




Integrating patients with chronic respiratory disease and heart failure into a combined breathlessness rehabilitation programme: a service redesign and pilot evaluation

Emma Chaplin ,¹ Sarah Ward,¹ Enya Daynes,^{1,2} Claire LA Bourne,³ Amy Stenson,¹ Amye Watt,¹ Nikki Gardiner,¹ Linzy Houchen-Wolloff,^{1,2} Sally J Singh^{1,2}

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For numbered affiliations see end of article.

Correspondence to

Dr Emma Chaplin;
emma.chaplin@uhl-tr.nhs.uk

ABSTRACT

Introduction The successful integration of patients with chronic heart failure (CHF) into a traditional pulmonary rehabilitation (PR) programme has previously been reported. Our aim was to reconfigure both our cardiac rehabilitation (CR) and PR services to enable us to deliver a symptom-based programme—breathlessness rehabilitation (BR), for patients with a primary symptom of breathlessness irrespective of the index diagnosis, or comorbid disease.

Methods After a service redesign process, patients attended a two times per week, group-based, tailored exercise and education programme for 6 weeks, delivered by CR and PR staff. The classes included both aerobic and resistance exercises and an overarching generic education programme alongside disease-specific components. Home programmes were reviewed at each session to facilitate progress and influence changes in exercise behaviour beyond the supervised programme. Generic clinical outcome measures were performed pre and post BR.

Staff focus groups were conducted to identify barriers and facilitators and explore staff perceptions.

Results 272 patients (n=193 chronic respiratory disease (CRD) and n=79 CHF) were assessed and enrolled into BR (153 men, mean (SD) age 68.8 (12.7) years, body mass index 28.8 (7.3), Medical Research Council 3 (IQR 2–4), New York Heart Association 2 (IQR 2–3)). 164 patients completed the programme. Statistically significant improvements were seen in both exercise capacity (incremental shuttle walking test: mean change 47.4 m; endurance shuttle walking test: mean change 310.7 s) and quadriceps strength (quadriceps maximal voluntary contraction: mean change 3.7 kg) ($p \leq 0.0001$) alongside a statistically significant reduction in dyspnoea (chronic respiratory questionnaire/chronic heart questionnaire - self reported - dyspnoea: mean change 0.4) and anxiety and depression scores (Hospital Anxiety and Depression Scale (HADS) - anxiety: -1.6; HADS - depression: -1.3) ($p \leq 0.0001$). Qualitative staff focus groups identified three subthemes: collaboration and integration, service quality and future challenges.

Discussion Overall the service redesign indicates the feasibility for staff and individuals with CRD and CHF to integrate into a breathlessness programme. Early data

Key messages

- Can patients benefit from an integrated rehabilitation programme treating the primary symptom of breathlessness rather than being disease specific?
- Service development of a breathlessness rehabilitation is feasible and clinically effective for patients with pulmonary and cardiac disease and is acceptable to healthcare professionals.
- Consensus is growing for the provision of breathlessness rehabilitation and this model may be feasible to grow with the provision of generic rehabilitation to other chronic conditions whose core complaint is breathlessness. This article describes our service reconfiguration.

suggests clinical effectiveness. Given the significance of comorbid disease it is an approach that warrants further consideration.

INTRODUCTION

Breathlessness, of which there are a number of causes, is one of the most common reasons for people presenting to emergency departments, with numbers increasing steadily each year.^{1,2} Individuals suffering from breathlessness typically lead sedentary lifestyles, falling into a vicious cycle of physical inactivity, deconditioning and severe breathlessness on exertion. Exercise intolerance can be a result from limb and respiratory muscle alterations caused by hypoxia, systemic inflammation and disuse.³ The National Institute for Health and Care Excellence^{4,5} recommends rehabilitation for individuals with chronic obstructive pulmonary disease (COPD) and chronic heart failure (CHF), comprising of an individually tailored



exercise regime, multidisciplinary education, support and self-management as an intervention to help alleviate symptoms.

Pulmonary rehabilitation (PR) and cardiac rehabilitation (CR) are widely provided as they are proven interventions^{6,7} recommended for both patients with cardiac and pulmonary disease improving quality of life, exercise capacity and skeletal muscle function, increasing physical activity as well as causing central desensitisation to dyspnoea. Both forms of rehabilitation can also have an impact on reducing hospital admissions.⁸⁻¹¹

Pulmonary rehabilitation is designed primarily for older individuals with chronic respiratory disease (such as COPD). The CR population is more diverse, ranging from secondary prevention in post myocardial infarction and cardiothoracic surgery patients to older individuals with CHF. Those with CHF are poorly represented in CR programmes despite strong evidence of effectiveness. Individuals with chronic respiratory disease (CRD) and CHF experience very similar symptoms and level of disability. Logic would therefore suggest that combined rehabilitation would be plausible and effective and breathlessness rehabilitation (BR) potentially brings together both diagnostic groups. These interventions are usually delivered as separate disease-specific programmes however their components are largely the same, both treating the primary symptom of breathlessness. Additionally, patients quite often have combined disease and share risk factors for other long-term conditions.^{1,12}

