TITLE PAGE

The effects of a video intervention on post-hospitalization pulmonary rehabilitation uptake

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Planning and design: SF, DB, WDCM; Conduct of randomized controlled trial: REB, SEJ, SSCK, CMN, SP; Conduct of embedded interviews: SEJ, SF; Manuscript writing: All authors; Final approval of manuscript: All authors; Guarantor: WDCM.

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What impact will this research will have on clinical medicine and how does this research add to our knowledge base?

Acute exacerbations of COPD are one of the commonest causes of emergency hospital admission worldwide. Following hospital discharge, people with COPD have significant impairments in physical functioning and health related quality of life and have high risk of readmission. Pulmonary rehabilitation, a program of care comprising exercise-training and education, improves exercise capacity and health related quality of life, and reduces readmissions. However patient uptake is low. This trial is the first with the primary aim of increasing uptake of post-hospitalization pulmonary rehabilitation. This trial demonstrated that a simple patient co-designed education video delivered at hospital discharge did not increase referral or uptake rates for post-hospitalization pulmonary rehabilitation.

Online data supplement

This article has an online data supplement, which is accessible from this issue's table of content online at www.atsjournal.org

Data sharing

No data on individual, de-identified participant data (including data dictionaries) will be shared unless specific requests are made. No additional, related documents will be made available unless specific requests are made. Request for data will be responded to on an individual basis, with the period the data is available for individually determined based upon each request.

Transparency declaration

This is an honest, accurate and transparent account of the study which was undertaken.

ABSTRACT

Rationale: Pulmonary rehabilitation following hospitalizations for exacerbations of chronic obstructive pulmonary disease (COPD) improves exercise capacity and health-related quality of life, and reduces readmissions. However, post-hospitalization pulmonary rehabilitation uptake is low. To date, no trials of interventions to increase uptake have been conducted.

Objective: Effect of a co-designed education video as an adjunct to usual care on post-hospitalization pulmonary rehabilitation uptake.

Methods: An assessor- and statistician-blinded randomized controlled trial with nested qualitative interviews of participants in the intervention group. Participants hospitalized with COPD exacerbations were assigned 1:1 to receive either usual care (COPD discharge bundle including pulmonary rehabilitation information leaflet) or usual care plus the co-designed education video delivered via a handheld tablet device at discharge. Randomization used minimization to balance age, sex, forced expiratory volume in 1 second (FEV_1) % predicted, frailty, transport availability and previous pulmonary rehabilitation experience.

Measurements and Main Results: The primary outcome was pulmonary rehabilitation uptake within 28 days of hospital discharge. 200 patients were recruited with 196 randomized (51% female, median (interquartile range) FEV_1 % predicted 36(27, 48)). Pulmonary rehabilitation uptake was 41% and 34% in the usual care and intervention groups respectively (p=0.37), with no differences in secondary (pulmonary rehabilitation referral and completion) or safety (readmissions and death) endpoints. Six of the fifteen participants interviewed could not recall receiving the video.

Conclusion: A co-designed education video delivered at hospital discharge did not improve post-hospitalization pulmonary rehabilitation uptake, referral or completion.

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INTRODUCTION

Acute exacerbations of chronic obstructive pulmonary disease (COPD) are one of the commonest causes of emergency hospital admission, and account for over 50% of healthcare costs associated with COPD (1). For patients, exacerbations requiring hospitalization are associated with significantly reduced physical activity levels (2), impaired health related quality of life (3), skeletal muscle dysfunction (4, 5) and reduced physical functioning (6). These consequences increase the risk of readmission, but are potentially amenable to treatment with exercise-training (7).

Pulmonary rehabilitation is a comprehensive, patient-tailored intervention that includes exercise-training and education, designed to optimise the physical and psychological well-being of people with chronic respiratory disease (8). In the latest iteration of the Cochrane systematic review, Puhan and colleagues included 20 randomised controlled trials and 1477 patients, and found moderate-to-large effects of post-exacerbation pulmonary rehabilitation on health-related quality of life and exercise capacity, and moderate quality evidence that post-exacerbation pulmonary rehabilitation reduces hospital readmissions (9). Accordingly, provision of pulmonary rehabilitation within four weeks of hospital discharge is recommended within international pulmonary rehabilitation and COPD guidelines (10-12).

Despite the evidence base and guideline recommendation, observational data suggest that uptake of post-exacerbation pulmonary rehabilitation is low (13, 14). However, a recent systematic review was unable to identify any randomized controlled trials of interventions that aimed to increase uptake of post-exacerbation pulmonary rehabilitation (15). As reported barriers to pulmonary rehabilitation include poor patient engagement with, or lack of awareness of, pulmonary rehabilitation (16), we hypothesized that education of patients

regarding the benefits of pulmonary rehabilitation might improve uptake. We used experience-based co-design (17) to produce a patient education video as a potentially low cost and easily implementable intervention with high fidelity.

The primary objective of the study was to determine whether using such a patient co-designed education video as an adjunct to usual care could enhance uptake of pulmonary rehabilitation within 28 days of discharge following a hospital admission for acute exacerbation of COPD. Some of the results have been previously reported in a conference abstract (18).

METHODS

Study design and participants

We conducted a parallel, two-group, assessor- and statistician- blinded, mixed methods, randomized controlled trial investigating the effects of a patient education video as an adjunct to usual care (delivery of a COPD discharge bundle), with embedded qualitative components. The study was approved by the London – City and East Research Ethics Committees (14/LO/1740) and registered on the ISRCTN registry (13165073).

Recruitment took place at Hillingdon Hospital, North West London, United Kingdom between February 2015 and May 2018. Details concerning eligibility, inclusion and exclusion criteria are detailed in the online supplement. All participants provided written informed consent.

Randomisation procedure

Participants were randomized 1:1 to either the control (COPD discharge bundle) or intervention (COPD discharge bundle plus patient education video) with minimization used to balance groups according to age, sex, lung function, transport, frailty, and naivety to pulmonary rehabilitation. Further details are found in the online data supplement.

Study interventions

All participants received usual care, comprising delivery of a COPD discharge bundle from a specialist respiratory allied health professional (19). This included standardised verbal information about pulmonary rehabilitation, supplemented by an information leaflet (see online data supplement). The intervention group was also provided with the same COPD discharge bundle but were asked to watch a patient co-designed education video. A secure internet link with password was also provided to allow access to the video after discharge. Further details of the intervention, as well as development of the education video, are described in the online data supplement.

Data collection

Along with a structured history, the following were measured: physical performance using four meter gait speed (4MGS) (6), spirometry, MRC dyspnoea score, disease-specific health-related quality of life (COPD Assessment Test (CAT) (3)). These were measured on the day of hospital discharge and at 90 days following hospital discharge.

Qualitative study

Using purposive sampling (taking account sex and uptake of pulmonary rehabilitation), topic-guided, audio recorded interviews of 15 participants in the intervention group were conducted to capture their perspectives about the education video and the research process (such as timing of the video). Qualitative interviews were conducted within a week after the end of the 90-day follow-up period.

Study outcomes

Outcome data were collected by a researcher blinded to treatment allocation, and qualitative interviews were conducted by a trained researcher. The primary outcome endpoint was percentage uptake of pulmonary rehabilitation within 28 days of hospital discharge within each treatment arm. Uptake was defined as documented attendance at a pulmonary rehabilitation assessment.

Secondary outcome endpoints were: 1) pulmonary rehabilitation uptake within 90 days of hospital discharge; 2) pulmonary rehabilitation referral rate, defined as the percentage of patients in each treatment arm for which a referral was received by the pulmonary rehabilitation team within 28 days of hospital discharge; 3) pulmonary rehabilitation completion rate, defined as percentage of patients starting pulmonary rehabilitation who attended ≥8 pulmonary rehabilitation sessions; 4) pulmonary rehabilitation adherence, defined as mean number of PR sessions attended by patients starting pulmonary rehabilitation; 5) change in physical performance (4MGS) between the day of discharge and 90 days post-discharge; 6) change in health related quality of life (CAT) between the day of discharge and 90 days post-discharge. Safety endpoints were mortality and hospital readmissions with 90 days of hospital discharge.

Sample size

In a previous study in the same setting, we demonstrated a post-hospitalisation pulmonary rehabilitation uptake of 24% (13). To demonstrate an increase in the primary outcome measure from 24% to 45% in the experimental group, 178 patients (89 in each group) were required with 80% power at the 5% significance level (MedCalc Software, Ostend, Belgium). To account for a potential 10% loss to follow-up, we aimed to recruit 100 participants to each group.

Sample size of the qualitative study was based on the predicted minimum number of interviews required to achieve saturation, in other words, the point at which gathering fresh data does not generate new theoretical insights (information related to the research question and objectives) and is based on the concept of Information Power (20). Based on the work of Guest *et al* (21) saturation of themes is usually reached by the twelfth interview. We therefore aimed to recruit a minimum of 12 patients for the qualitative interviews.

Analysis

Quantitative data analysis was completed by the trial statistician (WB) using Stata version 14.1 (StataCorp LP, Texas, USA). The statistician remained blinded to treatment allocations until completion of analysis. The pre-specified primary analysis was by intention to treat. Categorical data were presented as percentages, and compared between groups using the Pearson X^2 test. A p value <0.05 was considered statistically significant.

Change in physical performance and health related quality of life from hospital discharge to 90 days post-discharge were compared by trial group using independent samples Student's t test (two-sided) (22). Missing data was handled by multiple imputation; further details are in the online data supplement. A pre-planned sensitivity analysis considered patients who were naïve to pulmonary rehabilitation at recruitment.

Qualitative interview data were transcribed verbatim, anonymised and analysed using the Framework approach (23).

RESULTS

Figure 1 shows the trial CONSORT flowchart. We recruited 200 patients and randomized 196. The baseline characteristics of the 196 randomized participants randomised are shown in Table 1.

Uptake, referral rate, completion and adherence

Table 2 summarises the results of the primary and major secondary outcomes. Overall uptake of pulmonary rehabilitation was 37%, with no difference in uptake between the control (41%) and intervention (34%) groups; p=0.370. The Kaplan-Meier curve demonstrated no significant between group difference in time to uptake of pulmonary rehabilitation (Figure 2; log rank test p=0.490). No between group differences were seen in referral, completion or adherence rates (Table 2).

Change in health-related quality of life and physical performance

There were clinically and statistically significant improvement in CAT in both groups (Mean (standard deviation) change: Intervention: -2.94 (7.68); Control: -4.33 (7.38)) with no between group differences (p=0.212); Table 2. Similarly, although 4MGS improved in both groups, there were no significant between group differences (Mean (standard deviation) change in 4MGS: Intervention: 0.25 (0.26) m/s; Control: 0.23 (0.26) m/s; p=0.568); Table 2. The improvements seen in both groups are likely to indicate natural recovery following a hospitalization.

Health Resource Utilisation

During the 90-day follow-up period, the mortality rate was 2% and 1% for the control group and intervention groups respectively (p=1.000). All-cause readmission rates for the control and intervention groups were 15% and 22% respectively during the 90-day follow-up period. (p=0.871).

Sensitivity analysis

Of the 196 participants randomised, 95 (48%) had no previous pulmonary rehabilitation experience before recruitment to the study (PR-naïve). Similar to the overall study population data, the intervention had no effect on uptake, referral, or completion rates of post-hospitalization pulmonary rehabilitation in PR-naïve participants. Further details are outlined in Tables E1 and E2 of the Online Data Supplement.

Video intervention perspectives

Of the 15 participants who took part in qualitative interviews, eight participants did not take up pulmonary rehabilitation, with six of the seven interviewees who did take up pulmonary rehabilitation completing the programme. Six of those interviewed did not recall previously seeing the video, despite being in the intervention group. Four of these six did take up PR with three completing. None of the interviewed participants used the weblink to access the video after hospital discharge.

Patients who did recall viewing the video thought it well-presented, a good length and that the information provided was clear. Most stated it was helpful to see patients with lung conditions in the video talking about their experiences and the benefits of rehabilitation: "*because I know how she feels because I felt exactly the same as she did*." (female, aged 62, completer). Seven patients had no prior understanding about pulmonary rehabilitation: "*So the video showed me you know, what it was about. It is useful, it made it clear what was about to happen.*" (male, aged 51, completer). Patients also thought the video rather than a leaflet or verbal information was a better format for information to be retained: "*A video stays in your head. You can see the exercises. Piece of paper doesn't*." (female, aged 62, completer)

Views were mixed regarding the timing of the delivery of the video. Some participants thought it was the right time to show the video (just before discharge from hospital): *"I think you've got to get people whilst they're in hospital and I think the initial video is the right way to do it*." (female, aged 52, decliner). Other participants thought that showing the video in hospital was not the best time because patients might be too ill or tired: "*What I remember*

of it… I mean I was in a tiswas at the time as well... You got to be back on your feet to fully digest what's going on" (male, aged 79, decliner).

