Protocol for a single arm feasibility trial assessing home-based pulmonary rehabilitation for adults with idiopathic pulmonary fibrosis in Delhi, India

Abstract

Introduction

Idiopathic pulmonary fibrosis (IPF) is an interstitial lung disease (ILD), which often results in poor exercise tolerance, dyspnoea on exertion and reduced quality of life. (Spruit, Singh, Garvey, Zu Wallack, et al., 2013)Physicians state increasing cases and recognition of IPF in India. (Richeldi, Rubin, Avdeev, Udwadia, & Xu, 2015)Treatment for IPF in India currently follows global trends of using antifibrotics.(Richeldi et al., 2015)however, pulmonary rehabilitation (PR) is acknowledged in the management of IPF.(Raghu et al., 2011)Various methods exist for the delivery of PR, including home-based. At present, data is lacking in the feasibility of conducting home-based PR in adults with IPF living in India.

Methods and analysis

This study can be thought to comprise of three work-packages (WPs).

WP1 Collect qualitative data and conducting interviews from adults with a diagnosis of IPF, family caregivers and healthcare professionals to guide the content of the home-based PR trial using the SPACE for COPD Manual(n=40).

WP2 is a single-arm feasibility trial of home-based PR for people living with IPF in Delhi, India (n=30). The primary outcome will be feasibility; with progression to a full trial based on recruitment (percentage of eligible patients who are recruited) and retention (percentage who complete the outcome assessment). Secondary outcome measures will include measures of exercise capacity, respiratory symptoms, psychological wellbeing and the economic burden of chronic respiratory disease.

WP3, we will do a qualitative evaluation of the PR intervention through interviews with patients (up to n=30) and interviews with all healthcare staff involved in the delivery of the intervention.

Ethics and dissemination

Ethical approval will be obtained from the ethics review committee of the Metro Ethical Review Board, Metro Hospitals & Heart institute, Noida - India.and the University of Leicester, UK. The results of the trial will be disseminated through patient and public involvement events, local and international conference proceedings, and peer-reviewed journals.

Introduction

Idiopathic pulmonary fibrosis (IPF) is a chronic, progressive interstitial pneumonia that often presents as a chronic cough and dyspnoea upon exertion.(Raghu et al., 2011) At present, there is a lack of data demonstrating the prevalence of IPF & ILD's in India, but it could be suggested to be at least 130,000 cases. (Richeldi et al., 2015)As the disease progresses, there is a decline in pulmonary function.

Pulmonary Rehabilitation is a well-proven, internationally recommended, multidisciplinary intervention that aims to bring out lifestyle changes through exercise training, education, nutritional intervention and psychosocial support and this has been shown to significantly improve health related quality of life, exercise tolerance, breathlessness and fatigue. (Bolton et al., 2013; Global Initiative for Chronic Obstructive Lung Disease (GOLD), 2020; National Institute of Health and Care Excellence, 2018; Rochester et al., 2015)PR is a low cost, high impact intervention that improves the quality of life, reduces suffering, reduces mortality and reduces economic loss, relieves dyspnoea and fatigue, improves exercise capacity, improves psychological and emotional function, and enhances an individual's self-management of their condition.PR reverses the disability associated with CRDs, is supported by the highest level of evidence and is recommended in national and international guidelines. (Spruit, Singh, Garvey, ZuWallack, et al., 2013)

The World Health Organisation makes the case for the fundamental role of accessible and affordable rehabilitation(World Health Organization, 2017) and acknowledges an unmet need that is profound in LMICs where demand greatly outweighs capacity. (Sally J Singh, Halpin, Salvi, Kirenga, & Mortimer, 2019)PR has been listed in the Indian Chest Association Guidelines(Vaishali, Sinha, Maiya, & Bhat, 2019)is an important intervention but there is no experience of delivery. Specifically in terms of Pulmonary Rehabilitation and IPF, the joint American Thoracic Society/ European Respiratory Society/ Japanese Respiratory Society and Latin American Thoracic Association IPF guidelines suggest the majority of patients with IPF should be treated with pulmonary rehabilitation, but this may not be reasonable in a minority of patients; however, this comes from low-quality evidence. (Raghu et al., 2011)

There is increasing interest in home-based Pulmonary Rehabilitation due to the limited resources needed. The SPACE for COPD Manual is a self-management tool (Apps et al., 2013)that has been shown to improve dyspnoea, fatigue and emotion scores, exercise performance, anxiety and disease knowledge in adults with COPD after a 6 week intervention.(Mitchell et al., 2014)To date, the impact of a culturally-appropriate SPACE for COPD Manual in adults with IPF living in India is unknown. Therefore, the objectives of this study are to:

1. Adapt the content of the SPACE for COPD Manual(Apps et al., 2013) using qualitative data methods to make it appropriate for adults living with IPF in India.
2. Determine the feasibility of conducting home-based PR based on the SPACE for COPD© Manual for people living with IPF in India.
3. Assess the acceptability of home-based PR based on the SPACE for COPD© Manual (Apps et al., 2013) among Indian adults living with IPF and healthcare staff involved in its delivery.
4. Describe any changes in health of the adults living with IPF following completion of home-based PR based on the SPACE for COPD© Manual (Apps et al., 2013)
5. Assess the feasibility of a future trial and estimate the required sample size.