A previous study investigating the feasibility and effectiveness of integrating patients with CHF and into a COPD PR programme, without comorbid disease, using the model of PR,¹³ reported that patients with CHF who underwent exercise rehabilitation improved similarly in their exercise performance and health status to those with COPD. This suggested service provision could be targeted around common disability rather than the primary organ disease. More recently a group of clinical experts and patients confirmed the logic and durability of this model¹⁴ concluding that existing pulmonary and cardiac services should be able to provide a flexible service that accommodates patients with both COPD and CHF. It was suggested the collaboration of work forces was feasible although acknowledging the services were frequently provided by discreet clinical teams with no overarching management and increase capacity for services. It was proposed that these services should be symptom focused rather than disease based. Exercise training was felt to be a core component but also any intervention should address dyspnoea management, psychological and education components as well.

Our aim was to describe and evaluate the effectiveness of a service development for BR which integrated individuals with both respiratory and/or cardiac diseases into one programme. We also explored the staff experiences on delivering the programme.

METHODS

Service development

A review of health and social care in Leicester, Leicestershire and Rutland, UK, created opportunities to improve care by redesigning a system around the future needs of patients in a sustainable way which was needed due to the rise in the number of people living with long-term and complex conditions. In 2014, a 5-year strategic plan was set out which identified long-term conditions, including patients with respiratory disease and heart failure as an area for integrating care. For this to happen, it would mean joining up services and workforces and encouraging staff to work differently to meet the needs of the changing population. The framework used within the trust to enable this transformation and sustainable change in culture and ways of working to happen was Listening into Action (Copyright Optimise, 2021; Milton Keynes, UK) which is a comprehensive, outcome-oriented approach to engage all the right people behind quality outcomes. It provides a comprehensive and joined-up way to tackle improvements in specific service areas, delivered through the direct engagement of the people who work there.

Service reconfiguration

Staff from both CR and PR teams were involved in the process mapping of both services to identify commonalities and differences in service provision, paperwork and data management. Peer working was encouraged between the services to provide an appreciation of the individual services. External funding from Education for Health enabled accredited staff training to be provided for each of the teams on disease pathology and management in either Cardiovascular Disease or Essentials of COPD before the BR classes commenced. There were also in-service training sessions on CR/PR from the respective team for the other members of staff. Any other opportunities to attend training sessions in house on the respective topic were encouraged.

Design

This was a prospective mixed-methods service evaluation from between September 2017 and May 2019.

Ethics

Ethical approval was not required as the project was deemed to be audit. Consent was collected from participants as part of the routine clinical service.

Patient and public involvement

The initial idea for the project was presented to the department's Patient and public involvement (PPI) group (comprising of both cardiac and respiratory patients) some years ago with no preconceived plans of how this question might be addressed. There was support for the concept and an enthusiasm to be involved in the

development of the service. As the project evolved, the PPI group was continually involved and guidance sought as and when there was new information. Two of the PPI group members attended the steering group for the duration of data collection and dissemination of the project.

Revised programme structure

Participants

Patients were referred into CR and PR as normal by consultants, community heart failure nurses, specialist nurses, allied health professionals and general practitioners.

Eligibility criteria

Cardiac patients

Patients had a known diagnosis of heart failure (HF) (confirmed by echocardiogram ejection fraction (EF) <40%) or HF with a normal ejection fraction (normal EF, New York Heart Association (NYHA) 2 or more, 3 or more admissions over 12 months, self-reported symptoms on activity).

Pulmonary patients

Patients were eligible to partake if they had a confirmed diagnosis of a chronic respiratory disease (Medical Research Council (MRC) Dyspnoea Scale¹⁵ 2 and above).

Patients were excluded by either service if:

- ▶ They had a lack of motivation (declined face-to-face classes) to participate in the programme,
- ▶ Had severe musculoskeletal or neurological disorders that limited mobility; patients needed to be independently mobile with or without a walking aid,
- ▶ Had a severe psychiatric disorder,
- ▶ Had a cardiac event within the last 6 weeks or
- ▶ Had a history of falls.

Assessment

All patients referred to either the PR or CR services were scheduled a comprehensive one-to-one assessment with a member of the multidisciplinary team (MDT). These are registered healthcare professionals who are clinical specialists in either PR or CR. The assessment included a review of the patient's relevant medical and social history, as well as an assessment of their current level of exercise performance and health status. Local risk stratification protocols were adhered to with telemetry performed on those cardiac patients at risk of exercise-induced arrhythmias or hypotension.

Patient assessment was carried out using a disease-specific proforma individual to the services but collecting commonalities. Class paperwork was an amalgamation of the two services using the PR exercise diary for patients to record their progress in class and at home and the CR paperwork which was adapted to record patient observations, class attendance and exercises during class.

Setting

Patients attended a redesigned two times a week, group-based, tailored exercise and education programme for 6 weeks, delivered by CR and PR staff. Each session lasted 2 hours which was divided into an hour for exercise training and an hour for an education session. The BR was delivered at one of two sites in Leicestershire, UK: acute hospital or community setting. Each class had between 8–12 participants in a group depending on the site capacity.