Suggestions for improvements were to: include patients using oxygen, include younger patients, show a greater variety of exercise equipment including simpler ones used in community settings, and emphasise the social aspects of pulmonary rehabilitation.

Of the eight interviewed participants who declined to take up PR, three could not attend as they stated they were too unwell ("*But I couldn't do nothing like that now. No dear, oh no, I couldn't do that.*" - female, aged 91, decliner) or had other significant comorbidities ("*I declined because I've got other health issues at the moment. So, that's why I declined because I couldn't guarantee that I'd be there week in week out."* - female, aged 52, decliner). Two participants declined because they thought they were doing enough exercise already: "*So, people would come to see me, they were quite happy with what I was doing. With the walking I was doing.*" (male, aged 79, decliner). For the three remaining participants who did not take up PR, one was still working and the times did not suit, one could not attend as his wife was unwell, and the other stated they didn't have transport and it was too far to travel.

DISCUSSION

In this assessor- and statistician- blinded, randomized controlled trial, a patient co-designed education video shown on the day of hospital discharge had no effect upon patient uptake of post-hospitalization pulmonary rehabilitation. Furthermore, the intervention did not increase referral or completion rates. Although a significant proportion were unable to recall watching

the video at hospital discharge (suggesting the timing was inappropriate for some), qualitative interviews of participants in the intervention group revealed positive feedback regarding the education video, with those recalling watching the video making suggestions for improvement.

Despite a strong evidence base to support the benefits of post-hospitalization pulmonary rehabilitation (9) and guidelines recommendation (10, 11), observational studies have consistently shown low patient uptake and completion. Jones *et al* demonstrated that only 30% of patients were referred for early PR post-acute exacerbation of COPD, with less than 10% of eligible patients completing pulmonary rehabilitation following a hospital admission for an exacerbation (13). An analysis of Medicare beneficiaries showed that only 4225 (1.9%) of 223,832 individuals hospitalized with acute exacerbation of COPD in 2012 received pulmonary rehabilitation within six months of the index hospital admission (14). In a retrospective analysis of Veterans Health Administration and Medicare data of patients hospitalized with COPD between 2007 - 2011, only 1.5 – 2% were revealed to have attended at least one session of pulmonary rehabilitation (24).

Given that pulmonary rehabilitation is a cornerstone of management in COPD, there have been surprisingly few studies that have tried to address this implementation gap. In a systematic review of the available evidence on interventions for increasing uptake and completion of pulmonary rehabilitation, Jones *et al* were only able to identify one quasi-randomized controlled trial, which was assessed to be at high risk of bias (15). No studies were identified in the specific post-hospitalization pulmonary rehabilitation setting (15). In a subsequent systematic review, that was not limited to randomized controlled trials, Early and colleagues were able to identify five studies that included uptake of pulmonary rehabilitation

as an outcome (25). All were conducted in primary care or outpatient settings, and many were at high risk of bias due to study design (for example, uncontrolled and controlled before and after studies). Again, no interventional studies in the post-hospitalization setting were identified (25).

A strength of the current study was that this was the first randomized controlled trial to test an intervention designed to increase uptake of pulmonary rehabilitation in the post-exacerbation setting. The trial was adequately powered, with an intention to treat analysis, and all participants randomized to the intervention group received the treatment as intended at hospital discharge. Both control and intervention groups received best standard care, including the provision of a COPD discharge bundle (19) which included an information leaflet about post-hospitalization pulmonary rehabilitation. Previous studies have observed that effective and consistent delivery of a COPD discharge bundle is associated with an increase in pulmonary rehabilitation referrals (19). The outcome assessors were blinded, as was the statistician, who was blinded to group allocation throughout data analysis. In addition, the trial included a qualitative element which identified potential refinements to the intervention content and timing of delivery.

A further strength relates to the intervention being co-designed by key stakeholders, including patients who had previously experienced an acute exacerbation of COPD requiring hospitalization. The focus of the intervention was to educate patients about the benefits of post-hospitalization pulmonary rehabilitation as poor patient knowledge and engagement have consistently been observed to be major barriers to uptake (16, 26, 27). Experience based co-design, a quality improvement approach that enables staff and patients (or other service users) to co-design services in partnership, was used to develop the intervention. This

approach has been previously used in a range of clinical settings in the National Health Service (28, 29), including pulmonary rehabilitation (30). The qualitative feedback was positive with patients commenting that the video was well presented, a good length and the information provided was clear.

There were several limitations to the study. This was single-center study, using a specific video in a particular setting, and therefore the results do not preclude the success of future video interventions that might be developed for other settings or delivered at different stages of the patient pathway. A proportion of eligible patients did not consent to the research study, which reflects the difficulties of recruiting acutely unwell, hospitalised patients into research studies, and therefore a potential limitation of the study is the generalisability of the trial population. We also observed that a proportion of participants did not attend the face-to-face visit at three months. However, data for the primary and main secondary outcome measures (pulmonary rehabilitation uptake, referral, completion) were available for all trial participants. Missing data for physical performance and health related quality of life measures were also imputed. Due to the number lost to follow-up, we were unable to systematically collect data on reasons for non-uptake of PR. Another limitation was that we did not formally assess for cognitive dysfunction, digital literacy or internet availability at home, which may have helped with the interpretation of the study results.

There were several possible reasons why we did not see an increase in pulmonary rehabilitation uptake in the video intervention group. First, the video was provided without additional counselling as the intervention was designed to be low cost, easily implementable, and not burdensome on staff time. With hindsight, a greater focus on behavioural aspects, for example with health coaching (31), may have enhanced the benefits of showing the video.

Previous studies that have used device-based interventions with minimal counselling have also been unsuccessful in changing the behaviour of patients with COPD (32). Second, the involvement of key stakeholders in the design of the intervention may have provided important education for the staff responsible for referrals and improved their knowledge regarding pulmonary rehabilitation, with a positive knock-on effect upon referral rates in both control and intervention groups. Evidence to support this was the observation that overall referral (70%) and uptake (34%) rates in this study compared favourably with previous data from the same setting; Jones *et al* observed pulmonary rehabilitation referral and uptake rates of 31% and 24% respectively despite consistent delivery of a COPD discharge bundle. Third, the high pulmonary rehabilitation referral rates in both control and intervention settings may reflect the so-called "Hawthorne effect". In other words, the health care professionals responsible for referring to pulmonary rehabilitation may have modified their behaviour in response to being observed during the trial. Fourth, the barriers to post-hospitalisation pulmonary rehabilitation uptake are complex (16, 33), and the simple intervention tested in this trial may not have been able to address all these potential barriers. Fifth, we observed significant improvements in physical performance and health-related quality of life in both intervention and control groups, which is likely to reflect natural recovery from an exacerbation requiring hospitalization. This recovery may have influenced the decision of participants to take up pulmonary rehabilitation. Finally, the qualitative component of the study highlighted that a proportion of the intervention group (six of fifteen of those interviewed) had no recall of seeing the video at hospital discharge. A previous observational study showed that 57% of patients awaiting discharge following an exacerbation had cognitive impairment, with 20% considered to have pathologic impairment of processing speed (34). Cognitive impairment was not formally assessed in this study and

so it is unclear whether this impacted on the lack of efficacy of the intervention. Whether delivering the video intervention at a later date (for example in the post-discharge period rather than on day of hospital discharge), or changing the content of the video might influence the results requires further evaluation.

In this specific trial setting, we were unable to demonstrate an increase in referral or uptake rates of post-hospitalization pulmonary rehabilitation with the video intervention. However, given the intervention is cheap, easily implementable and not associated with any known adverse effects, further studies could be considered to identify potential roles for this education video. For example, the video might have value in facilitating the implementation and delivery of COPD discharge bundles in settings where this is not the standard of care, or as part of a more comprehensive behavioural intervention designed to educate patients, staff or carers.

CONCLUSION

In summary, this assessor- and statistician- blinded, randomized controlled trial demonstrated that a patient co-designed education video shown on the day of hospital discharge had no effect upon patient uptake of post-hospitalization pulmonary rehabilitation, nor on referral or completion rates. Further interventional trials are needed to address the low uptake rates of post-hospitalization pulmonary rehabilitation.

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FIGURE LEGENDS

Figure 1. CONSORT diagram for study flow

Figure 2. Kaplan-Meier curve demonstrating uptake of pulmonary rehabilitation within 28 days of discharge after hospitalisation for an acute exacerbation of COPD according to group allocation

TABLES

Table 1. Baseline characteristics for whole group and according to group allocation

Variable	Whole group (n=196)	Intervention group (n=98)	Control group (n=98)	p value
Gender: male (n (%))	95 (49)	49 (50)	46 (47)	0.668
Age (years)	69 (11)	70 (11)	68 (11)	0.391
FEV_1*/FVC†	0.53 (0.17)	0.53 (0.16)	0.53 (0.17)	0.757
FEV_1* (% predicted)	36 (27, 48)	38 (28, 49)	34 (26, 47)	0.454
MRC‡ score	4 (3, 5)	4 (3, 5)	4 (3, 5)	0.791
BMI§ (kg/m^2)	25.5 (21.9, 31.0)	26.2 (22.5, 31.9)	24.9 (21.8, 30.3)	0.285
Index of multiple deprivation	15170 (7213)	15783 (7508)	14550 (6886)	0.234
Smoking status: never/former/current (n (%))	4 (2) / 138 (70) / 54 (28)	1 (1) / 70 (71) / 27 (28)	3 (3) / 68 (69) / 27 (28)	0.598
Pack year history (years)	40 (27, 60)	40 (26, 55)	40 (28, 60)	0.562
Charlson Comorbidity Index	2 (1, 2)	2 (1, 2)	2 (1, 2)	0.926
Self-reported all-cause hospital admissions in previous year	1 (0, 2)	1 (0, 2)	1 (0, 2)	0.486
Self-reported courses of antibiotics in previous year	2 (1, 4)	2 (1, 3)	2 (1, 4)	0.979
Self-reported courses of steroids in previous year	1 (0, 3)	1 (0, 3)	2 (1, 4)	0.630
Home oxygen required at hospital discharge (n (%))	7 (4)	4 (4)	3 (3)	0.684
Acute non-invasive ventilation during admission (n (%))	22 (11)	11 (11)	11 (11)	0.944
Walking aid required on admission (n (%))	51 (26)	22 (22)	29 (30)	0.254
Own transport (n (%))	116 (59)	56 (57)	60 (61)	0.561
Living alone (n (%))	83 (43)	39 (40)	44 (45)	0.470
Hospital length of stay (days)	3 (1, 6)	3 (2, 7)	2 (1, 5)	0.129
Previous experience of PR‖ (n (%))	101 (52)	50 (51)	51 (52)	0.886
4MGS**: <0.60 m/s (n (%))	99 (51)	50 (51)	49 (50)	0.944
COPD Assessment Test	23 (8)	23 (8)	23 (8)	0.888

Data reported as mean (standard deviation) or median (25th centile, 75th centile) unless stated otherwise; Independent T-Test (or Mann-Whitney for non-normally distributed data) or Chi-Squared test was used to compare groups.

Abbreviations: * = forced expiratory volume in one second; † = forced vital capacity; ‡ = Medical Research Council dyspnoea scale; § = body mass index; $^{\|}$ = pulmonary rehabilitation; ** = four meter gait speed.

Table 2. Referral rate, uptake, completion and adherence to early PR for whole group and according to group allocation

Outcome	Whole group (n=196)	Intervention group (n=98)	Control group (n=98)	p value
Primary Outcome				
Uptake of PR* within 28 days (n (%))	73 (37)	33 (34)	40 (41)	0.370
Secondary Outcomes				
Referral to PR received within 28 days of hospital discharge (n (%))	138 (70)	70 (71)	68 (69)	0.754
Completion: Proportion of those taking up PR who complete PR (n (%))	38 (52)	15 (46)	23 (58)	0.305
Adherence: PR sessions completed by those taking up PR	9 (6)	8 (6)	10 (6)	0.268
Uptake of PR within 90 days (n (%))	107 (55)	52 (53)	55 (56)	0.911
Change in CAT† from discharge to 90 days	-3.6 (7.6)	-2.9 (7.7)	-4.3 (7.4)	0.212
Change in 4MGS‡ from discharge to 90 days (m/s)	0.24 (0.26)	0.25 (0.26)	0.23 (0.26)	0.568

Data reported as mean (standard deviation) unless stated otherwise. Independent T-Test or Chi-Squared Test were used to compare groups. The pulmonary rehabilitation program offers 2 supervised sessions per week for 8 weeks (i.e. 16 sessions).

Abbreviations: * = pulmonary rehabilitation; † = COPD Assessment Test; ‡ = four meter gait speed.