Methods and analysis

Study design and registration

A single-arm feasibility trial of home-based PR based on the SPACE for COPD© Manual (Apps et al., 2013) for adults living with IPF in Delhi, India, with qualitative evaluation from PR deliverers and participants. The PR intervention will be guided by qualitative data collected from adults with IPF, caregivers and healthcare professionals.

The trial will be conducted, analysed and reported according to the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) statement(Chan et al., 2013) and will be registered via International Standard Randomised Controlled Trial Number (ISRCTN).

Study setting

Institution based single centre (Metro Centre for Respiratory Diseases [MCRD]) feasibility study will be conducted at metro centre for respiratory diseases at Noida India. Centre runs ILD clinic one day a week and generally reviews about 30 cases / week. However, due to covid -19 ILD cases come by appointment every day of the week and its about 3-5 /day for face-to-face OPD and rest by tele consultations. New ILD cases constitute about 15% of ILD cases.

Participants

Interviews to guide home-based PR programme (WP1):

Interviews will be conducted with adults aged ≥18 years with a diagnosis of IPF (N=20), family caregivers (N=10) and healthcare professionals (N=10).

Healthcare professionals will be defined as: Those who have at least 1 year of experience and work directly with IPF patients, including specialists, nurses and physiotherapists.

Family caregivers will be defined as: Those who have and/or care for a family member diagnosed with IPF.

Home-based PR trial (WP2) including qualitative review (WP3):

People eligible for inclusion in the home-based PR trial will be: aged ≥18 years, confirmed diagnosis of IPF according to ATS/ERS guidelines and willing to provide informed consent.

Adults with comorbidities such as severe or unstable cardiovascular, other internal diseases and locomotor difficulties that preclude the exercise or malignant disease or other serious illness which will interfere with participation in the study, will be excluded. Individuals not eligible for the study will be recorded on a study screening log.

Healthcare professionals will be defined as: Those who have at least 1 year experience and work directly with IPF patients, including specialists, nurses and physiotherapists.

Family caregivers will be defined as: Those who have and/or care for a family member diagnosed with IPF.

Procedure

(WP1)

Healthcare professionals, family caregivers and adults living with IPF will be recruited by MCRD.

(WP2)

Eligible participants will be informed verbally about the study by the PI and CRC. Literate participants will be asked to read the patient information sheet (PIS) about the study, written in English or translated in the local language. Illiterate participants will have the contents read out to them by a study staff member, in the presence of a witness who will be present during the whole process. Participants will have the opportunity to discuss the PIS with the study medical personnel. Once the study staff is satisfied that the participant has understood the PIS, and is interested in taking part in the study, they will be taken through the informed consent process. Participants will give consent before undergoing screening tests and procedures. At the time of recruitment, patient's severity of illness will be examined by a qualified doctor and lung functions will be assessed using portable

spirometer. If this is not available, spirometry data from the previous 12 months will be used. If still eligible after the screening process, patients will be taken through another informed consent process. Information regarding the interest of participation in the study will be taken as field notes.

(WP3)

Experiences of the participants and healthcare professionals that were involved in the delivery of the intervention will be conducted, regarding the acceptability and feasibility of the trial in interviews. Participants who did not complete the trial will be asked to take part in a drop-out interview and information provided freely by the participants will be collected as field notes.

Usual care

Usual care will consist of routine advice for general breathing exercises and encouragement of physical activity along with pharmacotherapy.

Intervention

In addition to usual care described above, participants in the intervention arm will receive home-based PR based on the adapted SPACE for COPD Manual. The SPACE for COPD Manual is a comprehensive self-management tool that has been shown to improve anxiety, exercise performance and disease knowledge in adults with COPD. (Mitchell et al., 2014)

Due to the nature of this trial, the precise details and content of the home-based PR programme are unknown at this moment, as they will be heavily guided by the qualitative data collection within WP1. However, the intervention will comprise of the core elements of evidence-based rehabilitation, a programme of exercises and health education. Please see Appendix 1 for screenshots of the SPACE for COPD Manual in English; this provides an example of the home-based PR intervention.

The original SPACE for COPD Manual is divided into four stages and participants progress through the various educational topics. Table 1 shows the current SPACE for COPD content within each stage. The Manual currently contains educational material and a home exercise programme. Acquisition of skills is promoted through goal-setting strategies, coping planning and case studies. It incorporates an exercise regime that consists of a daily walking programme, and resistance training of the upper and lower limbs using free weights three times per week. The speed and duration of walking is prescribed based on results from the Endurance Shuttle Walk Test (ESWT)- see Secondary Outcome Measures for more information. The manual advises on training progression and includes an action plan for exacerbation management.

Calls will be conducted by healthcare professionals, PR staff and research staff throughout the intervention to participants to ensure they are progressing accordingly and answer any questions and queries.