Class structure—exercise modifications

Prior to the BR class starting, resting blood pressure (BP), heart rate (HR) on all patients and capillary blood glucose levels in patients with diabetes were performed. Polar watches to monitor heart rate were provided to those cardiac patients deemed at risk of exercise-induced complications. Oxygen saturations were monitored in those patients whose desaturation was a concern following their initial assessment. A warm-up of 10–15 min was used in line with national recommendations for HF exercise programmes.¹⁶

The classes included both aerobic and resistance exercises. In order to try and incorporate both service guidelines, the exercises were split into two circuits: aerobic and strength. The aerobic component was based on individually prescribed walking from the incremental shuttle walking test (ISWT)^{17 18} and endurance shuttle walking test (ESWT)¹⁹ performed at baseline. Walking time was progressed maintaining a Borg dyspnoea score²⁰ of between 3 and 5 with the aim of walking for 10 min continuously initially. Static cycling was also completed, if the patient was able to, starting at 5 min but this could be increased to 10 min if tolerated or if this was preferable to walking. The intensity was prescribed based on the patient's breathlessness and perceived exertion symptom scores. Strength training consisted of both upper (bicep curls and triceps pull ups) and lower (sit to stand and step ups) limb resistance training with dumbbells which was based on 1 repetition maximum. Progression was achieved by maintaining a Borg perceived exertion²¹ rating of 13–15. Patients were encouraged to also complete a home exercise programme comprising of daily walking and one further strength session on the days when they did not attend rehabilitation classes. Home programmes were reviewed at each session to facilitate progress and influence changes in exercise behaviour beyond the supervised programme. Following completion of both the aerobic and resistance training, a cool down was performed.

Class structure—education modifications

There was an overarching generic education programme alongside disease-specific components. Generic topics included diet, exercise, coping with breathlessness, target setting and managing anxiety with the disease-specific topics incorporating medications, symptom control/

managing exacerbations and disease education. The education sessions were based on those provided by both teams in the traditional PR and CR classes, determining commonalities and adjusting the sessions for relevance as a generic group. They were delivered by a member of either the PR or CR team for the generic topics. For those disease-specific topics, a member of each team delivered the education to the appropriate subset of patients.

Staffing

All BR classes had a minimum of three members of staff (two registered and one assistant practitioner) during the exercise session, and where possible, one member of staff from each of the rehabilitation teams (one CR and one PR). Qualified members of the MDT included nurses, physiotherapists and occupational therapists with at least 5 years experience in delivering rehabilitation in their specialty

Data collection

Clinical outcomes

Process mapping identified the generic clinical outcomes used by both the PR and CR teams. These were not exhaustive due to the need for national data collection (NACR (National Audit for Cardiac Rehabilitation) and the RCP NACAP PR audit (Royal College of Physicians National Asthma and COPD Audit Programme) by the individual teams.

Generic clinical outcome measures were performed at baseline and repeated at the discharge assessment following completion of the 6-week BR programme. Maximal exercise capacity (ISWT)¹⁷; endurance exercise capacity (ESWT)¹⁹; dyspnoea (chronic respiratory questionnaire - self reported - dyspnoea domain²²/chronic heart questionnaire - self reported - dyspnoea domain (CRQ-SR-D/CHQ-SR-D))²³; anxiety and depression (Hospital Anxiety and Depression Scale (HADS))²⁴; and muscle strength (quadriceps maximal voluntary contraction (QMVC)) were all collected. The Dartmouth COOP questionnaire was also used to assess generic functional status.²⁵ Each question is a single-item measurement of an aspect of functional status. It provides an indicator of functional status, and the scores are ordinal and therefore presented as frequencies per response domain. Higher scores are indicative of a worse health-related quality of life.

Patients were classed as a completer if they achieved 75% of the programme (8/12 classes) which is standard in clinical practice for those attending both traditional PR and CR classes.

Statistics

This was a pragmatic service evaluation. Analysis was primarily descriptive, that is, proportions and estimation of means and SD. A paired t-test was used to compare within-group changes in clinical outcomes with between group changes compared using an

independent t-test and χ^2 test. Data were analysed using the Statistical Package for the Social Sciences V.18 (SPSS).

Qualitative outcomes

A focus group methodology was chosen to enable discussions to emerge between participants that were less artificial than one-to-one semi-structured interviews.²⁶ Seven staff who were regularly involved in delivering the BR programme were invited to attend one of two focus groups which took place in October/November 2018. Focus groups were conducted by three research associates working in the Centre for Exercise and Rehabilitation Science team, all with experience in qualitative methods. The first one research associate (AS) acted as the main facilitator, asking the questions and 'steering' the discussion. The other two facilitators (ED and SC) observed, took notes and prompted group members on any discussions that needed further explanation in one focus group each. The focus group schedule was developed in conjunction with the MDT and devised based on relevant literature and experience of the team. The semi-structured topic guide included open questions which aimed to identify barriers and facilitators to delivering this new rehabilitation programme, staff feelings about working together, staff confidence in managing patients outside their usual specialty and explore staff training needs (see online supplemental box S1). Each focus group was audio-recorded and lasted approximately 1 hour.