FIGURES

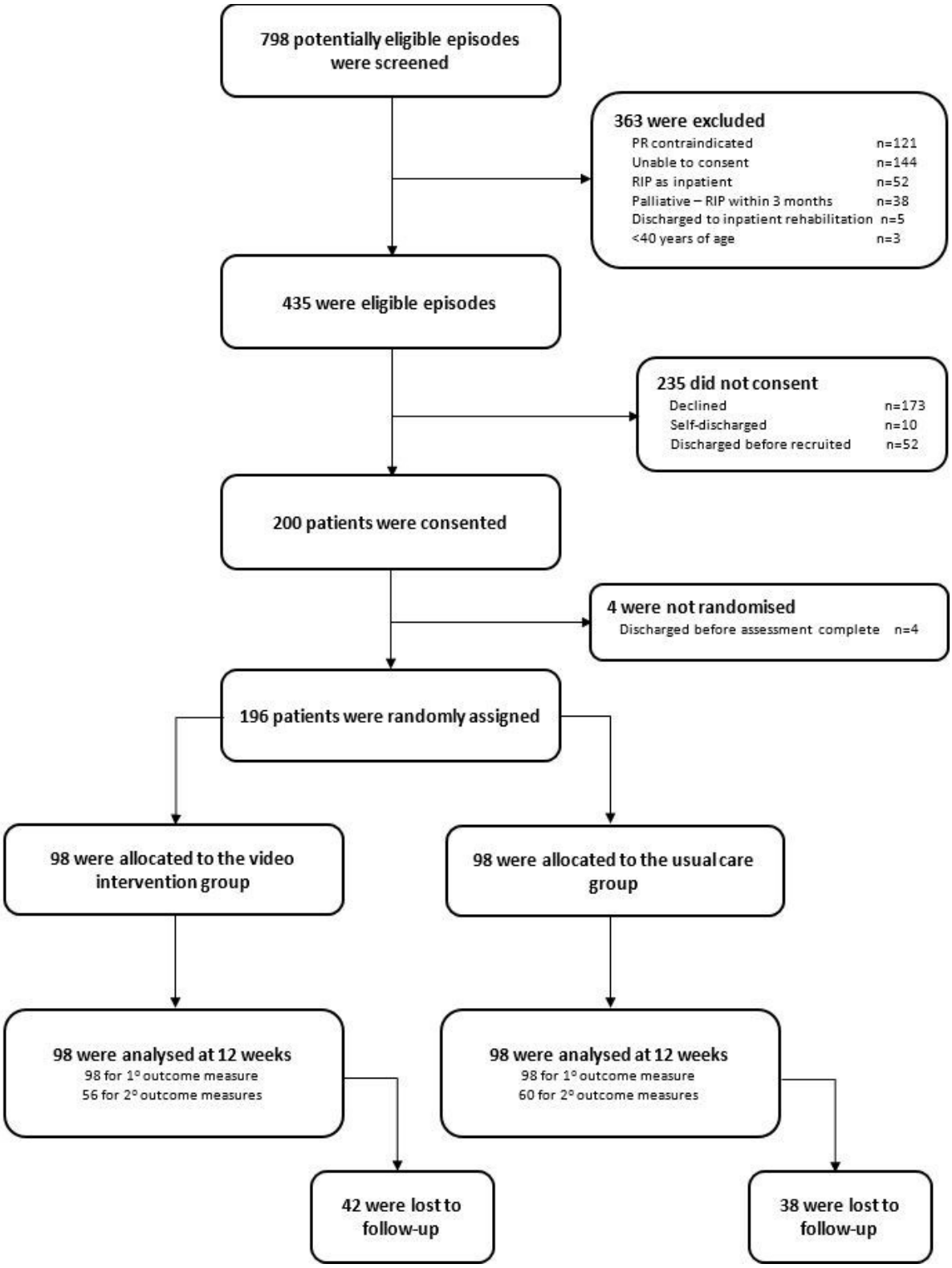

Figure 1. CONSORT diagram for study flow

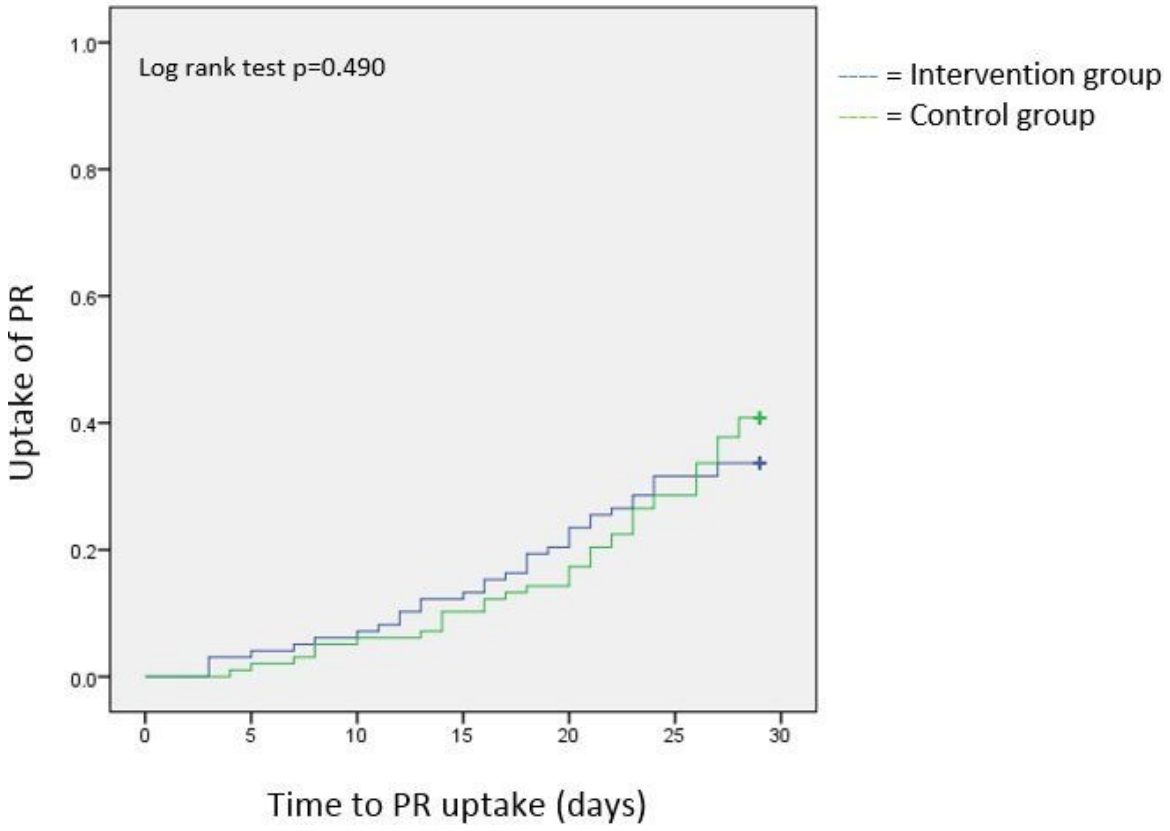

Figure 2. Kaplan-Meier curve demonstrating uptake of pulmonary rehabilitation within 28 days of discharge after hospitalisation for an acute exacerbation of COPD according to group allocation

ONLINE DATA SUPPLEMENT

Title

The effects of a video intervention on uptake of post-hospitalization pulmonary rehabilitation

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Video intervention development

Experience-based co-design was used to develop the video intervention tested in this trial. First, video-recorded interviews were conducted with patients to understand their experiences of pulmonary rehabilitation after an acute exacerbation of chronic obstructive pulmonary disease (COPD). One of the key issues raised by patients was insufficient information about the components of pulmonary rehabilitation, and the potential benefits for themselves. Second, clips which illustrated the key perceptions and experiences raised in the interviews (known as 'touch-points') were subsequently combined and edited to produce a 'touch-points' video. Third, this edited video was then played at three key stakeholder feedback events: 1) patients alone (all patients had experienced a hospitalisation for exacerbation of COPD, with some previously undergoing post-hospitalisation pulmonary rehabilitation); 2) health care professionals alone (from acute care teams involved in the inpatient care of patients with exacerbation of COPD and pulmonary rehabilitation teams); 3) joint patient and healthcare professional event. From these events, the key priority was to develop an education video that would allow real past patients to tell prospective patients about the benefits of pulmonary rehabilitation in a visual manner. Patient/staff co-design groups were then formed to develop the intervention, how it would be delivered and at which point in the patient pathway. A schematic of this process is outlined below (Figure E1). The video can now be accessed freely on YouTube:

(https://www.youtube.com/watch?v=56qcTg1CWnw).

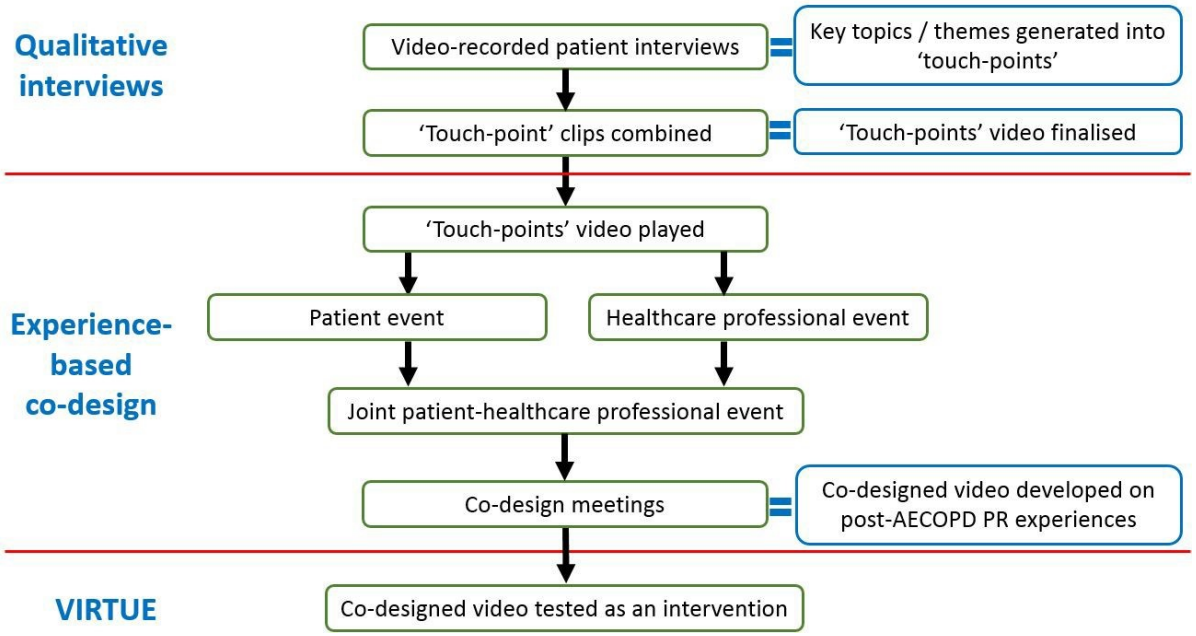

Figure E1. Schematic of experience-based co-design process

METHODS

Participants

Eligible participants were >40 years of age, hospitalised with either a primary diagnosis of an acute exacerbation of COPD or primary diagnosis of pneumonia with a secondary diagnosis of acute exacerbation of COPD, eligible for post-hospitalisation pulmonary rehabilitation (able to walk five metres independently, Medical Research Council (MRC) score ≥2), living within the borough of Hillingdon, and had capacity to consent. Exclusion criteria included significant co-morbidities that would make exercise unsafe (e.g. evidence of acute coronary syndrome or unstable ischaemic heart disease, severe aortic stenosis, uncontrolled cardiac arrythmia) and those receiving palliative care with expectation of death within three months.

Randomization

Participants were randomised 1:1 to either the control (COPD discharge bundle) or intervention (COPD discharge bundle plus patient education video). The allocation sequence was computer-generated (Minim), accessed by an administrator independent of the recruitment process, trial intervention, outcome assessments, clinical team or study researchers. Minimisation was used to balance groups according to age (years: </≥65), sex (male/female), forced expiratory volume in one second (FEV_1) percentage predicted (%predicted: </≥50), transport availability (independent driver with a car: yes/no), physical frailty status (four meter gait speed (4MGS): </≥0.6 metres/second (m/s) (6)) and self-reported previous experience of pulmonary rehabilitation (yes/no).

Intervention

The video was delivered via a handheld tablet device (iPad mini) provided by a researcher independent of the clinical, study research or pulmonary rehabilitation teams. Patients in the intervention group were also provided with a secure internet link and password so that they or relatives could access the education video after discharge from hospital. All patients were offered a referral for pulmonary rehabilitation at hospital discharge. Patients were also provided with telephone numbers to contact the hospital respiratory or pulmonary rehabilitation teams to request a referral after discharge. A referral was generated only with patient consent.

