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Research letter

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

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Take home message:

Home-based pulmonary rehabilitation is a clinically effective alternative for people who cannot attend centre-based programs.

To the editor,

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

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

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

From December 2016 to December 2019, people referred for PR were offered the option of a home-based program if they were unable or unwilling to attend centre-based PR. 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 program adhered to the previously published protocol [13], including a single home visit and once-weekly phone calls for 7 weeks. Home-based program completion was defined as participating in 70% of sessions.

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]. The application of the RE-AIM framework to this study is described in the online supplement.

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 program. 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 program. Implementation was evaluated using a fidelity checklist to document the delivery of program components, and maintenance was determined by the continuation of the program following the 1-year pilot period.

Statistical analyses were conducted using IBM SPSS statistics (v.26). Descriptive statistics are presented as mean (SD) or median (IQR) according to distribution. Categorical variables are reported descriptively using frequency (n) and proportion (%). Pre and post program effectiveness outcomes were compared using paired t-tests or the non-parametric equivalent depending upon distribution.

Reach: From December 2016 to December 2019, 279 individuals were referred for PR, 100 (36%) chose to undertake home-based PR, with 71 (71%) attending an initial assessment.

Program completion was achieved by 53 (75%) participants. Characteristics of participants are presented in Table 1.

Effectiveness: Following home-based PR, significant improvements in clinical outcomes were demonstrated (Table 1). One adverse event not related to the program (spontaneous pneumothorax at rest in end-stage interstitial lung disease) was reported.

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

Implementation: Program 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 program protocol for 20 (28%) participants. People with cognitive impairment required additional in-person home supervision to progress their program 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 PR. Patients prescribed inhaled medications had their device technique reviewed by a PR clinician. No participants attended the centre for additional self-management education.

Maintenance: The health service elected to continue the program after the 1-year pilot program, and it has now been running for 3 years. During the COVD-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 PR program 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 program participants (n=67, 94%) stated they would not have attended centre-based PR suggesting this model may have increased PR uptake. The increased accessibility and program flexibility were key features that have enabled continued delivery of home-based PR beyond the pilot period, with the program now part of 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 PR 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 PR 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 program is required to understand long term efficacy; however, implementation of home-based PR 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 PR provides evidence-based information for other organisations interested in replicating this program.

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Conflicts of interest: None to declare

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

Reach			
Total referrals			100
Attended initial assessment			71
Number of home visits/patient			1 [1, 4]
Number of phone calls/patient			7 [3, 7]
Completion			53
Characteristics			
Age (years), mean (SD)			71 (12)
Male : Female			28:43
FEV_1 (% predicted), mean (SD)			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	Symptom limitation		32
HBPR choice	Work commitments		24
	Transportation		15
Effectiveness			
Outcomes		Baseline	Change following HBPR
			n = 53
6MWD (metres)		360 [218, 541]	24 [6, 34] *
CRQ (score)	Dyspnoea	15 [10, 18]	3 [1, 5]*
	Fatigue	15 [11, 18]	2 [1, 3] *

	Emotional function	35 [28, 39]	2 [0, 3]
	Mastery	20 [16, 23]	2 [1, 3]*
CAT (score)		18 [13, 22)	-2 [-3, 1]*
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
Adoption			
Staff trained			7
Implementation			
Program modification			20
Pedometer use			20
Home diary completion			46
Maintenance			
Pilot period 1 year			>3 years

Data are n or median [IQR] unless indicated. n = 71 unless indicated. *clinically important change. CAT: COPD assessment test; COPD = chronic obstructive pulmonary disease; CRQ: chronic respiratory questionnaire; HADS: hospital anxiety and depression scale; HBPR = home-based pulmonary rehabilitation; MMRC: modified Medical Research Council dyspnoea scale; 6MWD: six-minute walk distance.

In this implementation study, we used the RE-AIM framework to evaluate the success of implementation into practice (http://www.re-aim.org)

The goal of RE-AIM is to improve the sustainable adoptions and implementation of effective, generalizable, evidence-based interventions.

The five steps to translate research into action are:

- **Reach** the target population
- **Effectiveness** or efficacy
- **Adoption** by target staff, settings, or institutions
- **Implementation** consistency, costs and adaptions made during delivery
- **Maintenance** of intervention effects in individuals and settings over time

Reach – The absolute number, proportion, and representativeness of individuals who are willing to participate in a given initiative, intervention, or program (www.re-aim.org/about/what-is-re-aim/reach)

In this study, Reach was measured by:

- Total number referred during the pilot period
- Characteristics of patients referred – age, gender, diagnosis, lung function, smoking status, BMI, housing
- Number who attend assessment
- Number of home visits
- Number of phone calls completed per patient
- Number who complete the program (attend 70% of planned sessions)

Efficacy – The impact of an intervention on important outcomes, including potential negative effects, quality of life, and economic outcomes (www.re-aim.org/about/what-is-re-aim/effectiveness-or-efficacy)

In this study, Efficacy was measured by:

- 6-minute walk distance
- Chronic Respiratory Disease questionnaire
- Modified Medical Research Council Scale
- Hospital Anxiety and Depression
- COPD Assessment Test
- Adverse events

Adoption – The absolute number, proportion, and representativeness of settings and intervention agents (people who deliver the program) who are willing to initiate a program (www.re-aim.org/about/what-is-re-aim/adoption)

In this study, Adoption was measured by:

- Number of staff who have completed Motivational Interviewing training
- Number of staff trained to deliver home visits
- Number of staff trained to deliver telephone calls

Implementation – At the setting level, implementation refers to the intervention agents' fidelity to the various elements of an intervention's protocol, including consistency of delivery as intended and the time and cost of the intervention. At the individual level, implementation refers to clients' use of the intervention strategies (www.re-aim.org/about/what-is-re-aim/implementation)

In this study, Implementation was measured by:

- Fidelity checklist to document delivery of program components – assessment, screening, group education offered, education package provided, inhaler technique reviewed, home exercise program prescribed and supervised at first visit, management of acute exacerbations discussed, ongoing exercise post PR discussed
- Number of home diaries completed

- Number of exercise sessions recorded in diaries
- Exercise goal attainment documented in diaries
- Confidence ratings in diaries
- Use of pedometer Yes/No

Maintenance – The extent to which a program or policy becomes institutionalized or part of the routine organizational practices and policies. Within the RE-AIM framework, maintenance also applies at the individual level. At the individual level, maintenance has been defined as the long-term effects of a program on outcomes after 6 or more months after the most recent intervention contact (www.re-aim.org/about/what-is-re-aim/maintenance)

In this study, Maintenance was measured by:

- Continuation of program following pilot period
- Ongoing participation in related programs
    - Home exercise program
    - Lungs in Action
    - Community exercise group