



## Home-based pulmonary rehabilitation: an implementation study using the RE-AIM framework

To the Editor:

Pulmonary rehabilitation is an effective intervention for people with chronic lung disease, with evidence for improvements in exercise capacity, breathlessness and health-related quality of life [1]. It is strongly recommended in clinical guidelines for the management of people with chronic obstructive pulmonary disease [2] and there is growing evidence for its effectiveness in other respiratory conditions [3–5]. The majority of pulmonary rehabilitation programmes are centre based, requiring participants to attend an outpatient centre for every session of supervised exercise and education related to self-management [6].

Despite the robust evidence for this model of care, access and uptake of centre-based pulmonary rehabilitation are universally poor [7]. Barriers to accessing centre-based programmes include travel and transportation, geographic distance, timing of the programme, and symptoms such as breathlessness and anxiety [8]. Estimates suggest <10% of eligible people complete pulmonary rehabilitation annually [9, 10]. For more people to access and complete pulmonary rehabilitation, alternative models of programme delivery must be considered. Australian and New Zealand pulmonary rehabilitation practice guidelines state that home-based pulmonary rehabilitation should be offered as an alternative to usual care or centre-based pulmonary rehabilitation [2]. However, models of home-based pulmonary rehabilitation tested in preliminary studies have rarely been implemented into clinical practice and very few centres offer home-based pulmonary rehabilitation [6]. This is likely to be due to initial experimental models that required significant staffing and resources or did not include all the necessary components of pulmonary rehabilitation [11, 12].

Recently, a home-based model of pulmonary rehabilitation demonstrated short-term outcomes that were equivalent to centre-based pulmonary rehabilitation in a randomised controlled trial [13]. The home-based model was designed to be accessible to patients, deliver the essential components of pulmonary rehabilitation and be easy to administer using minimal resources. We chose to implement this model alongside an existing centre-based pulmonary rehabilitation programme within an ambulatory chronic disease management service in metropolitan Melbourne, Australia. The service had not previously had a home-based pulmonary rehabilitation programme. The programmes were staffed by senior physiotherapists, an allied health assistant and a nurse.

This report describes the implementation of home-based pulmonary rehabilitation into our service.

From December 2016 to December 2019, people referred for pulmonary rehabilitation were offered the option of a home-based programme if they were unable or unwilling to attend centre-based pulmonary rehabilitation. Approval to report the implementation process and outcomes was granted prospectively by the Alfred Hospital Ethics Committee (project 449/17) including waiver of the requirement for informed consent.

The home-based programme adhered to the previously published protocol [13], including a single home visit and once-weekly phone calls for 7 weeks. Home-based programme completion was defined as participating in 70% of sessions.



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**Home-based pulmonary rehabilitation is a clinically effective alternative for people who cannot attend centre-based programmes** <https://bit.ly/33qPx7A>

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The RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) framework was used to evaluate the success of implementation and impact of translating research to “real-world” conditions [14].

Reach was determined by the total number of referrals; the characteristics of the participants; the number who attended assessments, home visits and phone calls; and those who completed the programme. Effectiveness was assessed by standard measurements of exercise capacity, health-related quality of life, symptoms and mood. Adoption was determined by the number of staff members who were trained to deliver the programme. Implementation was evaluated using a fidelity checklist to document the delivery of programme components and maintenance was determined by the continuation of the programme following the 1-year pilot period.

TABLE 1 Participant characteristics and outcomes according to RE-AIM framework

<b>Reach</b>		
Total referrals		100
Attended initial assessment		71
Number of home visits per patient		1 (1–4)
Number of phone calls per patient		7 (3–7)
Completion		53
<b>Characteristics</b>		
Age years		71±12
Male/female		28/43
FEV <sub>1</sub> % predicted		57±22
Long-term oxygen therapy		13
Diagnoses		
COPD		49
Asthma		8
Bronchiectasis		7
Interstitial lung disease		4
Pulmonary hypertension		2
Cystic fibrosis		1
Reason for HBPR choice		
Symptom limitation		32
Work commitments		24
Transportation		15
<b>Effectiveness</b>		
<b>Outcomes</b>	<b>Baseline</b>	<b>Change following HBPR (n=53)</b>
6MWD m	360 (218–541)	24 (6–34) <sup>#</sup>
CRQ score		
Dyspnoea	15 (10–18)	3 (1–5) <sup>#</sup>
Fatigue	15 (11–18)	2 (1–3) <sup>#</sup>
Emotional function	35 (28–39)	2 (0–3)
Mastery	20 (16–23)	2 (1–3) <sup>#</sup>
CAT score	18 (13–22)	–2 (–3–1) <sup>#</sup>
HADS score		
Anxiety	5 (2–9)	–1 (–2–0)
Depression	5 (2–9)	0 (–2–1)
mMRC score	2 (1–3)	34 (64%) score unchanged 19 (36%) score improved
<b>Adoption</b>		
Staff trained		7
<b>Implementation</b>		
Programme modification		20
Pedometer use		20
Home diary completion		46
<b>Maintenance</b>		
Pilot period 1 year		>3 years