Table 1: Current SPACE for COPD Content

Stage	Current SPACE for COPD Content
1	What's happened to your lungs?
	Exercise: how to get fitter
	Setting your goals
	Managing your stress

	Your emotions
	Controlling your breathing
	Your medication
2	How to stay fit
	Avoiding and managing days when you feel unwell
	Saving your energy
	The right foods when you feel unwell
	Clearing your chest
3	How to get stronger
	Managing your stress
	Healthy eating
	Traveling and your lung disease
4	Staying fit and your hobbies
	Your relationships
	Dealing with setbacks
	Sex and your lungs
	Breathe easy
Appendix	Frequently Asked Questions
	Setting your walking speed
	Help for carers
	Advice about oxygen
	Decision making
	Information about your medication
	Action plan
	Case studies

Outcomes

Primary outcome

Feasibility

Measures to assess feasibility are provided in Table 2 and include the comprehensive assessment of the feasibility of patient recruitment and the intervention delivery. Progression to a full trial will be based on a traffic light system whereby green indicates that it is feasible to proceed using the current trial methodology, amber indicates that modifications to the methodology are needed, and red indicates that it is not feasible to proceed.

1, Recruitment (percentage of eligible patients who are recruited): Green ≥60%; Amber 59-25%; Red <25%

2, Follow-up (percentage who complete the outcome assessment): Green ≥70%; Amber 69-50%; Red <50%

Table 2: Primary outcome measures- Feasibility and operational experience assessment	
Feasibility of patient recruitment	Data sources

Feasibility of screening and recruiting participants	Interviews with the healthcare professionals, screening log
Suitability of the inclusion criteria	Interviews with the healthcare professionals, screening log
Number of eligible patients, number of patients screened, number of patients invited to take part, actual number of participants who consent to take part	Screening log
Number of patients who refuse, drop out and the reasons for refuse and drop out	Interviews with the patients, screening log
Operational experience of intervention delivery	
Service provider and multi-disciplinary teams' willingness and ability to deliver the intervention	Interviews with healthcare professionals
The practicality of delivering the intervention in the proposed setting	Interviews with healthcare professionals and focus groups with participants
The time needed to collect the data Baseline visit- Time taken for each measure (each individual questionnaire and physical measure) Follow-up visit- Time taken for each measure (each individual questionnaire and physical measure)	Interviews with the healthcare professionals, Rehabilitation records
Data completeness and accuracy	Interviews with the healthcare professionals, Rehabilitation records, RedCap
Adherence to home exercise	Interviews with the patients and self-report exercise diary
The training and resources needed to deliver the intervention (ensuring readiness for a future much larger multi-center trial)	Interviews with the healthcare professionals and focus groups with participants, Rehabilitation records
Description of unintended events	Adverse events log, REDCap

Acceptability

The acceptability of the intervention among adults living with IPF and healthcare staff involved in its delivery will be assessed. Participants' experience of home-based PR, including any perceived benefits, challenges and changes they would make to the programme, will be explored in qualitative interviews after their discharge assessment or withdrawal. The experience of healthcare professionals regarding the PR intervention, such as their confidence in supporting the programme, the components of home-based PR, structure of home-based PR, the patient adherence to the PR exercises and how their perceptions changed over the course of the trial, will be explored in qualitative interviews at the end of the trial.

Secondary outcomes

The secondary outcomes of this study are provided in Table 3. Comparison of secondary outcome measures of baseline and post intervention, will describe any changes in the health of the adults living with COPD following completion of home-based PR.

Table 3: Secondary outcome measures		
Outcome measures	**Baseline**	**Post-intervention**
Socio-demographics	**X**	
Lung health (spirometry data, lung transfer factor, smoking status)	**X**	
Comorbidities	**X**	
Treatments	**X**	
Disease burden (MRC dyspnea grade, CCQ, CAT)	**X**	**X**
Economic impact of disease (WPAI)	**X**	**X**
Quality of life (EQ-5D-5L, KBILD)	**X**	**X**
Psychological wellbeing (Hospital Anxiety and Depression scale)	**X**	**X**
Physical function (5x sit-to-stand test)	**X**	**X**
Exercise capacity (ISWT, ESWT)	**X**	**X**

MRC - Medical Research Council, CCQ -Clinical COPD questionnaire, CAT- COPD Assessment Test, EQ-5D-5L EuroQol Five Dimensions Five Levels, ISWT - Incremental Shuttle Walk Test, ESWT - Endurance Shuttle Walk Tests, WPAI – Work Productivity and Activity Impairment questionnaire, KBILD- King's Brief Interstitial Lung Disease

If spirometry cannot be conducted during the baseline assessment, data from the previous 12 months can be used.

Sample size and recruitment target

This study is a feasibility trial that aims to provide data for an accurate estimation of the required sample size for future trials. Therefore, a formal sample size calculation is not required.

WP1: We hope to recruit a total of 40 adults living with IPF and their caregivers that will inform the design of the home-based PR.

WP2: We aim to recruit 30 participants to the home-based PR study.

WP3: We aim to recruit all (n=30) participants and all healthcare professionals involved in delivering the intervention for a qualitative evaluation post trial.

