ORIGINAL ARTICLE

The Effects of a Video Intervention on Posthospitalization Pulmonary Rehabilitation Uptake

A Randomized Controlled Trial

Ruth E. Barker[1,2], Sarah E. Jones[1,2], Winston Banya[3], Sharon Fleming[1], Samantha S. C. Kon[1,4], Stuart F. Clarke[4], Claire M. Nolan[1,2], Suhani Patel[1], Jessica A. Walsh[1], Matthew Maddocks[5], Morag Farquhar[6], Derek Bell[7], Jadwiga A. Wedzicha[2]*, and William D.-C. Man[1,2]

[1]Harefield Respiratory Research Group and [3]Medical Statistics, Research & Development, Royal Brompton and Harefield National Health Service (NHS) Foundation Trust, London, United Kingdom; [2]National Heart and Lung Institute and [7]National Institute for Health Research Collaboration for Leadership in Applied Health Research and Care Northwest London, Imperial College, London, United Kingdom; [4]Hillingdon Integrated Respiratory Service, the Hillingdon Hospitals NHS Foundation Trust, London, United Kingdom; [5]Cicely Saunders Institute of Palliative Care, Policy, and Rehabilitation, King's College London, London, United Kingdom; and [6]School of Health Sciences, University of East Anglia, Norwich, United Kingdom

Abstract

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

Objectives: To study the effect of a codesigned education video as an adjunct to usual care on posthospitalization PR uptake.

Methods: The present study was 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 PR information leaflet) or usual care plus the codesigned education video delivered via a handheld tablet device at discharge. Randomization used minimization to balance age, sex, FEV_1 % predicted, frailty, transport availability, and previous PR experience.

Measurements and Main Results: The primary outcome was PR uptake within 28 days of hospital discharge. A total of 200 patients were recruited, and 196 were randomized (51% female, median $FEV_{1\%}$ predicted, 36 [interquartile range, 27–48]). PR uptake was 41% and 34% in the usual care and intervention groups, respectively ($P = 0.37$), with no differences in secondary (PR referral and completion) or safety (readmissions and death) endpoints. A total of 6 of the 15 participants interviewed could not recall receiving the video.

Conclusions: A codesigned education video delivered at hospital discharge did not improve posthospitalization PR uptake, referral, or completion.

Keywords: chronic obstructive pulmonary disease; hospitalization; rehabilitation

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Correspondence and requests for reprints should be addressed to Ruth E. Barker, B.Sc., M.Res., NIHR Clinical Doctoral Research Fellow, Royal Brompton and Harefield NHS Foundation Trust, Harefield Pulmonary Rehabilitation Unit, Harefield Hospital, Middlesex, London UB9 6JH, UK. E-mail: r.barker2@rbht.nhs.uk.

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At a Glance Commentary

Scientific Knowledge on the Subject: Acute exacerbations of chronic obstructive pulmonary disease are one of the most common causes of emergency hospital admission worldwide. After hospital discharge, people with chronic obstructive pulmonary disease have significant impairments in physical functioning and health-related quality of life and have high risk of readmission. Pulmonary rehabilitation (PR), 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.

What This Study Adds to the Field: This trial is the first with the primary aim of increasing uptake of posthospitalization PR. This trial demonstrated that a simple patient-codesigned education video delivered at hospital discharge did not increase referral or uptake rates for posthospitalization PR.

Acute exacerbations of chronic obstructive pulmonary disease (COPD) are one of the most common 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 (PR) is a comprehensive, patient-tailored intervention that includes exercise training and education, designed to optimize 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 (9) included 20 randomized controlled trials and 1,477 patients and found moderate-to-large effects of postexacerbation PR on health-related quality of life and exercise capacity, and moderate-quality evidence that postexacerbation PR reduces hospital readmissions. Accordingly, provision of PR within 4 weeks of hospital discharge is recommended within international PR and COPD guidelines (8, 10, 11).