Data are n, median (interquartile range) or mean±sd. n=71 unless otherwise stated. RE-AIM: Reach, Effectiveness, Adoption, Implementation, Maintenance; FEV<sub>1</sub>: forced expiratory volume in 1 s; COPD: chronic obstructive pulmonary disease; HBPR: home-based pulmonary rehabilitation; 6MWD: 6-min walk distance; CRQ: Chronic Respiratory Questionnaire; CAT: COPD Assessment Test; HADS: Hospital Anxiety and Depression Scale; mMRC: modified Medical Research Council dyspnoea scale. <sup>#</sup>: clinically important change.

Statistical analyses were conducted using IBM SPSS Statistics (version 26). Descriptive statistics are presented as mean $\pm$ SD or median (interquartile range) according to distribution. Categorical variables are reported descriptively using frequency (n) and proportion (%). Pre- and post-programme effectiveness outcomes were compared using paired t-tests or the nonparametric equivalent depending upon distribution.

Reach: from December 2016 to December 2019, 279 individuals were referred for pulmonary rehabilitation, 100 (36%) chose to undertake home-based pulmonary rehabilitation, with 71 (71%) attending an initial assessment. Programme completion was achieved by 53 (75%) participants. Characteristics of participants are presented in table 1.

Effectiveness: following home-based pulmonary rehabilitation, significant improvements in clinical outcomes were demonstrated (table 1). One adverse event not related to the programme (spontaneous pneumothorax at rest in end-stage interstitial lung disease) was reported.

Adoption: additional core training to deliver the programme was learning the technique of motivational interviewing. This training was completed by seven community-based physiotherapists. The framework of our pulmonary rehabilitation service designated one senior clinician who was primarily responsible for providing structured telephone modules; with clinical cover provided by others as needed.

Implementation: programme audit showed that most participants used walking for aerobic exercise (n=65, 92%); of those, 20 (28%) used a pedometer; the remaining participants attended private gyms or used exercise equipment at home. Adaptations to the local context included modification of the programme protocol for 20 (28%) participants. People with cognitive impairment required additional in-person home supervision to progress their programme and used basic methods to record exercise. Home assessments of exercise capacity were completed for people who could not travel to the centre, and family members and/or interpreters were used for people of non-English speaking background. All participants received education on managing an acute exacerbation of their lung disease and ongoing exercise post-pulmonary rehabilitation. Patients prescribed inhaled medications had their device technique reviewed by a pulmonary rehabilitation clinician. No participants attended the centre for additional self-management education.

Maintenance: the health service elected to continue the programme after the 1-year pilot programme and it has now been running for 3 years. During the COVID-19 pandemic, it became the sole method for delivery of pulmonary rehabilitation, with adaptations including cessation of home visits and in-person assessments.

This implementation analysis has shown that the home-based pulmonary rehabilitation programme was able to be adapted to the setting and individual, allowing attendance by a range of people, including those who were working, who were not a notable group of participants in the original clinical trial [13]. Most programme participants (n=67, 94%) stated they would not have attended centre-based pulmonary rehabilitation, suggesting this model may have increased pulmonary rehabilitation uptake. The increased accessibility and programme flexibility were key features that have enabled continued delivery of home-based pulmonary rehabilitation beyond the pilot period, with the programme now part of the organisational core business. We were unable to complete long term follow-up of individuals beyond the intervention period due to service limitations.

Despite the success of implementation in our setting, there remain limitations to this model. A substantial number of participants chose home-based pulmonary rehabilitation but did not attend an initial assessment (n=29, 29%). Centre-based assessment may be a barrier to uptake of this model, and valid and sensitive home-based assessments are worthy of further investigation. Although participants in this home-based cohort improved clinically, we did not compare their outcomes to a centre-based group. A recent study comparing clinical outcomes of home- and centre-based pulmonary rehabilitation found smaller improvements in exercise capacity with home-based exercise, but similar improvements in quality of life [15]; however, this model did not involve motivational interviewing.

Ongoing evaluation of this programme is required to understand long-term efficacy; however, implementation of home-based pulmonary rehabilitation achieved broad reach in our health service, improved access and short-term outcomes for people otherwise unable to attend, and is now part of essential service delivery. The use of the RE-AIM framework to evaluate clinical implementation of home-based pulmonary rehabilitation provides evidence-based information for other organisations interested in replicating this programme.

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