Data collection

Single-arm feasibility trial

Data will be collected by trained researchers, following standard operating procedures during participants' study visits.

Qualitative evaluation

Interviews to guide the home-based intervention (WP1)

Interviews (face to face or online (video)/ telephone) will be conducted with adults living with IPF, family caregivers and healthcare professionals to guide the content of the home-based PR trial using the SPACE for COPD Manual (n=40). These will give an insight into the opinions and recommendations from individuals that will guide the home-based PR content. Taking into account COVID-19 guidelines and participant preference, we will use a hierarchical approach for the qualitative data collection. The preferred approach is to conduct face-to-face interviews with patients and with PR staff. If face-to-face contact is not possible, online (video) interviews will be conducted, however this is dependent on video/teleconferencing software availability. If online interviews are not feasible, data will be collected via telephone.

Interviews with participants (WP3)

Participants allocated to the intervention group will be invited to participate in discussions once they have completed their home-based PR programme. Interviews will give an insight on views, experiences, opinions and recommendations which will inform future home-based PR programmes. Interviews will be conducted with participants via Face to Face, Telephones Calls or Video Calls.

Qualitative discussions will be audio-recorded, expected to last approximately 45-90 minutes, and will be conducted by a trained moderator and a note-taker). Audio recordings will be transcribed verbatim, with identifiable information removed and translated to English. Consent will be obtained from participants prior to their involvement in qualitative research.

Interviews with PR staff (WP3)

Health care personnel involved in delivering PR will be invited to participate in in-depth interviews at the end of the study to discuss aspects of feasibility and acceptability, such as insights into barriers and facilitators to attendance, logistical barriers of running a home-based PR programme and their views of participants' experiences of the intervention. We anticipate conducting interviews with all staff involved in PR, each expected to last approximately 15-45 minutes. Interviews will be audio-recorded and will be conducted face-to-face by a trained interviewer. Interviews will be transcribed verbatim, with identifiable information removed and translated to English. If face to face interviews are not possible due to COVID-19 guidelines, we will conduct online (video) interviews, and if this is not feasible, we will conduct interviews via telephone.

Evaluation form

Participants within home-based PR will be asked to log their experience as they progress through the programme. This will be in the form of a dedicated evaluation form which is provided as supplementary material. Staff involved in PR will also receive the same evaluation form at the end of the study. This form will be provided at the end of a participant's rehabilitation programme.

Baseline sample characteristics

Basic demographics including age, sex, religion, nationality, marital status, age of leaving full-time education, education level, ethnicity, employment status, monthly income, lung health, smoking status (packs per year), biomass fuel exposure, primary respiratory diagnosis, time since diagnosis in years, secondary respiratory diagnoses, family history of lung disease, comorbidities will be recorded at baseline.

Spirometry (post bronchodilator Forced Expiratory Volume in the first second (FEV1), post bronchodilator Forced vital capacity (FVC), FEV1/FVC ratio), lung transfer factor, hospitalisations

within the last 12 months, and current treatments will be collected as the baseline data prior to the randomisation of participants.

Secondary outcome measures

All secondary outcomes will be compared between the home-based PR and usual care arms from baseline to 6 week follow-up (within 7 days of completing their last PR session).

Exercise capacity

The incremental shuttle walking test requires the patient to walk up and down a 10-meter course, identified by two cones inset 0.5 m from either end to avoid the need for abrupt changes in direction. The speed at which the patient walks is dictated by an audio signal played on an audio device. Each participant will receive standardised instructions to: "Walk at a steady pace, aiming to turn around when you hear the signal. You should continue to walk until you feel that you are unable to maintain the required speed without becoming unduly breathless". (S J Singh, Morgan, Scott, Walters, & Hardman, 1992) To ensure learning, a practice ISWT will be performed and the participant will receive encouragement from the physiotherapist throughout the test in an effort to increase the distance one can walk. The test is terminated when either 1) the patient indicates that they are unable to continue, 2) if the operator determines that the patient is not fit to continue, or 3) the operator assesses that the patient was unable to sustain the speed and cover the distance to the cone prior to the beep sounding. The minimal important difference (MID) is 36m. (Evans & Singh, 2019)

The Endurance Shuttle Walk Test (ESWT) is a constant-load exercise test which measures the ability of the participant to sustain a given sub-maximal exercise capacity; the participant aims to walk at 85% of their maximal ISWT walking speed. (Revill, Morgan, Singh, Williams, & Hardman, 1999) The ESWT is frequently used as an exercise tolerance outcome measure for PR. The endpoint of the test is the time the participant walks at the constant endurance speed. The test consists of pre-recorded audio signals at different frequencies giving a total of 16 walking speeds. The ESWT is responsive to PR with an MID following a 6-week PR programme between 174 and 279 seconds. (Zatloukal, Ward, Houchen-Wolloff, Harvey-Dunstan, & Singh, 2019)