Analysis of missing data

Missing data were explored and reported according to cause. Missing data were assumed to have occurred completely at random and were handled by a Markov Chain Monte Carlo method, using multiple imputations (10 datasets) using simulations from a Bayesian prediction distribution for normal data. Data were assumed to be from a multivariate normal and data augmentation was applied to Bayesian inference with missing data. The data were log transformed for multiple imputation then anti-logged for the analysis.

RESULTS

Sensitivity analysis

The pre-planned sensitivity analysis for patients who were naïve to pulmonary rehabilitation (PR-naïve) are included in Table E1 and E2.

Table E1. Baseline characteristics for all PR-naïve and according to group allocation

Variable	All PR-naïve (n=95)	PR-naïve intervention group (n=48)	PR-naïve control group (n=47)	p value
Gender: male (n (%))	39 (41)	21 (44)	18 (38)	0.589
Age (years)	69 (10)	71 (10)	67 (11)	0.053
FEV_1*/FVC†	0.54 (0.17)	0.54 (0.16)	0.54 (0.17)	0.696
FEV_1* (% predicted)	33 (25, 43)	33.5 (27, 43)	32 (25, 42)	0.739
MRC‡ score	4 (3, 5)	4 (4, 5)	4 (3, 5)	0.971
BMI§ (kg/m^2)	26.7 (7.1)	26.1 (6.6)	27.3 (7.6)	0.599
Index of multiple deprivation	15611 (7430)	15981 (7235)	15233 (7684)	0.626
Smoking status: never/former/current (n (%))	2 (2) / 29 (31) / 64 (67)	0 (0) / 13 (27) / 35 (73)	2 (4) / 16 (34) / 29 (62)	0.239
Pack year history (years)	40 (25, 60)	40 (20, 54)	42.5 (28, 68)	0.350
Charlson Comorbidity Index	1 (1, 2)	1 (1, 2)	2 (1, 2)	0.459
Self-reported all-cause hospital admissions in previous year	1 (0, 2)	1 (0, 2)	1 (0, 2)	0.968
Self-reported courses of antibiotics in previous year	2 (1, 5)	2 (1, 3)	2 (1, 6)	0.297
Self-reported courses of steroids in previous year	2 (0, 3)	1 (0, 3)	2 (0.5, 5)	0.225
Home oxygen required at hospital discharge (n (%))	4 (4)	3 (6)	1 (2)	0.334
Acute non-invasive ventilation during admission (n (%))	9 (10)	4 (8)	5 (11)	0.676
Walking aid required on admission (n (%))	27 (28)	10 (21)	17 (36)	0.098
Own transport (n (%))	29 (31)	16 (33)	13 (28)	0.548
Living alone (n (%))	43 (45)	21 (43)	22 (47)	0.765
Hospital length of stay (days)	3 (2, 7)	4 (2, 7)	3 (1, 5)	0.323
4MGS**: <0.60 m/s (n (%))	43 (45)	20 (42)	23 (49)	0.477
COPD Assessment Test	23 (8)	22 (8)	25 (7)	0.060

Data reported as mean (standard deviation) or median (25th centile, 75th centile) unless stated otherwise; Independent T-Test (or Mann-Whitney for non-normally distributed data) or Chi-Squared test was used to compare groups.

Abbreviations: * = forced expiratory volume in one second; † = forced vital capacity; ‡ = medical research council; § = body mass index; ** = four meter gait speed.

Table E2. Referral rate, uptake, completion and adherence to early PR for all PR-naïve and according to group allocation

Outcome	All PR-naïve (n=95)	PR-naïve intervention group (n=48)	PR-naïve control group (n=47)	p value
Primary Outcome				
Uptake of PR* within 28 days (n (%))	32 (34)	17 (35)	15 (32)	0.347
Secondary Outcomes				
Referral to PR received within 28 days of hospital discharge (n (%))	60 (63)	28 (58)	32 (68)	0.325
Completion: Proportion of those taking up PR who complete PR (n (%))	15 (47)	8 (47)	7 (47)	0.804
Adherence: PR sessions completed by those taking up PR	9 (6)	10 (6)	8 (6)	0.805
Uptake of PR within 90 days (n (%))	45 (47)	21 (44)	24 (50)	0.616
Change in CAT† from discharge to 90 days	-3.2 (7.5)	-2.4 (8.6)	-3.9 (6.1)	0.320

Change in 4MGS‡ from discharge to 90 days (m/s)	0.24 (0.27)	0.27 (0.28)	0.20 (0.26)	0.227

Data reported as mean (standard deviation) unless stated otherwise. Independent T-Test or Chi-Squared Test were used to compare groups.

Abbreviations: * = pulmonary rehabilitation; † = COPD Assessment Test; ‡ = four meter gait speed.

Factors associated with pulmonary rehabilitation uptake

Table E3 shows univariate and multivariate analysis of factors associated with pulmonary rehabilitation uptake in those referred for pulmonary rehabilitation. Increasing age was associated with increased pulmonary rehabilitation uptake, whilst hospital length of stay ≥ 8 days was associated with reduced pulmonary rehabilitation uptake. No other patient factors were associated with pulmonary rehabilitation uptake, including FEV1 %predicted, MRC dyspnoea score, smoking status, BMI, index of multiple deprivation, domiciliary oxygen use, four metre gait speed, CAT score, or own transport.

Table E3: Logistic regression for predictors of referral of early PR following hospitalisation for an acute exacerbation of COPD

		Uptake			
		Univariate analysis*		Multivariate analysis*	
		OR (95% confidence interval)	p value	OR (95% confidence interval)	p value
Sex (ref cat: female)		0.828 (0.423, 1.619)	0.581	-	-
Age		1.029 (0.997, 1.062)	0.077	1.045 (1.009, 1.082)	0.014+
FEV1 % predicted		1.006 (0.986, 1.027)	0.537	-	-
MRC score (ref cat: MRC 5)	2	1.631 (0.591, 4.500)	0.345	-	-
	3	1.129 (0.438, 2.914)	0.801	-	-
	4	0.612 (0.255, 1.465)	0.270	-	-
Index of multiple deprivation		1.000 (1.000, 1.000)	0.620	-	-
Self-reported all-cause hospital admissions in previous year		0.928 (0.809, 1.064)	0.285	-	-
Oxygen required during hospital admission (ref cat: no)		0.952 (0.463, 1.957)	0.894	-	-
Own transport (ref cat: yes)		0.885 (0.443, 1.765)	0.730	-	-
Hospital length of stay (ref cat: 0 to 1 days)	2 to 3 days	0.605 (0.241, 1.521)	0.286	0.649 (0.248, 1.697)	0.378
	4 to 7 days	0.472 (0.181, 1.232)	0.125	0.472 (0.175, 1.274)	0.138
	≥ 8 days	0.281 (0.096, 0.821)	0.020+	0.202 (0.064, 0.633)	0.006+
Previous experience of PR (ref cat: yes)		1.031 (0.525, 2.024)	0.928	-	-
4MGS (ref cat: <0.60 m/s)		0.950 (0.485, 1.864)	0.882	-	-
CAT		0.987 (0.944, 1.032)	0.574	-	-

*All variables were included in the multivariable analysis; enter method was used for the univariate analysis; backwards selection procedure was used for the multivariate analysis, with variables excluded from the multivariate model if p value <0.16; final multivariate model reported; **Not calculated due to low numbers in the never smoker group; +p=<0.05.

Pulmonary Rehabilitation leaflet

This information leaflet was provided as usual care for all participants recruited to this trial prior to discharge from hospital as part of the COPD discharge bundle.

A lifetime of specialist care

Royal Brompton & Harefield NHS
NHS Foundation Trust

Harefield Hospital

Pulmonary rehabilitation after an exacerbation

Contents

This leaflet gives general information on pulmonary rehabilitation after an exacerbation. It does not replace the need for personal advice from a healthcare professional. Please ask us if you have any questions.

What is an exacerbation?

When the symptoms of your lung condition suddenly become worse, it is called an exacerbation. This is usually treated in hospital as an inpatient or by a change in your medications (such as steroids or antibiotics).

What is pulmonary rehabilitation?

Pulmonary rehabilitation (PR) is a set of personalised classes to help you manage your breathlessness and gradually increase your fitness level.

Each class consists of an education and exercise session and lasts around two hours. Classes are held twice a week for eight weeks.

Why am I being offered PR now?

When you have an exacerbation, you may find you are less active. Even when you are starting to feel better, you may still find it harder to do your daily activities. Doctors have studied the effect of PR in patients after an exacerbation. They found that starting PR within two weeks of leaving hospital can help patients in the following ways:

- Make it easier to complete daily activities such as walking, climbing stairs or getting dressed
- Improve quality of life
- Reduce the risk of another exacerbation
- Reduce the possibility of needing another hospital stay
- Improve survival

What patients say about PR

PR is "making the best of what you have".

"It helps me on the road to recovery."

"I said 'that's for me' straight away. I accepted it as I did not want to get worse; I wanted to maintain what I have."

Is it safe for me?

Your healthcare professional will only recommend PR if you meet the medical criteria and it is safe for you to do so. A specialist physiotherapist will check what you can do and ensure it is safe for you to take part.

How do I get referred?

Your doctor, nurse or physiotherapist may recommend PR to you while you are in hospital. Your GP, practice nurses or community matron can also refer you. If you are unsure or would like help being referred, please contact us.

Once you have been referred, we will contact you within two weeks to talk to you about coming in for an assessment.

Please let us know if you have any questions about PR or why you have been referred.

What happens at the assessment?

A specialist physiotherapist will discuss your goals with you and complete a full lung health check-up. You can have the assessment even if your symptoms are worse than normal.

This will include checking:

- How well your lungs work
- How your lung condition affects your walking and daily activities
- Your medical history and medications
- How your lung condition affects you

You can bring a relative, friend or carer with you to all the appointments.

After the assessment, we will offer you a class within four weeks if appropriate.

What patients say about the assessment

"I was very nervous about the assessment but once I was there I was alright."

"The physio was great and explained everything. It was good that they spent a lot of time with me as I was feeling so vulnerable after my hospital stay."

What happens during the classes?

At your first class, we will introduce you to other patients with lung conditions. You will exercise with them in group sessions. Each class is split into an exercise session and education session.

Exercise
The specialist physiotherapist will design a programme specifically for you, based on your goals and medical history from your assessment. This will include a combination of arm and leg exercises with the option of using gym equipment.

What patients say about the exercises

"You are not alone; we are all in the same boat."

"I did a bit more than I thought so I was really pleased."

"They tailored it to my needs."

"It really helped me feel stronger."

Education
The education sessions are designed to provide you with the tools for managing your condition. Topics include:

- Question and answer session with a consultant
- Airway clearance and breathing techniques
- Inhaler technique
- How to manage a chest infection
- Coping with lung disease
- Relaxation and pacing yourself
- Benefits of exercise and how to exercise at home
- Medications
- Help on how to stop smoking
- Healthy lifestyle and diet

What patients say about the education classes

"I do not panic now when I am short of breath."

"It's great they spend time explaining things I've always wanted to know."

When and where are the classes?

There is a choice of classes at different times and locations, such as a hospital, gym or community hall, around North West London. Different patients prefer different environments, so we can discuss the most appropriate option for you.

Getting to the classes

If you do not have your own transport and are unable to use public transport, please ask a member of the team for advice.

Who can I contact for more information?

You can contact us on 01895 828 851 or send an email to hhpulmonaryrehab@rbht.nhs.uk.

A final word from our patients

"You don't know until you have a go."

"My quality of life improved. It does help."

"I'm so glad I did it. It was the best thing for my recovery."

If you have concerns about any aspect of the service you have received in hospital and feel unable to talk to those people responsible for your care, call PALS on 01895 826 572 or email pals@rbht.nhs.uk. This is a confidential service.

Royal Brompton Hospital
Sydney Street
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SW3 6NP
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UB9 6JH
tel: 01895 823 737
textphone: (18001) 01895 823 737

Website: www.rbht.nhs.uk

إذا كنت ترغب في الحصول على ترجمة فورية لمضمون هذه الوثيقة إلى اللغة العربية، يرجى منك الاتصال بأحد مستخدمينا بجناح المصلحة التي يتم فيها استشفائك. أحد موظفينا سيسعى لترتيب إجراءات الترجمة وإتمامها في الوقت المناسب لك.

Brosurteki bilginin Turkçe tercumesi için tedavi goruyor oldugunuz bolume bas vurunuz. Bolum personeli tercumenin gerçeklesmesini en kisa zamanda ayarlacaktir.