Qualitative data analysis

Data were transcribed verbatim by a professional transcription service and analysed using thematic analysis.²⁷ This approach follows six distinct stages: familiarisation with data; generating initial codes; searching for themes; reviewing themes; defining and naming themes and producing the report.

AS carried out initial coding and four other members of the team coded at least one transcript each to ensure validity and consistency, and to enhance interpretive authenticity (LH-W, MO, ED and SC). In addition, AS and LH-W discussed coding and theme decisions throughout data analysis, and other research team members met regularly to review emerging themes, and to search for and collate participant views.

RESULTS

Service development

After 18 months of integrated planning and education, the service was commenced by reallocating both standard PR and CR sessions to the novel breathlessness based programme. Once the programme had commenced, there have been minor adjustments to the service and continued in-service training.

Table 1 Baseline characteristics

	Whole group n=272		BR completers n=164
	CRD n=193	CHF n=79	
Gender (male:female)	99:94	54:25	86: 78
Age (years)	68.02±12.3	70.6±13.4	70.25±10.6
Body mass index (kg/m ²)	28.7±7.8	29.1±6.1	28.88±7.3
MRC dyspnoea grade (IQR)	3 (2–4)	–	3 (2–4)
NYHA classification of heart failure (IQR)	–	2 (2–3)	2 (2–3)
Pre ISWT (m)	212.3 (140.2)	210.2 (126.1)	225.6 (134.3)
Pre ESWT (s)	186.7 (122.4)	237.7 (211.6)	209.7 (142.8)
Pre QMVC (kg)	21.6 (10.7)	20.8 (7.7)	21.8 (10.1)
Pre HADS – anxiety	7.5 (4.4)	6.8 (4.3)	7.3 (4.3)
Pre HADS – depression	6.6 (3.7)	6.2 (3.4)	6.6 (3.6)
Pre CRQ/CHQ-SR-D	2.1 (1.4)	4.0 (1.4)*	2.2 (1.5)

**p<0.05.

.BMI, body mass index ; BR, breathlessness rehabilitation; CHF, chronic heart failure; CRD, chronic respiratory disease; CRQ/CHQ-SR-D, Chronic Respiratory Disease Questionnaire/Chronic Heart Disease Questionnaire – Self Report – Dyspnoea; ESWT, endurance shuttle walking test; HADS-A, Hospital Anxiety and Depression Score – anxiety; HADS-D, Hospital Anxiety and Depression Score – depression; ISWT, incremental shuttle walking test; kg, kilograms; kg/m², kilogram per metre squared; m, metres; MRC, Medical Research Council; NYH, New York Heart Association; QMVC, quadriceps maximal voluntary contraction.;

Clinical outcomes

Two hundred and seventy-two patients (n=193 CRD (COPD 126; asthma 15; Interstitial Lung Disease (ILD) 21; bronchiectasis 11; other 20) ; n=79 CHF (HF 36; HF with preserved ejection fraction (HFpEF) 20; HF with reduced ejection fraction 3; Myocardial Infarction (MI) 18; other 2)) were assessed and enrolled into BR. The cause of CHF was ischaemic in 46 patients versus 33 non-ischaemic; only 2 patients had an ICD in situ. Baseline characteristics of the completers are described in [table 1](#). Those that dropped out of the programme were significantly younger, had a lower exercise capacity and were less breathless.

One hundred and sixty-four patients (60%) completed the programme (n=127 CRD (66%); n=37 CHF (47%)), with a statistically significant difference in dropout rates between pulmonary and cardiac (34 vs 53%, p≤0.05) patients. The outcomes for the completers are outlined in [table 2](#). All measures except HADS - depression and chronic respiratory questionnaire (CRQ)/chronic heart questionnaire (CHQ) - dyspnoea showed changes that were clinically significant exceeding the MCID (minimal clinically important difference) following rehabilitation, where available from the literature. In context, MCID for ISWT in COPD=40 m²⁸ and in HF=42 m²⁹; MCID for ESWT in COPD=between 174–279 s³⁰; MCID for CRQ/CHQ=0.5³¹ and MCID for HADS=-1.5.³²

Statistically significant improvements (p≤0.0001) were seen in exercise capacity (mean change (95% CI): ISWT: 47.4 m (35.3 to 59.5); ESWT: 310.7 s (249.4 to 371.9)) and quadriceps strength (mean change (95% CI): QMVC: 3.7 kg (2.3 to 5.2)). Quality of life measures (mean change (95% CI): CRQ/CHQ - dyspnoea: 0.4 (0.1 to 0.6)) and

a reduction in the HADS (mean change (95% CI): HADS-A: -1.6 (-2.1 to -1.1); HADS-D: -1.3 (-1.7 to -0.8)) also showed a statistically significant improvement (p≤0.0001). Subgroup analysis showed significant within group changes (p≤0.005) for outcome measures except the CRQ/CHQ- dyspnoea in patients with CHF; however, there were no significant between group differences.