Physical function

The Sit-To-Stand (STS) test is a commonly used functional performance measure of lower-limb strength. (Bohannon, 1995) The five-repetition sit-to-stand test (FTSTS) measures the time taken to stand five times from a sitting position as rapidly as possible. The FTST is partly dependent on lower limb muscle function and balance, and is a common activity of daily living that measures performance such as time up and go, and gait speed. (S. E. Jones et al., 2013) The FTSTS is reliable, valid and responsive to PR with an estimated MCID of 1.7 seconds. (S. E. Jones et al., 2013)

Respiratory symptoms

The Medical Research Council (MRC) dyspnoea scale is a 5-point self-administered questionnaire based on the sensation of breathing difficulty experienced by the patient during daily life activities. Patients recognise their own level of respiratory fatigue used to measure functional dyspnoea (27). The questionnaire is short, easy to use and has grades ranging from 1 (none) to 5 (almost compete incapacity), with high grades indicating high perceived respiratory disability.(Fletcher, 1960)The MRC dyspnoea scale is responsive to PR with estimated MCID of 1 points.(Crisafulli & Clini, 2010)

Psychological wellbeing

The Hospital Anxiety and Depression Scale (HADS) questionnaire is a validated, easy to use screening tool for anxiety and depression symptoms in a hospital outpatient setting. (Nowak et al., 2014) The self-report rating scale is composed of 14 items with two 7-item subscales (HADS-A and HADS-D), both ranging from 0- to 21 with higher scores indicating more severe distress. The HADS questionnaire is validated for screening for anxiety and depression from patients. The HADS is responsive to PR with estimated MCID of 2 points on each subscale. (Smid et al., 2017)

Heath related quality of life

The European Quality of Life 5-Dimensions (EQ-5D-5L) questionnaire is a standardised questionnaire, developed to measure of health outcomes and defines health in terms of five dimensions: mobility, self-care, usual activities, pain or discomfort and anxiety or depression. (The EuroQol Group, 1990)The EQ-5D-5L will be used to calculate patient costs per quality adjusted life year (QALY). EQ-5D-5L is responsive to change following pulmonary rehabilitation, with a MCID of 0.05 (utility index) and 7.0 (visual analogue scale). (Nolan et al., 2016)

The King's Brief Interstitial Lung Disease (KBILD) is a self-administered, interstitial lung disease specific measure of health related quality of life, that comprises of 15 items with three domains (psychological, breathlessness and activities and chest symptoms). The KBILD has been shown to be valid, (Patel et al., 2012) reproducible, (Patel et al., 2012)and responsive following PR, with an MCID of 3.9 points for the total score.(Nolan et al., 2019) (REF)

The Clinical COPD questionnaire (CCQ) is a simple 10-time validated Health related quality of life (HRQoL) questionnaire with good psychometric properties (van der Molen et al., 2003). It consists of 10 items, each scored between 0-6, divided into three domains (symptoms, functional, mental). The total score is calculated by summing the scores of the individual items and dividing by 10 (the number of individual items) giving a total score between 0-6 with higher scores representing worse HRQoL. The CCQ is responsive to PR with an estimated minimal important improvement of 0.4(Kon et al., 2014).

The COPD Assessment Test (CAT) is a validated, self-administered, short and simple questionnaire that measures HRQoL. (P. W. Jones et al., 2009) The CAT consists of eight items, each scored between 0- and 5 scored with a range of 0- to 40; scores of 0-10, 11-20, 21-30, 31-40 representing mild, moderate, severe or very severe negative impact on HRQoL, respectively. The CAT is responsive to the effects of PR with an estimated minimal clinically important difference (MCID) of 2 points. (Kon et al., 2014)The CAT has been shown to be valid in adults with IPF specifically. (Grufstedt, Shaker, & Konradsen, 2018)

Cost/benefit analysis

The Work Productivity and Activity Impairment (WPAI) questionnaire is a validated instrument to measure impairments in work and activities, both paid and unpaid. The WPAI self-administered questionnaire measures time missed from work, impairment of work and regular activities due to overall health and symptoms, during the past seven days. (Reilly, Zbrozek, & Dukes, 1993) We have added two follow-up supplementary questions, following the WPAI format, to measure productivity with respect to regular household duties in low resource settings.

The cost of starting and running a home-based PR program will include single and recurrent costs. Single payments will include the necessary costs needed to set up and run PR. Recurrent costs refer to any item with a life expectancy of ≤1 year (e.g. disposable materials). (Lucas & Gilles, 2003) The fixed costs will be captured prior to enrolling the first participant into the home-based PR programme

and the recurrent costs will be collected at the mid-stage of recruitment. The average fixed and recurrent costs will be calculated separately. Table 4 demonstrates the variables that will be used to calculate fixed and recurrent costs.