 December 2013

TITLE PAGE

The effects of a video intervention on post-hospitalization pulmonary rehabilitation uptake

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Planning and design: SF, DB, WDCM; Conduct of randomized controlled trial: REB, SEJ, SSCK, CMN, SP; Conduct of embedded interviews: SEJ, SF; Manuscript writing: All authors; Final approval of manuscript: All authors; Guarantor: WDCM.

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What impact will this research will have on clinical medicine and how does this research add to our knowledge base?

Acute exacerbations of COPD are one of the commonest causes of emergency hospital admission worldwide. Following hospital discharge, people with COPD have significant impairments in physical functioning and health related quality of life and have high risk of readmission. Pulmonary rehabilitation, a program of care comprising exercise-training and education, improves exercise capacity and health related quality of life, and reduces readmissions. However patient uptake is low. This trial is the first with the primary aim of increasing uptake of post-hospitalization pulmonary rehabilitation. This trial demonstrated that a simple patient co-designed education video delivered at hospital discharge did not increase referral or uptake rates for post-hospitalization pulmonary rehabilitation.

Online data supplement

This article has an online data supplement, which is accessible from this issue's table of content online at www.atsjournal.org

Data sharing

No data on individual, de-identified participant data (including data dictionaries) will be shared unless specific requests are made. No additional, related documents will be made available unless specific requests are made. Request for data will be responded to on an individual basis, with the period the data is available for individually determined based upon each request.

Transparency declaration

This is an honest, accurate and transparent account of the study which was undertaken.

ABSTRACT

Rationale: Pulmonary rehabilitation following hospitalizations for exacerbations of chronic obstructive pulmonary disease (COPD) improves exercise capacity and health-related quality of life, and reduces readmissions. However, post-hospitalization pulmonary rehabilitation uptake is low. To date, no trials of interventions to increase uptake have been conducted.

Objective: Effect of a co-designed education video as an adjunct to usual care on post-hospitalization pulmonary rehabilitation uptake.

Methods: An assessor- and statistician-blinded randomized controlled trial with nested qualitative interviews of participants in the intervention group. Participants hospitalized with COPD exacerbations were assigned 1:1 to receive either usual care (COPD discharge bundle including pulmonary rehabilitation information leaflet) or usual care plus the co-designed education video delivered via a handheld tablet device at discharge. Randomization used minimization to balance age, sex, forced expiratory volume in 1 second (FEV_1) % predicted, frailty, transport availability and previous pulmonary rehabilitation experience.

Measurements and Main Results: The primary outcome was pulmonary rehabilitation uptake within 28 days of hospital discharge. 200 patients were recruited with 196 randomized (51% female, median (interquartile range) FEV_1 % predicted 36(27, 48)). Pulmonary rehabilitation uptake was 41% and 34% in the usual care and intervention groups respectively (p=0.37), with no differences in secondary (pulmonary rehabilitation referral and completion) or safety (readmissions and death) endpoints. Six of the fifteen participants interviewed could not recall receiving the video.

Conclusion: A co-designed education video delivered at hospital discharge did not improve post-hospitalization pulmonary rehabilitation uptake, referral or completion.

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Indexing terms

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INTRODUCTION

Acute exacerbations of chronic obstructive pulmonary disease (COPD) are one of the commonest causes of emergency hospital admission, and account for over 50% of healthcare costs associated with COPD (1). For patients, exacerbations requiring hospitalization are associated with significantly reduced physical activity levels (2), impaired health related quality of life (3), skeletal muscle dysfunction (4, 5) and reduced physical functioning (6). These consequences increase the risk of readmission, but are potentially amenable to treatment with exercise-training (7).

Pulmonary rehabilitation is a comprehensive, patient-tailored intervention that includes exercise-training and education, designed to optimise the physical and psychological well-being of people with chronic respiratory disease (8). In the latest iteration of the Cochrane systematic review, Puhan and colleagues included 20 randomised controlled trials and 1477 patients, and found moderate-to-large effects of post-exacerbation pulmonary rehabilitation on health-related quality of life and exercise capacity, and moderate quality evidence that post-exacerbation pulmonary rehabilitation reduces hospital readmissions (9). Accordingly, provision of pulmonary rehabilitation within four weeks of hospital discharge is recommended within international pulmonary rehabilitation and COPD guidelines (10-12).

Despite the evidence base and guideline recommendation, observational data suggest that uptake of post-exacerbation pulmonary rehabilitation is low (13, 14). However, a recent systematic review was unable to identify any randomized controlled trials of interventions that aimed to increase uptake of post-exacerbation pulmonary rehabilitation (15). As reported barriers to pulmonary rehabilitation include poor patient engagement with, or lack of awareness of, pulmonary rehabilitation (16), we hypothesized that education of patients

regarding the benefits of pulmonary rehabilitation might improve uptake. We used experience-based co-design (17) to produce a patient education video as a potentially low cost and easily implementable intervention with high fidelity.

The primary objective of the study was to determine whether using such a patient co-designed education video as an adjunct to usual care could enhance uptake of pulmonary rehabilitation within 28 days of discharge following a hospital admission for acute exacerbation of COPD. Some of the results have been previously reported in a conference abstract (18).

METHODS

Study design and participants

We conducted a parallel, two-group, assessor- and statistician- blinded, mixed methods, randomized controlled trial investigating the effects of a patient education video as an adjunct to usual care (delivery of a COPD discharge bundle), with embedded qualitative components. The study was approved by the London – City and East Research Ethics Committees (14/LO/1740) and registered on the ISRCTN registry (13165073).

Recruitment took place at Hillingdon Hospital, North West London, United Kingdom between February 2015 and May 2018. Details concerning eligibility, inclusion and exclusion criteria are detailed in the online supplement. All participants provided written informed consent.

Randomisation procedure

Participants were randomized 1:1 to either the control (COPD discharge bundle) or intervention (COPD discharge bundle plus patient education video) with minimization used to balance groups according to age, sex, lung function, transport, frailty, and naivety to pulmonary rehabilitation. Further details are found in the online data supplement.

Study interventions

All participants received usual care, comprising delivery of a COPD discharge bundle from a specialist respiratory allied health professional (19). This included standardised verbal information about pulmonary rehabilitation, supplemented by an information leaflet (see

online data supplement). The intervention group was also provided with the same COPD discharge bundle but were asked to watch a patient co-designed education video. A secure internet link with password was also provided to allow access to the video after discharge. Further details of the intervention, as well as development of the education video, are described in the online data supplement.

Data collection

Along with a structured history, the following were measured: physical performance using four meter gait speed (4MGS) (6), spirometry, MRC dyspnoea score, disease-specific health-related quality of life (COPD Assessment Test (CAT) (3)). These were measured on the day of hospital discharge and at 90 days following hospital discharge.

Qualitative study

Using purposive sampling (taking account sex and uptake of pulmonary rehabilitation), topic-guided, audio recorded interviews of 15 participants in the intervention group were conducted to capture their perspectives about the education video and the research process (such as timing of the video). Qualitative interviews were conducted within a week after the end of the 90-day follow-up period.

Study outcomes

Outcome data were collected by a researcher blinded to treatment allocation, and qualitative interviews were conducted by a trained researcher. The primary outcome endpoint was

percentage uptake of pulmonary rehabilitation within 28 days of hospital discharge within each treatment arm. Uptake was defined as documented attendance at a pulmonary rehabilitation assessment.

Secondary outcome endpoints were: 1) pulmonary rehabilitation uptake within 90 days of hospital discharge; 2) pulmonary rehabilitation referral rate, defined as the percentage of patients in each treatment arm for which a referral was received by the pulmonary rehabilitation team within 28 days of hospital discharge; 3) pulmonary rehabilitation completion rate, defined as percentage of patients starting pulmonary rehabilitation who attended ≥8 pulmonary rehabilitation sessions; 4) pulmonary rehabilitation adherence, defined as mean number of PR sessions attended by patients starting pulmonary rehabilitation; 5) change in physical performance (4MGS) between the day of discharge and 90 days post-discharge; 6) change in health related quality of life (CAT) between the day of discharge and 90 days post-discharge. Safety endpoints were mortality and hospital readmissions with 90 days of hospital discharge.

Sample size

In a previous study in the same setting, we demonstrated a post-hospitalisation pulmonary rehabilitation uptake of 24% (13). To demonstrate an increase in the primary outcome measure from 24% to 45% in the experimental group, 178 patients (89 in each group) were required with 80% power at the 5% significance level (MedCalc Software, Ostend, Belgium). To account for a potential 10% loss to follow-up, we aimed to recruit 100 participants to each group.

Sample size of the qualitative study was based on the predicted minimum number of interviews required to achieve saturation, in other words, the point at which gathering fresh data does not generate new theoretical insights (information related to the research question and objectives) and is based on the concept of Information Power (20). Based on the work of Guest *et al* (21) saturation of themes is usually reached by the twelfth interview. We therefore aimed to recruit a minimum of 12 patients for the qualitative interviews.

Analysis

Quantitative data analysis was completed by the trial statistician (WB) using Stata version 14.1 (StataCorp LP, Texas, USA). The statistician remained blinded to treatment allocations until completion of analysis. The pre-specified primary analysis was by intention to treat. Categorical data were presented as percentages, and compared between groups using the Pearson X^2 test. A p value <0.05 was considered statistically significant.

Change in physical performance and health related quality of life from hospital discharge to 90 days post-discharge were compared by trial group using independent samples Student's t test (two-sided) (22). Missing data was handled by multiple imputation; further details are in the online data supplement. A pre-planned sensitivity analysis considered patients who were naïve to pulmonary rehabilitation at recruitment.

Qualitative interview data were transcribed verbatim, anonymised and analysed using the Framework approach (23).

RESULTS

Figure 1 shows the trial CONSORT flowchart. We recruited 200 patients and randomized 196. The baseline characteristics of the 196 randomized participants randomised are shown in Table 1.

Uptake, referral rate, completion and adherence

Table 2 summarises the results of the primary and major secondary outcomes. Overall uptake of pulmonary rehabilitation was 37%, with no difference in uptake between the control (41%) and intervention (34%) groups; p=0.370. The Kaplan-Meier curve demonstrated no significant between group difference in time to uptake of pulmonary rehabilitation (Figure 2; log rank test p=0.490). No between group differences were seen in referral, completion or adherence rates (Table 2).

Change in health-related quality of life and physical performance

There were clinically and statistically significant improvement in CAT in both groups (Mean (standard deviation) change: Intervention: -2.94 (7.68); Control: -4.33 (7.38)) with no between group differences (p=0.212); Table 2. Similarly, although 4MGS improved in both groups, there were no significant between group differences (Mean (standard deviation) change in 4MGS: Intervention: 0.25 (0.26) m/s; Control: 0.23 (0.26) m/s; p=0.568); Table 2. The improvements seen in both groups are likely to indicate natural recovery following a hospitalization.

Health Resource Utilisation

During the 90-day follow-up period, the mortality rate was 2% and 1% for the control group and intervention groups respectively (p=1.000). All-cause readmission rates for the control and intervention groups were 15% and 22% respectively during the 90-day follow-up period. (p=0.871).

Sensitivity analysis

Of the 196 participants randomised, 95 (48%) had no previous pulmonary rehabilitation experience before recruitment to the study (PR-naïve). Similar to the overall study population data, the intervention had no effect on uptake, referral, or completion rates of post-hospitalization pulmonary rehabilitation in PR-naïve participants. Further details are outlined in Tables E1 and E2 of the Online Data Supplement.

Video intervention perspectives

Of the 15 participants who took part in qualitative interviews, eight participants did not take up pulmonary rehabilitation, with six of the seven interviewees who did take up pulmonary rehabilitation completing the programme. Six of those interviewed did not recall previously seeing the video, despite being in the intervention group. Four of these six did take up PR with three completing. None of the interviewed participants used the weblink to access the video after hospital discharge.

Patients who did recall viewing the video thought it well-presented, a good length and that

the information provided was clear. Most stated it was helpful to see patients with lung conditions in the video talking about their experiences and the benefits of rehabilitation: "*because I know how she feels because I felt exactly the same as she did*." (female, aged 62, completer). Seven patients had no prior understanding about pulmonary rehabilitation: "*So the video showed me you know, what it was about. It is useful, it made it clear what was about to happen.*" (male, aged 51, completer). Patients also thought the video rather than a leaflet or verbal information was a better format for information to be retained: "*A video stays in your head. You can see the exercises. Piece of paper doesn't*." (female, aged 62, completer)

Views were mixed regarding the timing of the delivery of the video. Some participants thought it was the right time to show the video (just before discharge from hospital): *"I think you've got to get people whilst they're in hospital and I think the initial video is the right way to do it*." (female, aged 52, decliner). Other participants thought that showing the video in hospital was not the best time because patients might be too ill or tired: "*What I remember of it… I mean I was in a tiswas at the time as well... You got to be back on your feet to fully digest what's going on"* (male, aged 79, decliner).