Frequency analysis performed on the COOP showed improvements in six out of the nine categories; no change was seen in social support, social activities and feelings which patients scored as 1 (no impairment) ([table 3](#)).

No adverse events were reported during the time period of the service evaluation.

Qualitative results

Qualitative focus groups took place 1 year after the new BR programme had commenced. Seven staff members took part (six women): one occupational therapist, three physiotherapists, one nurse and two assistant practitioners. The overarching theme identified from the analysis was evolving perceptions with three emerging main themes (collaboration and integration, service quality and future challenges) and nine subthemes. Online supplemental table S2 in the online supplement describes the findings in detail (see Qualitative Themes and Sub Themes findings Table) and also contains exemplar quotes.

DISCUSSION

More often than not patients with COPD have at least one other chronic health condition which will have implications for outcomes.³³ It is reported that of those patients referred to PR, between 51% and 96% have


Table 2 Outcomes for individual disease groups and whole group completers

	CRD n=127			CHF n=37			Whole Group n=164		
	Pre mean (SD)	Post mean (SD)	Change mean (95% CI)	Pre mean (SD)	Post mean (SD)	Change mean (95% CI)	Pre mean (SD)	Post mean (SD)	Change mean (95% CI)
ISWT (m)	231.8 (±138.0)	277.5 (±150.6)	45.6 (33.0 to 58.2) ^c	205.8 (±121.5)	258.9 (±154.6)	53.1 (20.5 to 85.6) ^c	225.6 (±134.3)	273.0 (±151.3)	47.4 (35.3 to 59.5) ^c
ESWT (s)	201.6 (±120.5)	510.1 (±429.2)	308.5 (239.5 to 377.5) ^c	249.5 (±220.7)	570.8 (±333.6)	321.3 (183.6 to 459.0) [*]	209.7 (±142.8)	520.4 (±414.1)	310.7 (249.4 to 371.9) [*]
QMVC (kg)	21.9 (±10.5)	25.7 (±10.5)	3.7 (2.1 to 5.4) [*]	20.8 (±7.7)	24.4 (±7.3)	3.6 (1.8 to 5.4) [*]	21.8 (±10.1)	25.5 (±10.1)	3.7 (2.3 to 5.2) [*]
HADS-A	7.4 (±4.3)	6.0 (±4.0)	-1.5 (-2.0 to -0.9) ^c	6.5 (±4.4)	4.5 (±4.1)	-2.1 (-3.2 to -1.0) ^c	7.3 (±4.3)	5.7 (±4.0)	-1.6 (-2.1 to -1.1) ^c
HADS-D	6.5 (±3.6)	5.7 (±4.0)	-0.8 (-1.2 to -0.3) [*]	6.8 (±3.5)	3.7 (±3.0)	-3.0 (-4.5 to -1.6) [*]	6.6 (±3.6)	5.3 (±3.9)	-1.3 (-1.7 to -0.8) [*]
CRQ/CHQ - SR -dyspnoea	2.1 (±1.4)	2.5 (±1.9)	0.4 (0.1 to 0.6) [*]	4.0 (±1.4)	4.7 (±1.1)	0.7 (-0.9 to 2.3)	2.2 (±1.5)	2.6 (±2.0)	0.4 (0.1 to 0.6) [*]

All values are mean (±SD) unless otherwise stated.

^ap<0.0001; C: clinically relevant (meets minimal clinically important difference for this population).

CHF, chronic heart failure; CRD, chronic respiratory disease; CRQ/CHQ - SR - dyspnoea, Chronic Respiratory Questionnaire/Chronic Heart Questionnaire - self reported - dyspnoea domain; ESWT, endurance shuttle walking test; HADS-A, Hospital Anxiety and Depression Score - anxiety; HADS-D, Hospital Anxiety and Depression Score - depression; ISWT, incremental shuttle walking test; kg, kilograms; m, metres; QMVC, Quadriceps maximal Voluntary Contraction.

Table 3 Dartmouth COOP

Dartmouth COOP domains*	Pre n=40	Post n=40
Physical fitness	4	3
Feelings	1	1
Daily activities	3	2
Social activities	1	1
Pain	4	3
Change in health	3	1-2
Overall health	4	3
Social support	1	1
Quality of life	3	2

All values are frequencies per response category.

*Higher scores in COOP (range 1-5) indicate worse health-related quality of life.

at least one coexisting condition.¹² The best care for these patients with multimorbidity is to provide patient-centred care rather than disease specific. PR and CR are widely established effective models of care. Previous research has shown that exercise training programmes improve exercise capacity in and health-related quality of life in both disease groups.^{6 8 34} In a recent consensus, 87% of stakeholders thought that patients with CHF could exercise using COPD training principles and vice versa.¹⁴ The British Heart Foundation (a large charitable organisation supporting cardiac patients) published a report 'Turning back the tide on heart and circulatory diseases'³⁵ which encourages reimagining rehabilitation services and to explore more joined up models of BR. Within the National Health Service (NHS) long-term plan for England (2019),³⁶ it is recognised that generic cardiac and pulmonary programmes have been shown to be effective for single index conditions and that this provides an opportunity to manage the groups collaboratively enabling more patients to access a programme. This is a novel description of a service redevelopment and evaluation of BR for those with CRD and CHF. We have demonstrated that combining expertise from staff with clinical expertise in CR and PR is possible. However, this required considerable service redesign, staff and patient engagement and workforce training. Overall though it was felt to be a positive experience; patients were happy to be in a combined class regardless of their condition and the staff learnt from each other, sharing specialist skills and knowledge, strengthening their skill set.