Table 4: The variables used to calculate fixed and recurrent costs (not an exhaustive list)	
Fixed costs	**Recurrent costs**
Venue hire	Venue hire
Electrical equipment (laptop, printer)	Staff time to conduct home-based PR (assessment at baseline and discharge, conduct PR classes, telephone calls and data entry)
	Disposable equipment (for blood glucose monitor, spirometer mouthpieces, nose-clips, glyceryl trinitrate spray)
Equipment for shuttle walking tests (cones, licenses, stop watches, tape measure, electrical equipment to play audio)	Servicing costs (spirometer, PR equipment, specifically treadmills and cycle ergometers)
Equipment for PR assessment (height stadiometer, weight scales, sphygmomanometer, pulse oximeter, spirometer, calibration syringe, country-specific equipment)	Miscellaneous (Oxygen cylinders, questionnaire licenses, stationery (paper))
Additional safety equipment (blood glucose monitor, Oxygen cylinder holder)	
Miscellaneous (filing cabinets, storage units, questionnaire translations, questionnaire licenses, staff uniform)	
	Personal protective equipment for staff and patients during assessments Cleaning products

Data management

Data collected during the study will be entered into a database using Research Electronic Data Capture (REDCap), which is a web-based platform (40, 41). Access to the database will be via a secure password protected web-interface. The participants will be identified by a study-specific identification code. Data will be validated using real-time data entry validation and electronic checks lead by the Independent Data Monitoring Committee (IDMC), established at the University of Leicester, UK.

Quantitative data analysis

The data will be analysed using IBM SPSS Statistics for Windows. Data for baseline and follow-up time-points will be presented as descriptive statistics as appropriate. No inferential statistics will be performed due to the feasibility design of the trial.

Qualitative data analysis

Qualitative data will be analyzed using Thematic Analysis. This approach follows six distinct stages: familiarization with data; generating initial codes; searching for themes; reviewing themes; defining

and naming themes and producing the report. The responsible investigator will carry out initial coding and a sample of focus group transcripts will be coded by a second member of the team to improve consistency and to enhance interpretive authenticity. Throughout the data analysis, the team will meet to discuss and review emerging themes and search the accounts that provide contesting views of the same phenomena. Close attention will be paid to the complexity and interactions inherent in the focus group data.

Adverse events

All adverse events and serious adverse events will be recorded on an adverse event log, within study trial management paperwork, case report forms and REDCap. There will be no formal interim analysis of data due to the feasibility nature of the trial. The IDMC will review high level safety data. Adverse events will be monitored at least every month, and as needed on an ad hoc basis, to ensure the continuing safety of the participants. The Scientific Committee will determine the need to terminate the trial. Participant who experiences any such event will be directed to the appropriate hospital and all the necessary care will be ensured and followed-up until the participant has resolved or stabilized.

Ethics and dissemination

Ethical approval will be obtained from the ethics review committee of the Metro Ethical Review Board, Metro Hospitals & Heart institute, Noida - India and the University of Leicester, UK. The results of the trial will be disseminated through patient and public involvement events, local and international conference proceedings, and peer-reviewed journals. Privacy and the confidentiality of all information and identities of participants will be strictly maintained and will not be disclosed when publishing the results of the study.

Compensation for travelling will be provided to all the participants. All patient-facing study documents will be translated to Hindi to ensure clear communication. Participation will be without compulsion and each participant has the right to withdraw at any time, without providing a reason. Consent form and data sheets will be securely stored in a separate locked cupboard. Study computers will be password protected. All the data will be stored safely up to 6 years and after 6 years consent form and data sheets will be disposed of appropriately. Study team and IDMC only will have access to final trial dataset. Data from the Global RECHARGE Core Dataset will be made available following the completion of this project and we are considering the best tools to use to make this database available to the wider community. Any modifications of the protocol will be updated on trial registry (ISRCTN) and will be informed to the ethics review committee and the participants. Participants will be provided the provisions for re-consenting after any change of the approved protocol, if appropriate. It will be made clear in the publication of trial findings.

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Appendix 1 (screenshot of SPACE for COPD Manual)

Exercise: How to get fitter

This exercise programme is designed just for you. It is based on your response to exercise as well as scientific principles of exercise training. Keeping to this programme will give you the most benefits from your exercise.

You may have noticed a decrease in your ability to perform certain physical activities. This may be most obvious when you compare how much you can do against how much a friend or relative of the same age can do.

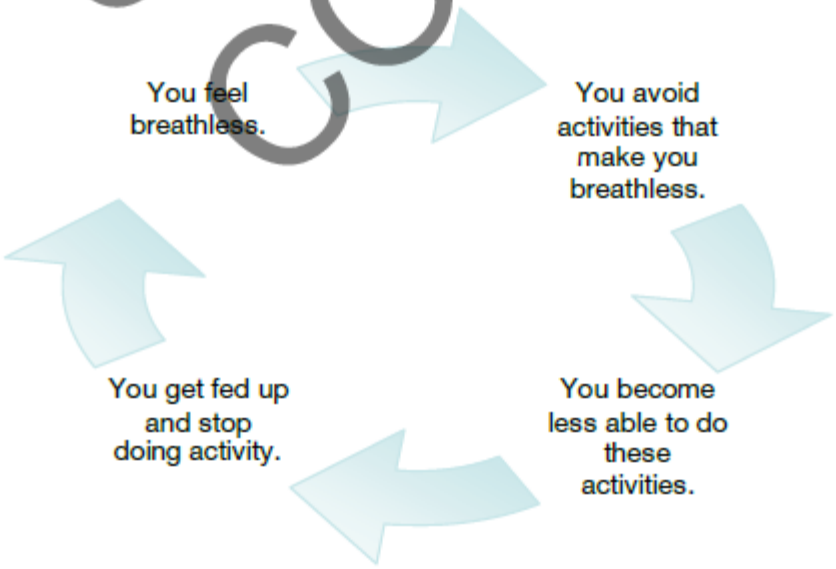
You may notice an increase in breathlessness when you walk upstairs, walk up a hill or do the more basic day-to-day activities, such as getting dressed or washed. In some cases, breathlessness may stop you doing a particular activity altogether.