Suggestions for improvements were to: include patients using oxygen, include younger patients, show a greater variety of exercise equipment including simpler ones used in community settings, and emphasise the social aspects of pulmonary rehabilitation.

Of the eight interviewed participants who declined to take up PR, three could not attend as they stated they were too unwell ("*But I couldn't do nothing like that now. No dear, oh no, I couldn't do that.*" - female, aged 91, decliner) or had other significant comorbidities ("*I declined because I've got other health issues at the moment. So, that's why I declined because I couldn't guarantee that I'd be there week in week out."* - female, aged 52, decliner). Two

participants declined because they thought they were doing enough exercise already: "*So, people would come to see me, they were quite happy with what I was doing. With the walking I was doing.*" (male, aged 79, decliner). For the three remaining participants who did not take up PR, one was still working and the times did not suit, one could not attend as his wife was unwell, and the other stated they didn't have transport and it was too far to travel.

DISCUSSION

In this assessor- and statistician- blinded, randomized controlled trial, a patient co-designed education video shown on the day of hospital discharge had no effect upon patient uptake of post-hospitalization pulmonary rehabilitation. Furthermore, the intervention did not increase referral or completion rates. Although a significant proportion were unable to recall watching the video at hospital discharge (suggesting the timing was inappropriate for some), qualitative interviews of participants in the intervention group revealed positive feedback regarding the education video, with those recalling watching the video making suggestions for improvement.

Despite a strong evidence base to support the benefits of post-hospitalization pulmonary rehabilitation (9) and guidelines recommendation (10, 11), observational studies have consistently shown low patient uptake and completion. Jones *et al* demonstrated that only 30% of patients were referred for early PR post-acute exacerbation of COPD, with less than 10% of eligible patients completing pulmonary rehabilitation following a hospital admission for an exacerbation (13). An analysis of Medicare beneficiaries showed that only 4225 (1.9%)

of 223,832 individuals hospitalized with acute exacerbation of COPD in 2012 received pulmonary rehabilitation within six months of the index hospital admission (14). In a retrospective analysis of Veterans Health Administration and Medicare data of patients hospitalized with COPD between 2007 - 2011, only 1.5 – 2% were revealed to have attended at least one session of pulmonary rehabilitation (24).

Given that pulmonary rehabilitation is a cornerstone of management in COPD,

there have been surprisingly few studies that have tried to address this implementation gap.

In a systematic review of the available evidence on interventions for increasing uptake and completion of pulmonary rehabilitation, Jones *et al* were only able to identify one quasi-randomized controlled trial, which was assessed to be at high risk of bias (15). No studies were identified in the specific post-hospitalization pulmonary rehabilitation setting (15). In a subsequent systematic review, that was not limited to randomized controlled trials, Early and colleagues were able to identify five studies that included uptake of pulmonary rehabilitation as an outcome (25). All were conducted in primary care or outpatient settings, and many were at high risk of bias due to study design (for example, uncontrolled and controlled before and after studies). Again, no interventional studies in the post-hospitalization setting were identified (25).

A strength of the current study was that this was the first randomized controlled trial to test an intervention designed to increase uptake of pulmonary rehabilitation in the post-exacerbation setting. The trial was adequately powered, with an intention to treat analysis, and all participants randomized to the intervention group received the treatment as intended at hospital discharge. Both control and intervention groups received best standard care, including the provision of a COPD discharge bundle (19) which included an information leaflet

about post-hospitalization pulmonary rehabilitation. Previous studies have observed that effective and consistent delivery of a COPD discharge bundle is associated with an increase in pulmonary rehabilitation referrals (19). The outcome assessors were blinded, as was the statistician, who was blinded to group allocation throughout data analysis. In addition, the trial included a qualitative element which identified potential refinements to the intervention content and timing of delivery.

A further strength relates to the intervention being co-designed by key stakeholders, including patients who had previously experienced an acute exacerbation of COPD requiring hospitalization. The focus of the intervention was to educate patients about the benefits of post-hospitalization pulmonary rehabilitation as poor patient knowledge and engagement have consistently been observed to be major barriers to uptake (16, 26, 27). Experience based co-design, a quality improvement approach that enables staff and patients (or other service users) to co-design services in partnership, was used to develop the intervention. This approach has been previously used in a range of clinical settings in the National Health Service (28, 29), including pulmonary rehabilitation (30). The qualitative feedback was positive with patients commenting that the video was well presented, a good length and the information provided was clear.

There were several limitations to the study. This was single-center study, using a specific video in a particular setting, and therefore the results do not preclude the success of future video interventions that might be developed for other settings or delivered at different stages of the patient pathway. A proportion of eligible patients did not consent to the research study, which reflects the difficulties of recruiting acutely unwell, hospitalised patients into research studies, and therefore a potential limitation of the study is the generalisability of the trial

population. We also observed that a proportion of participants did not attend the face-to-face visit at three months. However, data for the primary and main secondary outcome measures (pulmonary rehabilitation uptake, referral, completion) were available for all trial participants. Missing data for physical performance and health related quality of life measures were also imputed. Due to the number lost to follow-up, we were unable to systematically collect data on reasons for non-uptake of PR. Another limitation was that we did not formally assess for cognitive dysfunction, digital literacy or internet availability at home, which may have helped with the interpretation of the study results.

There were several possible reasons why we did not see an increase in pulmonary rehabilitation uptake in the video intervention group. First, the video was provided without additional counselling as the intervention was designed to be low cost, easily implementable, and not burdensome on staff time. With hindsight, a greater focus on behavioural aspects, for example with health coaching (31), may have enhanced the benefits of showing the video. Previous studies that have used device-based interventions with minimal counselling have also been unsuccessful in changing the behaviour of patients with COPD (32). Second, the involvement of key stakeholders in the design of the intervention may have provided important education for the staff responsible for referrals and improved their knowledge regarding pulmonary rehabilitation, with a positive knock-on effect upon referral rates in both control and intervention groups. Evidence to support this was the observation that overall referral (70%) and uptake (34%) rates in this study compared favourably with previous data from the same setting; Jones *et al* observed pulmonary rehabilitation referral and uptake rates of 31% and 24% respectively despite consistent delivery of a COPD discharge bundle. Third, the high pulmonary rehabilitation referral rates in both control and intervention

settings may reflect the so-called “Hawthorne effect”. In other words, the health care professionals responsible for referring to pulmonary rehabilitation may have modified their behaviour in response to being observed during the trial. Fourth, the barriers to post-hospitalisation pulmonary rehabilitation uptake are complex (16, 33), and the simple intervention tested in this trial may not have been able to address all these potential barriers. Fifth, we observed significant improvements in physical performance and health-related quality of life in both intervention and control groups, which is likely to reflect natural recovery from an exacerbation requiring hospitalization. This recovery may have influenced the decision of participants to take up pulmonary rehabilitation. Finally, the qualitative component of the study highlighted that a proportion of the intervention group (six of fifteen of those interviewed) had no recall of seeing the video at hospital discharge. A previous observational study showed that 57% of patients awaiting discharge following an exacerbation had cognitive impairment, with 20% considered to have pathologic impairment of processing speed (34). Cognitive impairment was not formally assessed in this study and so it is unclear whether this impacted on the lack of efficacy of the intervention. Whether d~~D~~elivering the video intervention at a later date (for example in the post-discharge period rather than on day of hospital discharge), or changing the content of the video might ~~have~~ influence~~d~~ the ~~current findings~~results requires further evaluation.~~.~~

In this specific trial setting, we were unable to demonstrate an increase in referral or uptake rates of post-hospitalization pulmonary rehabilitation with the video intervention. However, given the intervention is cheap, easily implementable and not associated with any known adverse effects, further studies could be considered to identify potential roles for this education video. For example, the video might have value in facilitating the implementation

and delivery of COPD discharge bundles in settings where this is not the standard of care, or as part of a more comprehensive behavioural intervention designed to educate patients, staff or carers.

CONCLUSION

In summary, this assessor- and statistician- blinded, randomized controlled trial demonstrated that a patient co-designed education video shown on the day of hospital discharge had no effect upon patient uptake of post-hospitalization pulmonary rehabilitation, nor on referral or completion rates. Further interventional trials are needed to address the low uptake rates of post-hospitalization pulmonary rehabilitation.

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FIGURE LEGENDS

Figure 1. CONSORT diagram for study flow

Figure 2. Kaplan-Meier curve demonstrating uptake of pulmonary rehabilitation within 28 days of discharge after hospitalisation for an acute exacerbation of COPD according to group allocation

TABLES

Table 1. Baseline characteristics for whole group and according to group allocation

Variable	Whole group (n=196)	Intervention group (n=98)	Control group (n=98)	p value
Gender: male (n (%))	95 (49)	49 (50)	46 (47)	0.668
Age (years)	69 (11)	70 (11)	68 (11)	0.391
FEV_1/FVC†	0.53 (0.17)	0.53 (0.16)	0.53 (0.17)	0.757
FEV_1 (% predicted)	36 (27, 48)	38 (28, 49)	34 (26, 47)	0.454
MRC‡ score	4 (3, 5)	4 (3, 5)	4 (3, 5)	0.791
BMI§ (kg/m^2)	25.5 (21.9, 31.0)	26.2 (22.5, 31.9)	24.9 (21.8, 30.3)	0.285
Index of multiple deprivation	15170 (7213)	15783 (7508)	14550 (6886)	0.234
Smoking status: never/former/current (n (%))	4 (2) / 138 (70) / 54 (28)	1 (1) / 70 (71) / 27 (28)	3 (3) / 68 (69) / 27 (28)	0.598
Pack year history (years)	40 (27, 60)	40 (26, 55)	40 (28, 60)	0.562
Charlson Comorbidity Index	2 (1, 2)	2 (1, 2)	2 (1, 2)	0.926
Self-reported all-cause hospital admissions in previous year	1 (0, 2)	1 (0, 2)	1 (0, 2)	0.486
Self-reported courses of antibiotics in previous year	2 (1, 4)	2 (1, 3)	2 (1, 4)	0.979
Self-reported courses of steroids in previous year	1 (0, 3)	1 (0, 3)	2 (1, 4)	0.630
Home oxygen required at hospital discharge (n (%))	7 (4)	4 (4)	3 (3)	0.684
Acute non-invasive ventilation during admission (n (%))	22 (11)	11 (11)	11 (11)	0.944
Walking aid required on admission (n (%))	51 (26)	22 (22)	29 (30)	0.254
Own transport (n (%))	116 (59)	56 (57)	60 (61)	0.561
Living alone (n (%))	83 (43)	39 (40)	44 (45)	0.470
Hospital length of stay (days)	3 (1, 6)	3 (2, 7)	2 (1, 5)	0.129
Previous experience of PR‖ (n (%))	101 (52)	50 (51)	51 (52)	0.886
4MGS**: <0.60 m/s (n (%))	99 (51)	50 (51)	49 (50)	0.944
COPD Assessment Test	23 (8)	23 (8)	23 (8)	0.888

Data reported as mean (standard deviation) or median (25th centile, 75th centile) unless stated otherwise; Independent T-Test (or Mann-Whitney for non-normally distributed data) or Chi-Squared test was used to compare groups.

Abbreviations: * = forced expiratory volume in one second; † = forced vital capacity; ‡ = Medical Research Council dyspnoea scale; § = body mass index; $^{\|}$ = pulmonary rehabilitation; ** = four meter gait speed.

Table 2. Referral rate, uptake, completion and adherence to early PR for whole group and according to group allocation

Outcome	Whole group (n=196)	Intervention group (n=98)	Control group (n=98)	p value
Primary Outcome				
Uptake of PR* within 28 days (n (%))	73 (37)	33 (34)	40 (41)	0.370
Secondary Outcomes				
Referral to PR received within 28 days of hospital discharge (n (%))	138 (70)	70 (71)	68 (69)	0.754
Completion: Proportion of those taking up PR who complete PR (n (%))	38 (52)	15 (46)	23 (58)	0.305
Adherence: PR sessions completed by those taking up PR	9 (6)	8 (6)	10 (6)	0.268
Uptake of PR within 90 days (n (%))	107 (55)	52 (53)	55 (56)	0.911
Change in CAT† from discharge to 90 days	-3.6 (7.6)	-2.9 (7.7)	-4.3 (7.4)	0.212
Change in 4MGS‡ from discharge to 90 days (m/s)	0.24 (0.26)	0.25 (0.26)	0.23 (0.26)	0.568

Data reported as mean (standard deviation) unless stated otherwise. Independent T-Test or Chi-Squared Test were used to compare groups. The pulmonary rehabilitation program offers 2 supervised sessions per week for 8 weeks (i.e. 16 sessions).

Abbreviations: * = pulmonary rehabilitation; † = COPD Assessment Test; ‡ = four meter gait speed.