Following a consensus event which reviewed the current evidence surrounding outcome measures in PR and CR, health-related quality of life, exercise capacity and symptom evaluation were voted as the most important categories to assess for clinical purposes.³⁷ Overall, this data indicate that a BR programme is effective at improving generic outcomes for participants regardless of their primary diagnosis. However, although the symptom of breathlessness improved statistically

within the group it did not meet the MCID and therefore may not be clinically relevant. Patients had positive outcomes in both exercise capacity and health-related quality of life that were both statistically and clinically relevant as well as reflective of our traditional PR service and UK national audit data.^{38 39} Compared with the study by Evans *et al*,¹³ the cardiac group made similar improvements in exercise capacity and quality of life scores. Due to our inclusion criteria for the BR programme, patients with differing respiratory conditions not just COPD were included which may have accounted for smaller improvements in outcomes. Pilot data from the REHAB-HF study (2017)⁴⁰ suggested exercise capacity improved following rehabilitation. However, these changes, although similar to this study, were seen after a 12-week programme which started while patients were in hospital.

The Dartmouth COOP has been shown to be valid and responsive in patients with COPD⁴¹ and it is simple, reliable, quick and easy to perform and score. Improvements in this cohort were seen in the domains relating to physical fitness, daily activities, pain and quality of life, all of which are known to improve with PR and CR using other outcome measures. This suggests that patients are engaging with self-management of their conditions in order to gain these benefits.

Quality standards and audits helped inform joining of the two services. When initially looking at the design of the service, staff were mindful of incorporating outcomes that both services needed to report nationally and where possible commonalities that would enable reporting and evaluating the service possible.

BR has also allowed for the implementation of joint CR and PR services, using the clinical skills and knowledge of staff effectively, which in turn has benefitted patients who attend. As a result of this, there has been an increase in the number of cohorts provided, increasing capacity and patient choice. This also helps to meet the expectations of the NHS long-term plan. There were initial reservations by staff (as outlined in the focus groups) but following regular meetings of the teams to review both service practices and paperwork, it became apparent that there were more commonalities than first thought. However, this programme is unique to the UK healthcare system and may not be feasible in other countries due to the structure and eligibility criteria for attending a rehabilitation programme. This programme has enabled both services to be able to offer more choice to patients and integrate working with community rehabilitation teams with a commissioning model in place. Other long-term conditions may benefit (outside of pulmonary and cardiac conditions) from the programme, but this would require further evaluation.

In both COPD and CHF studies^{42–44} comparing centre-based or hospital-based versus a home-based setting, no significant differences were found between the two settings. One of the BR classes was held at a non-acute hospital setting and recruited lower risk patients. Those patients that tended to be more complex and sicker were

advised to attend at the hospital-based BR class. Polar monitors were worn by patients that were identified as potentially presenting with exercise-induced complications otherwise it was felt HR and BP checks prior to commencing each exercise class was sufficient for monitoring the stability of the patients.

Although there were a higher proportion of dropouts in the CHF group, documentation did not show a trend or particular reason to account for this. Reasons given were typical to those described by patients dropping out from traditional rehabilitation programmes for example, transport, family commitments, comorbidities. The programme was designed for older patients with HF and therefore there may have been a bias towards those with HFpEF who historically are older patients. This may have contributed to the high number of dropouts in this group also. A limitation to the study, is there was no control group; this was due to it being a service reconfiguration and evaluation. However, compared with traditional PR classes, similar outcomes were found. If time had allowed, further qualitative analysis of the patients' experience would have provided useful information to inform future developments of the service and quality improvement.

Due to there being general similarities in core topics of the educational component, it made delivery of the majority of the education to both cardiac and respiratory patients feasible while tailoring some of the disease-specific information.

For BR rehabilitation to be truly generic, the intervention needs to be patient focused which includes an intervention to address exercise capacity and also dyspnoea, psychological and educational needs of patients and carers.

CONCLUSION

We anticipate that this model may be feasible to grow with the provision of generic rehabilitation to other chronic conditions whose core complaint is breathlessness. Being able to see more patients with fewer resources in a combined programme will increase capacity in the separate disease-specific classes for patients with more complex needs. Given the significance of comorbid disease it is an approach that warrants further consideration.