What about my breathing – won't exercise make it worse?

We all get breathless with exercise – it is a normal response.

Olympic athletes get breathless after performing their event. They don't have COPD – they have just taken their bodies to the limit of their fitness.

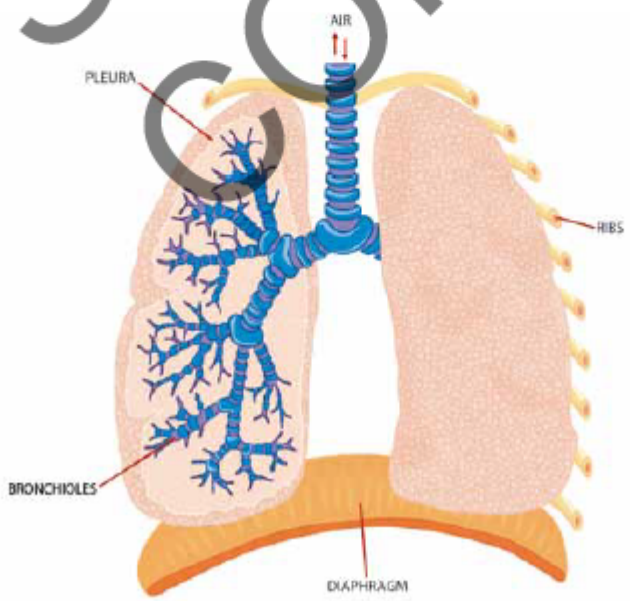
Have a look at the diagram below and see if it looks familiar to you.



What's happened to your lungs?

Your body needs oxygen to survive. Oxygen travels around your body in red blood cells in your bloodstream. Oxygen cannot get into your blood directly through your skin. Your lungs transport oxygen from the air and transfer it into your bloodstream.

Your lungs lie on either side of your heart and fill the inside of your chest. In an adult, each lung weighs about 0.5 kilograms. Although the right lung is a little larger than the left one because there is more room for it, the left lung has to share its space with the heart. Both lungs are made up of lobes – three on the right and two on the left. The inside of your lungs looks like a giant sponge. It is a mass of fine tubes, the smallest of which end in tiny air sacs. These are the alveoli. There are around 300 million of these alveoli. If you spread them out, they would cover a piece of ground roughly the size of a tennis court. These alveoli have very thin walls, which criss-cross with fine blood vessels known as capillaries.



The three important phases of exercise

Every exercise session should contain three important phases. Each phase is unique and has its own purpose.

1 Warm-up phase

This helps you to move gradually from rest to exercise. A warm-up begins with a low-intensity exercise. This helps to reduce the stress placed on your heart and muscles. The warm-up helps to slowly increase your breathing, raise your heart rate and your body temperature.

2 Conditioning phase

The conditioning phase follows on from the warm-up. It is during this phase of exercise where most benefits for your heart are gained. During the conditioning phase you should follow the recommended intensity (how hard), duration (how long), frequency (how often) and type of exercise laid out for you.

3 Cool-down phase

This phase ends your exercise programme. It lets your body gradually recover from the conditioning phase. The aim of a cool-down is to allow your heart rate and blood pressure to return to normal. The best cool-down is to slowly decrease the intensity of your exercise. This prevents dizziness, palpitations or sudden drops in blood pressure.

See the next page for an example of a warm-up and cool-down.

Your walking diary

How hard was it today?
0 = very easy, 10 = almost impossible

0	1	2	3	4	5	6	7	8	9	10

	Date	Minutes of continuous walking	How hard was it?	Total walk time (minutes)	Date	Minutes of continuous walking	How hard was it?	Total walk time (minutes)
Mon	7/11	4.02	7	21.18				
Tues								
Wed								
Thurs								
Fri								
Sat								
Sun								
Mon								
Tues								
Wed								
Thurs								
Fri								
Sat								
Sun								
Mon								
Tues								
Wed								
Thurs								
Fri								
Sat								
Sun								

Moving on

Each day you should aim to gradually increase your walking, before you need to slow down and stop. To start with, you may only be able to increase the time you walk by a few seconds – it all counts!

Once you have built up to walking for five minutes without stopping, you should gradually progress through the steps below. In stage 1, you are aiming for a non-stop walk of 15 minutes, but a total of 30 minutes walking a day.

