH-HF are consistent with those seen in the REACH-HF trial.[12] Our findings also echo the international body of literature showing that HRQoL improvements for people with HF engaging in home-based CR are similar to those participating in centre-based provision.[12,28] That the magnitude of improvement in total MLHF scores was not only statistically significant but also clinically meaningful, with a ≥ 5 point improvement in almost two-thirds of participants.

The COVID-19 pandemic necessitated modifications to the delivery of REACH-HF in the SCOT:REACH-HF study. These shifts included to online facilitator training; to the majority of facilitator-patient contacts being by telephone or clinic (rather than home) visit; and to a slightly lower average contact time (4.8 vs. 5.3 h in the trial), and fewer overall sessions (5 h vs. 6.5 in the trial).[15] However, these do not appear to have reduced the effectiveness of the intervention. Analysis of our qualitative data does, however, suggest that 'hybrid' approaches to training and programme delivery may be preferable to health professionals, vs. fully remote implementation. Our analysis also suggests that roll-out could be supported by fostering opportunities for collaboration and knowledge exchange, for example, by supporting study days, 'bite size' training, and other local and national profile-raising opportunities.

It is interesting to compare our findings with those recently published on implementation of REACH-HF in four sites in NHS England. Conducted prior to and at the start of the COVID-19 pandemic (June 2019 to June 2020), similar adaptations to the REACH-HF model of delivery were needed. However, this study, which drew on routine data only, reported more modest improvements in HRQoL (pre–post MLHF total score mean change: −2.1). Reasons for this smaller improvement in HRQoL are unclear, but may reflect better HRQoL (lower MLHF scores) at baseline in the English cohort compared with SCOT:REACH-HF (mean MLHF total scores of 36.1 vs. 44.5).

There is a clear need for evidence to support clinicians and policy makers in assessing the implementability and applicability—both to their patients and local settings—of the findings from trials—and other means of developing and testing—complex health interventions.[18,29] SCOT:REACH-HF uniquely provides formal evaluation of the implementation of a home-based CR programme, following demonstration of its clinical and cost-effectiveness in a recent RCT.[15] The mixed-method design of the study allowed a rounded assessment of implementation, based on analysis of quantitative outcome, qualitative interview, and other essential implementation data. As such, it has addressed fundamental questions relating REACH-HF's implementability, cost, and scalability.[15]

Limitations

Our study has several potential limitations. Some patients (19%) and caregivers (43%) did not complete the study, which reduced statistical power and might have caused attrition bias. However, we found few differences in demographics, medical history, or baseline outcomes in withdrawals vs. those who completed follow-up. Furthermore, the large effect on the primary outcome (MLHF) suggests the risk of Type II errors because of loss of sample size was probably small. Due to COVID-19 restrictions, we were unable to assess exercise capacity. The demographic and medical characteristics of people with HF in this study were similar to recent large international randomised HF trials including PARADIGM-HF.[30] However, the mean age of SCOT:REACH-HF patient-participants was some 10 years younger than the general HF population in United Kingdom.[31] While we were unsuccessful in enrolling participants of any ethnicity other than white participating health boards comprised areas of very low ethnic diversity (with typically less than 1% of the population of each coming from non-white ethnic groups). Our study findings can therefore not be directly extrapolated to a non-white population. Lastly, while we had a relatively small sample of sites and short follow-up period, our sites were geographically diverse and included urban and remote/rural populations.

Conclusions

Substantive improvements were seen in self-reported HRQoL and self-management by people with HF, following participation in the evidence-based REACH-HF CR and self-management programme, when implemented in CR services of six NHS Scotland regional Health Boards. Although undertaken during the COVID-19 pandemic—which required most sites to deliver REACH-HF primarily by telephone and clinic-based contacts rather than home-visits—the improvements seen in the recent REACH-HF RCT were nevertheless replicated. Findings from the SCOT:REACH-HF study support scaled roll-out of the home-based REACH-HF programme across NHS Scotland, as an alternative to traditional centre-based models, in order to improve CR access and uptake for people with HF and their families.

Supplementary material

Supplementary material is available at *European Journal of Cardiovascular Nursing* online.

Acknowledgements

We would like to thank all the people with HF and their friends and family who participated, together with the facilitators and supporting staff across our four study sites. We thank our PPI group—Brown Cardoo, Mary Cardoo, Gary Curlewis, Farzana Kausir, Tom Kennedy, Isobel Kennedy, Rashmi Kumar, Margaret Ogden, Robbie Panton,

David Plizga, Debs Smith, Mic Starbuck, and the late Ian Barbour—for their help in co-producing the study materials and outputs. Finally, our thanks go to Julie Riddell, Elaine Hindle and the Population Health Research Facility at the MRC/CSO Social and Public Health Sciences Unit; Claire Kerr and colleagues at the Robertson Centre for Biostatistics, University of Glasgow; and the SCOT:REACH-HF Advisory Group—Susan Dawkes, Richard Forsyth, Nick Hartshorne-Evans, Edwin Jesudason, and Louise Taylor—for their strategic advice and support.

Funding

The work was funded by Heart Research UK, grant no. RG2685. The study was conducted and the manuscript completed while CP was a Research Fellow at the University of Glasgow. AP's time was supported by the Medical Research Council (grant number MC_UU_00022/1) and Chief Scientist Office of the Scottish Government Health and Social Care Directorates (grant number SPHSU16).

Conflict of interest: These affiliations had no influence on the interpretation or presentation of the results of the presentstudy. J.G.F.C. is supported by a British Heart Foundation Centre of Research Excellence award RE/18/6/34217. J.G.F.C. reports research funding and personal honoraria from Abbott, Amgen, Astra-Zeneca, Bayer, Boehringer-Ingelheim, Bristol Myers Squibb, Cytokinetics, Idorsia, Johnson & Johnson, Medtronic, Myokardia, Novartis, NI Medical, Pharmacosmos, Pharma Nord, Philips, Respicardia, Servier, Torrent, Vifor, Viscardia. The other authors declare no competing interests.

Data availability

The data presented in this article are available on application to the study PI.

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