FIGURES

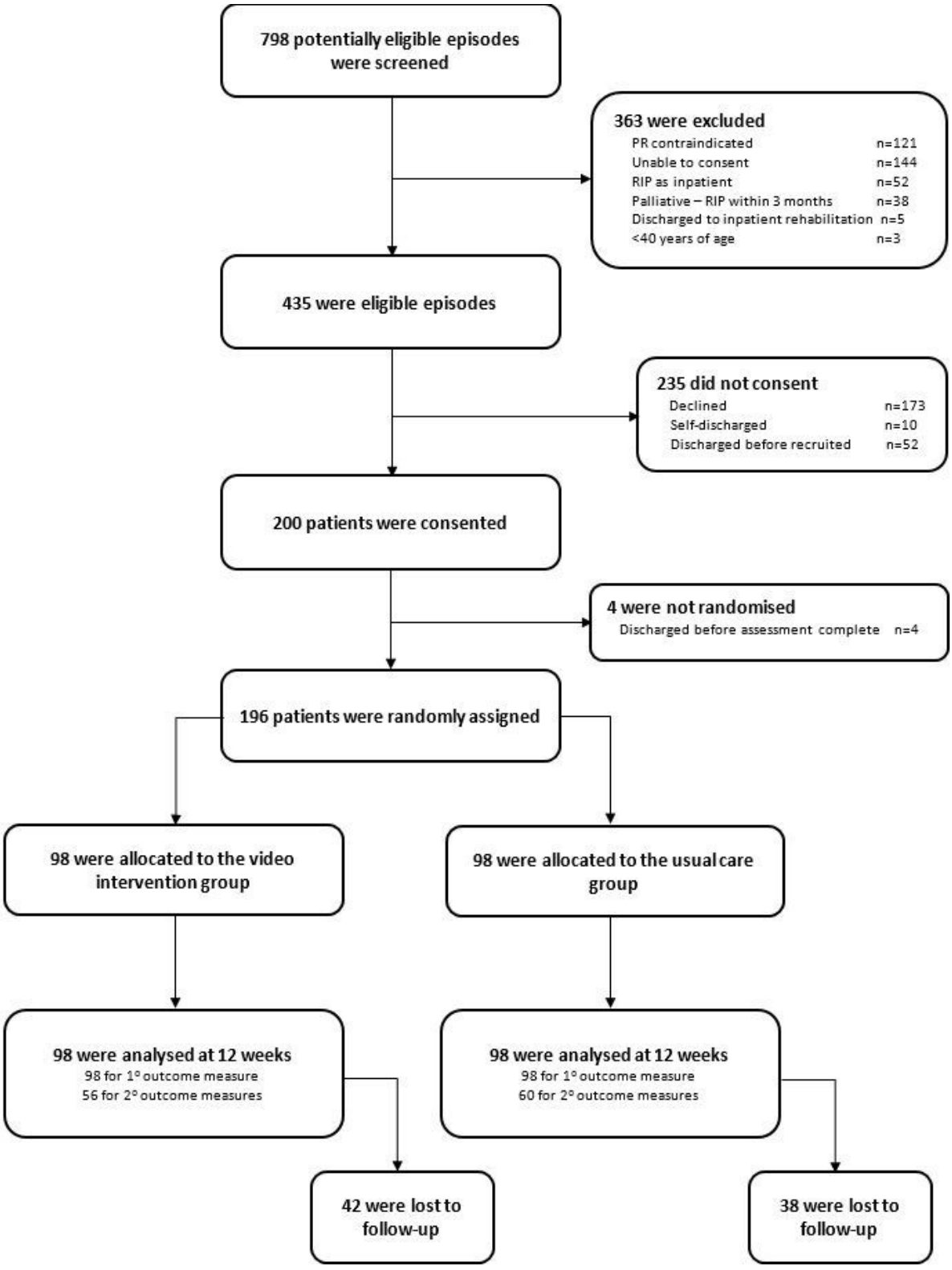

Figure 1. CONSORT diagram for study flow

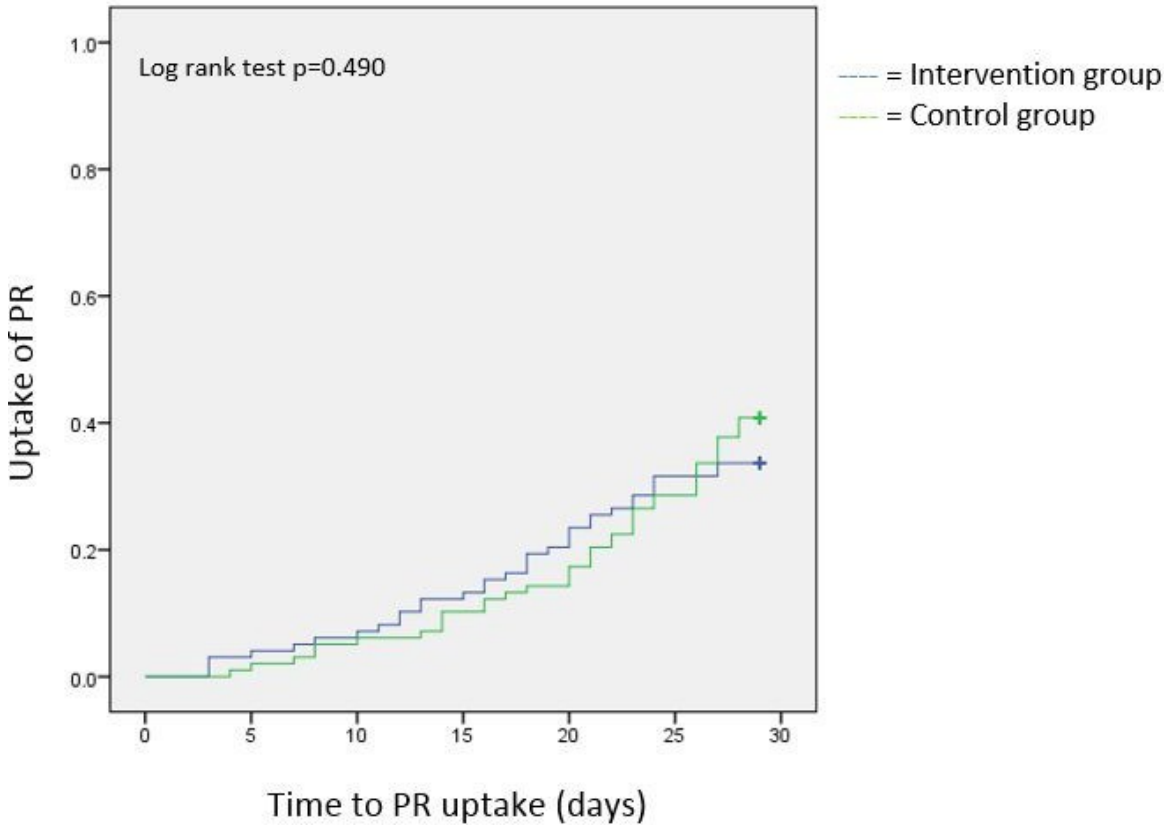

Figure 2. Kaplan-Meier curve demonstrating uptake of pulmonary rehabilitation within 28 days of discharge after hospitalisation for an acute exacerbation of COPD according to group allocation

ONLINE DATA SUPPLEMENT

Title

The effects of a video intervention on uptake of post-hospitalization pulmonary rehabilitation

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Video intervention development

Experience-based co-design was used to develop the video intervention tested in this trial. First, video-recorded interviews were conducted with patients to understand their experiences of pulmonary rehabilitation after an acute exacerbation of chronic obstructive pulmonary disease (COPD). One of the key issues raised by patients was insufficient information about the components of pulmonary rehabilitation, and the potential benefits for themselves. Second, clips which illustrated the key perceptions and experiences raised in the interviews (known as 'touch-points') were subsequently combined and edited to produce a 'touch-points' video. Third, this edited video was then played at three key stakeholder feedback events: 1) patients alone (all patients had experienced a hospitalisation for exacerbation of COPD, with some previously undergoing post-hospitalisation pulmonary rehabilitation); 2) health care professionals alone (from acute care teams involved in the inpatient care of patients with exacerbation of COPD and pulmonary rehabilitation teams); 3) joint patient and healthcare professional event. From these events, the key priority was to develop an education video that would allow real past patients to tell prospective patients about the benefits of pulmonary rehabilitation in a visual manner. Patient/staff co-design groups were then formed to develop the intervention, how it would be delivered and at which point in the patient pathway. A schematic of this process is outlined below (Figure E1). The video can now be accessed freely on YouTube:

(https://www.youtube.com/watch?v=56qcTg1CWnw).

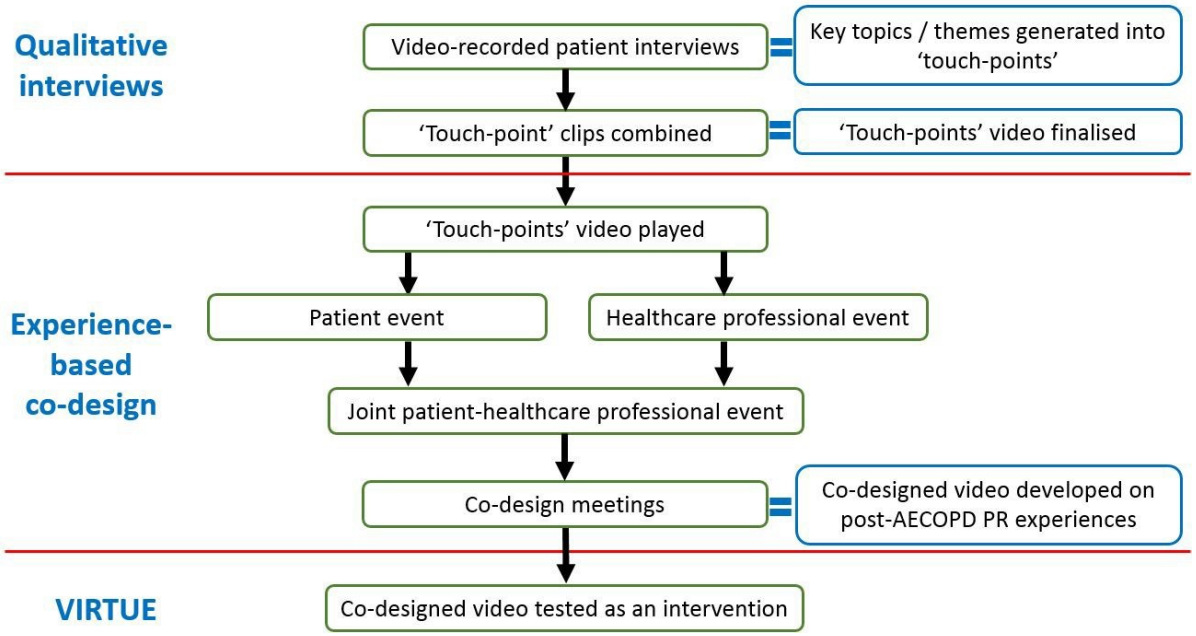

Figure E1. Schematic of experience-based co-design process

METHODS

Participants

Eligible participants were >40 years of age, hospitalised with either a primary diagnosis of an acute exacerbation of COPD or primary diagnosis of pneumonia with a secondary diagnosis of acute exacerbation of COPD, eligible for post-hospitalisation pulmonary rehabilitation (able to walk five metres independently, Medical Research Council (MRC) score ≥2), living within the borough of Hillingdon, and had capacity to consent. Exclusion criteria included significant co-morbidities that would make exercise unsafe (e.g. evidence of acute coronary syndrome or unstable ischaemic heart disease, severe aortic stenosis, uncontrolled cardiac arrythmia) and those receiving palliative care with expectation of death within three months.

Randomization

Participants were randomised 1:1 to either the control (COPD discharge bundle) or intervention (COPD discharge bundle plus patient education video). The allocation sequence was computer-generated (Minim), accessed by an administrator independent of the recruitment process, trial intervention, outcome assessments, clinical team or study researchers. Minimisation was used to balance groups according to age (years: </≥65), sex (male/female), forced expiratory volume in one second (FEV_1) percentage predicted (%predicted: </≥50), transport availability (independent driver with a car: yes/no), physical frailty status (four meter gait speed (4MGS): </≥0.6 metres/second (m/s) (6)) and self-reported previous experience of pulmonary rehabilitation (yes/no).

Intervention

The video was delivered via a handheld tablet device (iPad mini) provided by a researcher independent of the clinical, study research or pulmonary rehabilitation teams. Patients in the intervention group were also

provided with a secure internet link and password so that they or relatives could access the education video after discharge from hospital. All patients were offered a referral for pulmonary rehabilitation at hospital discharge. Patients were also provided with telephone numbers to contact the hospital respiratory or pulmonary rehabilitation teams to request a referral after discharge. A referral was generated only with patient consent.