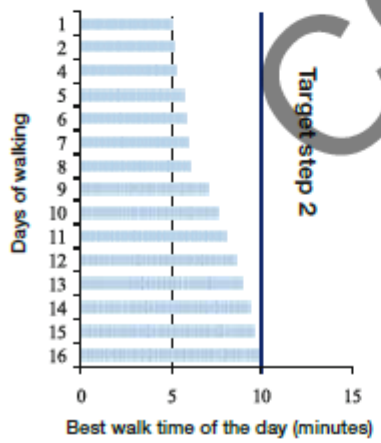
This has been split into three easy steps for you to follow.

Step 1 - Daily

5 minutes	5 minutes	5 minutes	5 minutes	5 minutes	5 minutes	= 30 minutes

As the days progress

This graph shows how your walking time should progress through step 1. As you can see, your best walk time of the day should steadily increase as the days go on. It is OK if this is only by a few seconds each day. This is a guide only. Your walking times may increase more quickly or slowly than this.



Once you can achieve a 10-minute walk, you should move onto step 2. Remember, it may take a few weeks but if you are doing well, keep it up and you will iÜrove.

The following page shows steps 2 and 3.

Managing breathlessness

There are a number of approaches to managing your breathlessness, including:

- **pacing your activities;**
- **choosing appropriate positions to reduce breathlessness; and**
- **breathing techniques.**

1 Pacing your activities

This is a very simple and effective way of saving energy and so your breath.

- **Plan ahead – think about any tasks you need to do and then break these up into smaller jobs.**
- **See the advice in the saving your energy section in stage 2.**

Do things at a steady pace – don't rush.

Rest before you lose your breath completely – you won't need to rest as long.

Frequent short rests are better than long ones.

Other useful sections
Saving your energy

2 Choosing appropriate positions to reduce breathlessness

Try and sit in the positions shown on the following page. The position you choose depends on the circumstances.

It is important to gently lean forwards (almost slouching) and keep your hands and shoulders relaxed. It is probably easier to lean forwards and let your shoulders and hands relax while sitting, although you can use the same principles while standing.

Good positions to relieve breathlessness

Elbows on knees

Hands and shoulders relaxed

1 Bicep curls


Hold one weight or container in each hand. Straighten your arms by your side (palms facing out). Keep your elbows tucked into your chest, bend at your elbows bringing your hands to your shoulders. Repeat.

2 Sitting to standing

Sit in a chair, holding your weights in your hands. Make sure the chair is stable and will not move as you stand up. You should choose a firm chair that you do not sink into. Position your feet hip-width apart.

Stand up (try not to use the arms of the chair to help you) then sit down again. Repeat.

3 Pull-ups

Hold a weight or container in each hand (palms facing in). Stand with your arms in front of your thighs and draw your hands up to your face until your elbows are pointing outwards at 90°. Slowly lower. Repeat.


4 Step-ups

All you need for this exercise is a step (for example, the bottom step of your stairs). When stepping up, your knee should bend no more than a 90° angle and your thigh should be parallel to the floor. Also, make sure your whole foot is firmly placed on the step before stepping up fully.

Step up with one foot and then bring your other foot up so you are standing on the step with both feet. Step down with one foot, then the other. Continue switching the lead foot until you have finished. Repeat.

If you do not have your own weights, you can use old four- or six-pint milk containers, as described below.

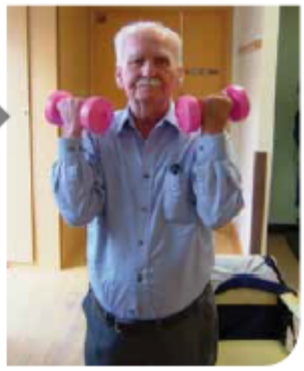
Hand-held weight system using plastic milk containers

Fill up the milk container with water to the pint marking that is closest to the weight you have been told to use. See above for your individual starting weight.

One pint	0.6kg (or 1lb 5oz)
Two pints	1.2kg (or 2lb 10oz)
Three pints	1.8kg (or 3lb 13oz)
Four pints	2.4kg (or 5lb 4oz)
Five pints	3kg (or 6lb 9oz)
Six pints	3.6kg (or 7lb 14oz)

Kg = kilogram **lb = pound** **oz = ounce**

Recording your programme



To monitor your progress, it is important to record what you achieve and the weight used. The important things to record are:

- **the date;**
- **the number of repetitions completed (eight to 12 up to three sets);**
- **what weight you were using; and**
- **how hard it was. Use the scale below to show how hard it was for you, ranging from values 0 to10.**

0 = very easy, 10 = almost impossible

0	1	2	3	4	5	6	7	8	9	10

Supplementary Material

Pulmonary Rehabilitation Satisfaction Survey

Please tick the relevant column for your answer to each statement below:	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
I can do more of my daily activities since completing pulmonary rehabilitation.					
My levels of fitness have improved since beginning pulmonary rehabilitation.					
I have found pulmonary rehabilitation to be worthwhile.					
The information in the education talks was useful.					
Pulmonary rehabilitation has helped me to manage my lung condition more effectively.					
I would recommend this pulmonary rehabilitation course to others with a lung condition.					

- **What were the most useful aspects of the course?**

- **Is there anything you feel we could add to the course?**

- **Do you have a comment that that we could use for promotion of the program which would encourage other patients to participate?**