Author affiliations

¹Centre for Exercise and Rehabilitation Science, Pulmonary Rehabilitation Department, University Hospitals of Leicester NHS Trust, Leicester, UK

²Department of Respiratory Sciences, University of Leicester, Leicester, UK

³School of Psychological, Social and Behavioural Sciences, Coventry University Faculty of Health and Life Sciences, Coventry, UK

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ORCID iD

Emma Chaplin <http://orcid.org/0000-0003-0981-2980>

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Box S1. Focus group schedule**Opening**

Introduction

Confirm consent

Withdrawal

Questions

- To get us started, can you tell me a little bit about your role within this service?
- Can I just take you back to the LiA (Listening into Action) event in which you first started talking about a combined service – what did you think about it at that time? Specifically, what did you envisage the benefits/challenges might be?
- Have these changed as the service has developed?
- Please can you describe the training you had prior to the commencement of breathlessness rehab – was there anything that wasn't covered that you would have liked to be covered?
- How did you feel about working with other HCPs outside of your usual team?
- Can you tell me about the dynamics of the teams since breathlessness rehab has started?
- How do you find working on different sites? (*prompt*: how has it been managed?)
- How have you felt about working with different patient groups/delivering rehab to different patient groups? (*prompt*: how did you feel at the beginning/how do you feel now?)
- What are the pros/cons of breathlessness rehab, compared to PR/CR?
- What do you think about how beneficial the service currently is to patients?
- What do you think could be done to improve the current service?
- How do you see this service being delivered in the future? What do you think about potentially combining both pulmonary and cardiac rehabilitation for all classes in the future?

End

Table S2. Main themes and sub themes findings**Main Theme: Collaboration and Integration****Sub-Themes:****Staff apprehension:**

Staff acknowledged that combining the patient populations made sense for symptom management. However, they discussed their apprehension about sufficient knowledge of the other disease population after being in a specialist area for so long.

"It did make sense [to combine the cardiac and respiratory rehabilitation programmes] because they have got the same symptoms, but for me obviously, as a nurse, my whole background has been in cardiac. So to then have it faced with me that you're looking after people in a class that have got lung conditions, which I'm probably not au fait with, that was a bit of the worry." (F1, CR)

"When I first heard about what the plans were to integrate the services essentially, in some ways it made sense, because a lot of it was crossed over with treating the patients for symptoms rather than their actual disease primarily. But then there's also, isn't there, there's that fear of change and doing something different and trying to work it out..." (F5, PR)

Both teams acknowledged that although they both provided rehabilitation services, these services were run differently and as such there were some initial concerns as to what the change would look like and whether the patients would be able to manage the adapted programme. With this being said, there was also a recognition that the teams needed to move forward and embrace changes positively.

"I think there's always a bit of a threat, isn't there, when you have a change and you think oh I don't know what to do with that kind of patient and that's not what I signed up for, etc. But it's important to move forward and to look at things as a whole team." (F2, PR)

Managing classes:

One of the initial concerns with combining the programmes was that the guidelines for the different services were not comparable. This meant the teams had to agree the commonalities and try and come to a compromise that both patient populations would be able to manage.

"I guess the guidelines are a little bit different, aren't they, slightly for cardiac to pulmonary and we do follow them, don't we, I suppose we have to with, I guess if you're thinking about blood pressures and things, you may still exercise someone with a blood pressure that's above 100 diastolic, whereas we wouldn't in cardiac, you see, so I think those are the little things, probably teething problems, weren't they, and getting staff to understand that it's just different in cardiac really." (F1, CR)

"So when we came together we'd already been up at Loughborough for quite some time, so it wasn't so much of an issue. You know, we knew the place, we knew how it all worked. And we just converted one of our pulmonary classes here at Glenfield into the breathlessness class. So it was just a matter of tweaking maybe how we ran the class, but apart from that it was essentially pretty much what we'd always been doing." (F5, PR)

Treating patients the same irrespective of their primary diagnosis, was important to staff but was something that developed over time as staff became more confident with the different disease populations.

"I don't think I'd see the patients as different, to be honest. Once they're in the class I know that a qualified member of the team has seen them, I know they're in the right class for comorbidities or

whatever else they've got, they're safe to be in that class exercising. So once they're in the class I don't think I say ah he's heart failure, that one's COPD." (F4, PR)

Learning from each other:

Many of the staff found working with other HCP's to be an interesting and positive experience as they were able to learn from each other's knowledge and skill. Staff felt reassured to know that there was always support from another member of the MDT in the specialist area that they may not have been as confident in. The teams seemed to be split by their stratification of risk, which would go on to define the intensity of the exercise that was prescribed. Staff also found it interesting to work with different patients.

"It's been very interesting to work together and to learn more about what each other does." (F2, CR)

"You've always got that support of the other people that do deal with the lung conditions that you can ask anything you're not sure about, so yeah." (F1, CR)

"I think the benefits [of the breathlessness programme] are obviously working with other healthcare professionals and learning something new, so working with different patients that you wouldn't necessarily work with normally." (F5, PR)

Views on service delivery:

Over time, the initial barriers expressed around trying to deliver a joint service reduced as it became more apparent that there were more crossovers between the services than staff had originally thought.

"Although the [cardiac and respiratory] services are both rehabilitation services, they're run very differently, but then when you actually looked at it more closely there are a lot of crossovers, so it was quite easy to integrate it." (F5, PR)

Staff seemed unsure of how breathlessness rehabilitation would be delivered in the future, though they were willing to continue and saw its constantly adapting nature as a positive learning experience.