Analysis of missing data

Missing data were explored and reported according to cause. Missing data were assumed to have occurred completely at random and were handled by a Markov Chain Monte Carlo method, using multiple imputations (10 datasets) using simulations from a Bayesian prediction distribution for normal data. Data were assumed to be from a multivariate normal and data augmentation was applied to Bayesian inference with missing data. The data were log transformed for multiple imputation then anti-logged for the analysis.

RESULTS

Sensitivity analysis

The pre-planned sensitivity analysis for patients who were naïve to pulmonary rehabilitation (PR-naïve) are included in Table E1 and E2.

Table E1. Baseline characteristics for all PR-naïve and according to group allocation

Variable	All PR-naïve (n=95)	PR-naïve intervention group (n=48)	PR-naïve control group (n=47)	p value
Gender: male (n (%))	39 (41)	21 (44)	18 (38)	0.589
Age (years)	69 (10)	71 (10)	67 (11)	0.053
$FEV_1^*/FVC^\dagger$	0.54 (0.17)	0.54 (0.16)	0.54 (0.17)	0.696
FEV_1^* (% predicted)	33 (25, 43)	33.5 (27, 43)	32 (25, 42)	0.739
MRC‡ score	4 (3, 5)	4 (4, 5)	4 (3, 5)	0.971
BMI§ (kg/m^2)	26.7 (7.1)	26.1 (6.6)	27.3 (7.6)	0.599
Index of multiple deprivation	15611 (7430)	15981 (7235)	15233 (7684)	0.626
Smoking status: never/former/current (n (%))	2 (2) / 29 (31) / 64 (67)	0 (0) / 13 (27) / 35 (73)	2 (4) / 16 (34) / 29 (62)	0.239
Pack year history (years)	40 (25, 60)	40 (20, 54)	42.5 (28, 68)	0.350
Charlson Comorbidity Index	1 (1, 2)	1 (1, 2)	2 (1, 2)	0.459
Self-reported all-cause hospital admissions in previous year	1 (0, 2)	1 (0, 2)	1 (0, 2)	0.968
Self-reported courses of antibiotics in previous year	2 (1, 5)	2 (1, 3)	2 (1, 6)	0.297
Self-reported courses of steroids in previous year	2 (0, 3)	1 (0, 3)	2 (0.5, 5)	0.225
Home oxygen required at hospital discharge (n (%))	4 (4)	3 (6)	1 (2)	0.334
Acute non-invasive ventilation during admission (n (%))	9 (10)	4 (8)	5 (11)	0.676
Walking aid required on admission (n (%))	27 (28)	10 (21)	17 (36)	0.098
Own transport (n (%))	29 (31)	16 (33)	13 (28)	0.548
Living alone (n (%))	43 (45)	21 (43)	22 (47)	0.765
Hospital length of stay (days)	3 (2, 7)	4 (2, 7)	3 (1, 5)	0.323
4MGS**: <0.60 m/s (n (%))	43 (45)	20 (42)	23 (49)	0.477
COPD Assessment Test	23 (8)	22 (8)	25 (7)	0.060

Data reported as mean (standard deviation) or median (25^{th} centile, 75^{th} centile) unless stated otherwise; Independent T-Test (or Mann-Whitney for non-normally distributed data) or Chi-Squared test was used to compare groups.

Abbreviations: * = forced expiratory volume in one second; † = forced vital capacity; ‡ = medical research council; § = body mass index; ** = four meter gait speed.

Table E2. Referral rate, uptake, completion and adherence to early PR for all PR-naïve and according to group allocation

Outcome	All PR-naïve (n=95)	PR-naïve intervention group (n=48)	PR-naïve control group (n=47)	p value
Primary Outcome				
Uptake of PR* within 28 days (n (%))	32 (34)	17 (35)	15 (32)	0.347
Secondary Outcomes				
Referral to PR received within 28 days of hospital discharge (n (%))	60 (63)	28 (58)	32 (68)	0.325
Completion: Proportion of those taking up PR who complete PR (n (%))	15 (47)	8 (47)	7 (47)	0.804
Adherence: PR sessions completed by those taking up PR	9 (6)	10 (6)	8 (6)	0.805
Uptake of PR within 90 days (n (%))	45 (47)	21 (44)	24 (50)	0.616
Change in CAT† from discharge to 90 days	-3.2 (7.5)	-2.4 (8.6)	-3.9 (6.1)	0.320
Change in 4MGS‡ from discharge to 90 days (m/s)	0.24 (0.27)	0.27 (0.28)	0.20 (0.26)	0.227

Data reported as mean (standard deviation) unless stated otherwise. Independent T-Test or Chi-Squared Test were used to compare groups.

Abbreviations: * = pulmonary rehabilitation; † = COPD Assessment Test; ‡ = four meter gait speed.

Factors associated with pulmonary rehabilitation uptake

Table E3 shows univariate and multivariate analysis of factors associated with pulmonary rehabilitation uptake in those referred for pulmonary rehabilitation. Increasing age was associated with increased pulmonary rehabilitation uptake, whilst hospital length of stay ≥ 8 days was associated with reduced pulmonary rehabilitation uptake. No other patient factors were associated with pulmonary rehabilitation uptake, including FEV1 %predicted, MRC dyspnoea score, smoking status, BMI, index of multiple deprivation, domiciliary oxygen use, four metre gait speed, CAT score, or own transport.

Table E3: Logistic regression for predictors of referral of early PR following hospitalisation for an acute exacerbation of COPD

		Uptake			
		Univariate analysis*		Multivariate analysis*	
		OR (95% confidence interval)	p value	OR (95% confidence interval)	p value
Sex (ref cat: female)		0.828 (0.423, 1.619)	0.581	-	-
Age		1.029 (0.997, 1.062)	0.077	1.045 (1.009, 1.082)	0.014⁺
FEV1 % predicted		1.006 (0.986, 1.027)	0.537	-	-
MRC score (ref cat: MRC 5)	2	1.631 (0.591, 4.500)	0.345	-	-
	3	1.129 (0.438, 2.914)	0.801	-	-
	4	0.612 (0.255, 1.465)	0.270	-	-
Index of multiple deprivation		1.000 (1.000, 1.000)	0.620	-	-
Self-reported all-cause hospital admissions in previous year		0.928 (0.809, 1.064)	0.285	-	-
Oxygen required during hospital admission (ref cat: no)		0.952 (0.463, 1.957)	0.894	-	-
Own transport (ref cat: yes)		0.885 (0.443, 1.765)	0.730	-	-
Hospital length of stay (ref cat: 0 to 1 days)	2 to 3 days	0.605 (0.241, 1.521)	0.286	0.649 (0.248, 1.697)	0.378
	4 to 7 days	0.472 (0.181, 1.232)	0.125	0.472 (0.175, 1.274)	0.138
	≥ 8 days	0.281 (0.096, 0.821)	0.020⁺	0.202 (0.064, 0.633)	0.006⁺
Previous experience of PR (ref cat: yes)		1.031 (0.525, 2.024)	0.928	-	-
4MGS (ref cat: <0.60 m/s)		0.950 (0.485, 1.864)	0.882	-	-
CAT		0.987 (0.944, 1.032)	0.574	-	-

*All variables were included in the multivariable analysis; enter method was used for the univariate analysis; backwards selection procedure was used for the multivariate analysis, with variables excluded from the multivariate model if p value <0.16; final multivariate model reported; **Not calculated due to low numbers in the never smoker group; ⁺p=<0.05.

Pulmonary Rehabilitation leaflet

This information leaflet was provided as usual care for all participants recruited to this trial prior to discharge from hospital as part of the COPD discharge bundle.

A lifetime of specialist care

Royal Brompton & Harefield NHS
NHS Foundation Trust

Harefield Hospital

Pulmonary rehabilitation after an exacerbation

Contents

This leaflet gives general information on pulmonary rehabilitation after an exacerbation. It does not replace the need for personal advice from a healthcare professional. Please ask us if you have any questions.

What is an exacerbation?

When the symptoms of your lung condition suddenly become worse, it is called an exacerbation. This is usually treated in hospital as an inpatient or by a change in your medications (such as steroids or antibiotics).

What is pulmonary rehabilitation?

Pulmonary rehabilitation (PR) is a set of personalised classes to help you manage your breathlessness and gradually increase your fitness level.

Each class consists of an education and exercise session and lasts around two hours. Classes are held twice a week for eight weeks.

Why am I being offered PR now?

When you have an exacerbation, you may find you are less active. Even when you are starting to feel better, you may still find it harder to do your daily activities. Doctors have studied the effect of PR in patients after an exacerbation. They found that starting PR within two weeks of leaving hospital can help patients in the following ways:

- Make it easier to complete daily activities such as walking, climbing stairs or getting dressed
- Improve quality of life
- Reduce the risk of another exacerbation
- Reduce the possibility of needing another hospital stay
- Improve survival

What patients say about PR

PR is "making the best of what you have".

"It helps me on the road to recovery."

"I said 'that's for me' straight away. I accepted it as I did not want to get worse; I wanted to maintain what I have."

Is it safe for me?

Your healthcare professional will only recommend PR if you meet the medical criteria and it is safe for you to do so. A specialist physiotherapist will check what you can do and ensure it is safe for you to take part.

How do I get referred?

Your doctor, nurse or physiotherapist may recommend PR to you while you are in hospital. Your GP, practice nurses or community matron can also refer you. If you are unsure or would like help being referred, please contact us.

Once you have been referred, we will contact you within two weeks to talk to you about coming in for an assessment.

Please let us know if you have any questions about PR or why you have been referred.

What happens at the assessment?

A specialist physiotherapist will discuss your goals with you and complete a full lung health check-up. You can have the assessment even if your symptoms are worse than normal.

This will include checking:

- How well your lungs work
- How your lung condition affects your walking and daily activities
- Your medical history and medications
- How your lung condition affects you

You can bring a relative, friend or carer with you to all the appointments.

After the assessment, we will offer you a class within four weeks if appropriate.

What patients say about the assessment

"I was very nervous about the assessment but once I was there I was alright."

"The physio was great and explained everything. It was good that they spent a lot of time with me as I was feeling so vulnerable after my hospital stay."

What happens during the classes?

At your first class, we will introduce you to other patients with lung conditions. You will exercise with them in group sessions. Each class is split into an exercise session and education session.

Exercise
The specialist physiotherapist will design a programme specifically for you, based on your goals and medical history from your assessment. This will include a combination of arm and leg exercises with the option of using gym equipment.

What patients say about the exercises

"You are not alone; we are all in the same boat."

"I did a bit more than I thought so I was really pleased."

"They tailored it to my needs."

"It really helped me feel stronger."

Education
The education sessions are designed to provide you with the tools for managing your condition. Topics include:

- Question and answer session with a consultant
- Airway clearance and breathing techniques
- Inhaler technique
- How to manage a chest infection
- Coping with lung disease
- Relaxation and pacing yourself
- Benefits of exercise and how to exercise at home
- Medications
- Help on how to stop smoking
- Healthy lifestyle and diet

What patients say about the education classes

"I do not panic now when I am short of breath."

"It's great they spend time explaining things I've always wanted to know."

When and where are the classes?

There is a choice of classes at different times and locations, such as a hospital, gym or community hall, around North West London. Different patients prefer different environments, so we can discuss the most appropriate option for you.

Getting to the classes

If you do not have your own transport and are unable to use public transport, please ask a member of the team for advice.

Who can I contact for more information?

You can contact us on 01895 828 851 or send an email to hhpulmonaryrehab@rbht.nhs.uk.

A final word from our patients

"You don't know until you have a go."

"My quality of life improved. It does help."

"I'm so glad I did it. It was the best thing for my recovery."

If you have concerns about any aspect of the service you have received in hospital and feel unable to talk to those people responsible for your care, call PALS on 01895 826 572 or email pals@rbht.nhs.uk. This is a confidential service.

Royal Brompton Hospital
Sydney Street
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SW3 6NP
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textphone: (18001) 020 7352 8121

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Harefield
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UB9 6JH
tel: 01895 823 737
textphone: (18001) 01895 823 737

Website: www.rbht.nhs.uk

إذا كنت ترغب في الحصول على ترجمة فورية لمضمون هذه الوثيقة إلى اللغة العربية، يرجى منك الاتصال بأحد مستخدمينا بجناح المصلحة التي يتم فيها استشفائك. أحد موظفينا سيسعى لترتيب إجراءات الترجمة وإتمامها في الوقت المناسب لك.

Brosurteki bilginin Turkçe tercumesi için tedavi goruyor oldugunuz bolume bas vurunuz. Bolum personeli tercumenin gerçeklesmesini en kisa zamanda ayarlayacaktir.