

Additional file 1: Summary of the SPHERE trial intervention using TiDIER and CERT criteria

TiDIER Criteria	Description
1. Brief Name	SPHERE (Supervised Pulmonary Hypertension Exercise Rehabilitation) trial: a complex exercise rehabilitation intervention for people with pulmonary hypertension
2. Why? Rationale	A definitive trial of an exercise-based rehabilitation programme for people with pulmonary hypertension is needed. The SPHERE trial aims to investigate whether a supervised outpatient exercise rehabilitation programme, is clinically and cost-effective when compared to usual care, for people living with pulmonary hypertension.
3. What? Materials provided	
Participants receiving SPHERE intervention	Participants in intervention group receive participant workbook and home exercise plan
Participants receiving usual care	Participants receiving usual care receive British Lung Foundation ‘keep active booklet’
Practitioners	Practitioners receive practitioner manuals and behavioural education cribsheets.
Practitioner training for intervention delivery	
Training format	One day interactive training session and comprehensive practitioner manual.
Who provided training	Health Psychologist and Clinical exercise physiologist (research fellow)
Who received training	Practitioners
4. Procedures	
Supervised exercise programme	Participants will attend twice weekly, one-hour, supervised group exercise sessions within existing cardio-pulmonary rehabilitation programmes. Practitioners shall review and progress exercise programme each week as necessary
Home exercise programme	Participants will be instructed to follow the SPHERE home exercise plan each week. Participants will choose 6-8 of 24 available exercises and complete circuits at moderate intensity with an additional warm-up and cool-down. No equipment is needed. Home exercise plan shall be reviewed each week with practitioner.
Behavioural education sessions	One to one sessions will be delivered before, or after, one of the weekly gym sessions aimed at improving adherence to exercise. Topics will include motivation and goal setting, fear avoidance, pacing of activity, controlling negative thinking, stress management, and overcoming setbacks

5. Who Provided?	Practitioners will be NHS clinical exercise physiologists (i.e. in possession of sport science degree) or chartered physiotherapists with a minimum of two years' experience working with clinical populations. All practitioners will complete one days training and complete an assessment before they are permitted to deliver the intervention
6. How?	Participants will attend face to face group sessions. They will receive two one to one familiarisation sessions with a practitioner at the start of the programme. Behavioural sessions will be delivered one to one. The home exercise plan will be performed unsupervised at home but with face to face review after the group exercise sessions
7. Where?	Participants will attend NHS outpatient cardiopulmonary rehabilitation departments for the supervised exercise sessions, behavioural coaching sessions (in a private room) and home exercise review.
8. When and how much?	
Supervised exercise programme	Participants will attend twice weekly, one-hour, supervised group exercise sessions for eight weeks. Exercise sessions will consist of individualised, moderate intensity exercise (40-70% heart rate reserve, Borg scale 12-14, breathlessness scale 3-4), that includes aerobic, muscular strength and 'functional fitness' exercise
Behavioural education sessions	Participants will receive six x 30-minute behavioural coaching sessions before or after one of the weekly supervised exercise sessions
Home exercise programme	Participants will follow the home exercise plan once a week for 45-minutes alongside the eight-week supervised exercise programme. They will choose 6-8 of 24 available exercises and complete circuits of selected exercise at moderate intensity with an additional warm-up and cool-down.
9. Tailoring	Participants starting level of exercise will be calculated based on results of an individual fitness assessment (incremental shuttle walk test) prior to start of programme. Both supervised and home exercise programmes shall be reviewed each week by practitioner and up titrated if intensity levels drop below those detailed above.
10. Modifications	The intervention was modified after feedback from practitioners and participants during pre-piloting. Key changes included: (1) additional detailed explanation of home exercise plan to promote adherence/safety of unsupervised exercise component (2) provision of adapted functional exercise for the extremely debilitated (3) additional content added to coaching behavioural sessions to combat negative thought patterns concerning activity by participants. Other adaptations included

	the provision of clear laminated ‘crib sheets’ to practitioners as visual prompts during behavioural coaching
11. How well planned?	
Participants	During two familiarisation sessions in the first week of exercise, participants will be shown how to monitor and record exercise intensity (using heart rate, rating of perceived exertion and breathlessness) in their exercise prescription booklets. These booklets will also record duration frequency and progression of the exercise programme and attendance to behavioural sessions. It will be reviewed and updated each week in discussion with a practitioner. Participant workbooks that contain a home exercise record sheet will be given to all participants so they can record the duration and intensity of the home exercise plan
Practitioners	SPHERE training day emphasises adherence to the SPHERE practitioner manual. An assessment following training will be completed to evaluate the practitioner’s readiness to deliver the intervention and/or the need for further training. A senior research fellow (SE), responsible for training, will conduct quality control visits to sites every 4-6 weeks observing at least one exercise or behavioural session with each participating practitioner. Performance and adherence to the standardised protocol will be judged against pre-defined criteria. Where performance is substandard, feedback will be given and another visit arranged.
Additional information as per CERT criteria	
HOW?: delivery	ITEM 1: Equipment. Participants will use cardiovascular exercise machines (bikes, treadmills rowers) or walking for aerobic exercise component of the exercise programme. Resistance and functional exercise will utilise weight machines, free weights, resistance bands, medicine balls, weight bags, steps and benches as required to meet the individual’s ability level. Provision of equipment will necessarily differ by site dependant on available resource. ITEM 14 B: How exercises are tailored to the individual. All participants will perform an individual assessment with the practitioner prior to starting the exercise prescription. At this assessment the participant’s level of fitness will be measured along with any other orthopaedic limitations that would preclude certain types of exercise for example excessive walking might cause arthritic knee pain. The practitioner can then prescribe an exercise programme at the correct relative intensity (see when and how much? above) and utilise equipment that the participant can use without musculo-skeletal discomfort.

	<p>ITEM 15: the decision rule for determining the starting level. Participants will complete two familiarisation sessions during the first week to gradually introduce them to exerting themselves to moderate levels of exertion and breathlessness in a safe environment. Dependant on their degree of limitation all participants will start with a duration 20-60 minutes aerobic exercise at the lower end of the target range of intensity described earlier.</p>
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