"Well, I would say that we know it can work now. We've tried it and we've seen the benefits and that patients have enjoyed it and it works well. It's about selecting the right patients, but yeah now I would say we feel more positive about it, don't we?...More comfortable about it, but it's just about re-evaluating it, which I guess that's what we're doing." (F2, CR)

Main Theme: Service Quality

Sub-Themes:

Patient benefits:

Feedback from patients was overwhelmingly positive, describing how they had found it enjoyable and beneficial. Staff felt the programme had worked with the majority of those patients who had completed, and the benefits were easy to see. This was further evidenced by comparable results to those of standard cardiac and pulmonary classes. Similarly the number of incidents was minimal reflecting those reported in specific rehab services previously and so it was felt the structure of the programme worked.

"From the patients that I've seen, obviously I've only seen breathlessness, most of them complete and most of them give you positive feedback that they've enjoyed it and they've improved." (F2, CR)

"When we did the closed programme though, all the results were comparable to normal services and

they improved.” (F5, PR)

“We’ve had minimal incidents of people being unwell or whatever, so it’s obviously a good structure, it obviously works OK.” (F1, CR)

Compared with standard classes, staff noticed patients were working harder as they were required to move more between circuits and this was reflected positively in the outcomes. Respiratory patients found the warm-up harder, but were otherwise unaware of being in a mixed cohort with cardiac patients.

“I had a comment from a patient who had done pulmonary rehab previously who had come back and done breathlessness and just said that the warm-up was just far too long for them when they did the breathlessness compared to pulmonary.” (F3, PR)

“I think just keeping the patients moving a lot more, because in our standard classes they quite often like to have quite big rests in between doing their weights or doing their walking and things and have a bit of a chinwag with the person next to them; whereas, you know, it’s full-on for an hour and a quarter to get them going through everything and it just means that they, I think, work that little bit harder, I think the results have been better with patients that we’ve seen doing the breathlessness programme.” (F5, PR)

Providing patient choice:

Feedback from staff highlighted that Breathlessness rehabilitation provided more patient choice and increased access to rehabilitation overall, enabling staff to use their clinical judgement in what they can offer to patients.

“So we’ve got the breathlessness, we’ve got straight heart failure for the very deconditioned patient or they can go into normal rehab. So it gives us more choices and the more choices that’s better, isn’t it, so it becomes more bespoke for the patient.” (F1, CR)

“We have patients with heart failure in our classes and if that is the main diagnosis for them obviously why are they going to pulmonary rehab. The name breathlessness makes sense for them, but it doesn’t mean that the breathlessness rehab will take over. It’s going to be there as another option, even though it’s fundamentally the same programme, the same exercises that you are giving to patients.” (M, PR)

Main Theme: Future Challenges

Sub-Themes:

Not fully integrated service:

Whilst the teams are integrated during classes, staff felt that each team still tended to look after its own patients. This becomes more apparent when there are split education sessions. Staff also felt there were a number of barriers to becoming a fully integrated service, the majority of which were due to necessary individual service processes (e.g. assessments/discharges) and outcomes (e.g. questionnaires) needed for reporting to different national audits.

“But we’re not fully integrated because you’ve still got to look after your individual patients. So cardiac still do the initial assessments and we still do our initial assessments, and we discharge our own patients as well.” (F5, PR)

“Primarily you are still looking after your own patients, although we integrate in the class.” (F1, CR)

Limited facilities:

Facilities at the centre in which Breathlessness Rehabilitation was set up were felt to be superior to those at the main hospital site. This was due to facilities allowing patients to exercise in one room, which is easier to manage than classes at the hospital where patients can be exercising in different places, resulting in staff being split up and classes feeling slightly disordered. The downside to this site is that it is a non-hospital site and this has to be taken into account when offering classes to patients – risk stratification is paramount.

“I mean because Loughborough with the place being air conditioned and things like that everybody walks inside. But here you can have them walking on the corridor, walking on the treadmill, walking outside. So it just splits everybody off which can just feel a bit chaotic at times.” (F4, PR)

“I think it’s absolutely fine here, but the downside is that we need to vacate the room, because there is another programme coming after us which starts in our programme.” (M, PR)

“You have to be conscious of who you’re putting into the classes, because it’s not a hospital site, so if they need transport or if they need oxygen or they’re quite high risk patients you wouldn’t want them up there.” (F5, PR)

Additional training:

Training was provided initially; however, staff felt it was insufficient and could have benefitted from spending time in the other service to gain a better insight into how each of the services compared. The need for further training was recognised. The education component of each service is delivered differently, and some staff felt they needed additional training to deliver this more confidently.

“I’d have liked to have gone to, if we’d have done it where we’d have all rotated...to all the areas first then we would have known about cardiac patients and the types of drugs they’re on and what a cardiac class is normally like.” (F4, PR)

“I think perhaps, I’m probably speaking for myself here, but we need to improve our knowledge of the education, so we can deliver it better. So I don’t know if all the people who are doing the class are comfortable with the education topics.” (F2, CR)