Despite the evidence base and guideline recommendation, observational data suggest that uptake of postexacerbation PR is low (12, 13). However, a recent systematic review was unable to identify any randomized controlled trials of interventions that aimed to increase uptake of postexacerbation PR (14). As reported barriers to PR include poor patient engagement with, or lack of awareness of, PR (15), we hypothesized that education of patients regarding the benefits of PR might improve uptake. We used experience-based codesign (16) 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-codesigned education video as an adjunct to usual care could enhance uptake of PR within 28 days of discharge after a hospital admission for acute exacerbation of COPD. Some of the results of this study have been previously reported in a conference abstract (17).

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 is registered on the International Standard Randomised Controlled Trial Number registry (13165073).

Recruitment took place at Hillingdon Hospital, North West London, 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.

Randomization 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 PR. Further details are found in the online supplement.

Study Interventions

All participants received usual care, comprising delivery of a COPD discharge bundle from a specialist respiratory allied health professional (18). This included standardized verbal information about PR, supplemented by an information leaflet (*see* the online supplement). The intervention group was also provided with the same COPD discharge bundle but was asked to watch a patient-codesigned 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 supplement.

Data Collection

Along with a structured history, the following were measured: physical performance using 4-m gait speed (4MGS)

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(6); spirometry; Medical Research Council dyspnea score; and 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 after hospital discharge.

Qualitative Study

Using purposive sampling (taking in to account sex and uptake of PR), 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 1 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 PR within 28 days of hospital discharge within each treatment arm. Uptake was defined as documented attendance at a PR assessment.

Secondary outcome endpoints were *1*) PR uptake within 90 days of hospital discharge; *2*) PR referral rate, defined as the percentage of patients in each treatment arm for which a referral was received by the PR team within 28 days of hospital discharge; *3*) PR completion rate, defined as percentage of patients starting PR who attended eight or more PR sessions; *4*) PR adherence, defined as mean number of PR sessions attended by patients starting PR; *5*) change in physical performance (4MGS) between the day of discharge and 90 days after discharge; and *6*) change in health-related quality of life (CAT) between the day of discharge and 90 days after 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 posthospitalization PR uptake of 24% (12). 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). 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 (19). Based on the work of Guest and colleagues (20), saturation of themes is usually reached by the 12th interview. We therefore aimed to recruit a minimum of 12 patients for the qualitative interviews.

Statistical Analysis

Quantitative data analysis was completed by the trial statistician (W.B.) using Stata version 14.1 (StataCorp LP). The statistician remained blinded to treatment allocations until completion of analysis. The prespecified primary analysis was by intention to treat. Categorical data were presented as percentages and compared between groups using the Pearson chi-square test. A P value less than 0.05 was considered statistically significant.

Change in physical performance and health-related quality of life from hospital discharge to 90 days after discharge were compared by trial group using independent samples Student's t test (two-sided) (21). Missing data were handled by multiple imputation; further details are available in the online supplement. A preplanned sensitivity analysis considered patients who were naive to PR at recruitment.

Qualitative interview data were transcribed verbatim, anonymized, and analyzed using the Framework approach (22).

Results

Figure 1 shows the trial CONSORT (Consolidated Standards of Reporting Trials) flowchart. We recruited 200 patients and randomized 196. The baseline characteristics of the 196 randomized participants are shown in Table 1.

Uptake, Referral Rate, Completion, and Adherence

Table 2 summarizes the results of the primary and major secondary outcomes. Overall uptake of PR 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 PR (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 [SD] 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 [SD] 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 after a hospitalization.

Health Resource Utilization

During the 90-day follow-up period, the mortality rate was 2% and 1% for the control 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 randomized participants, 95 (48%) had no previous PR experience before recruitment to the study (PR-naive). Similar to the overall study population data, the intervention had no effect on uptake, referral, or completion rates of posthospitalization PR in PR-naive participants. Further details are outlined in Tables E1 and E2 in the online supplement.

Video Intervention Perspectives

Of the 15 participants who took part in qualitative interviews, 8 participants did not take up PR, with 6 of the 7 interviewees who did take up PR completing the program. 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, of a good length, and that the information provided was clear. Most stated that it was helpful to see patients with lung conditions in the

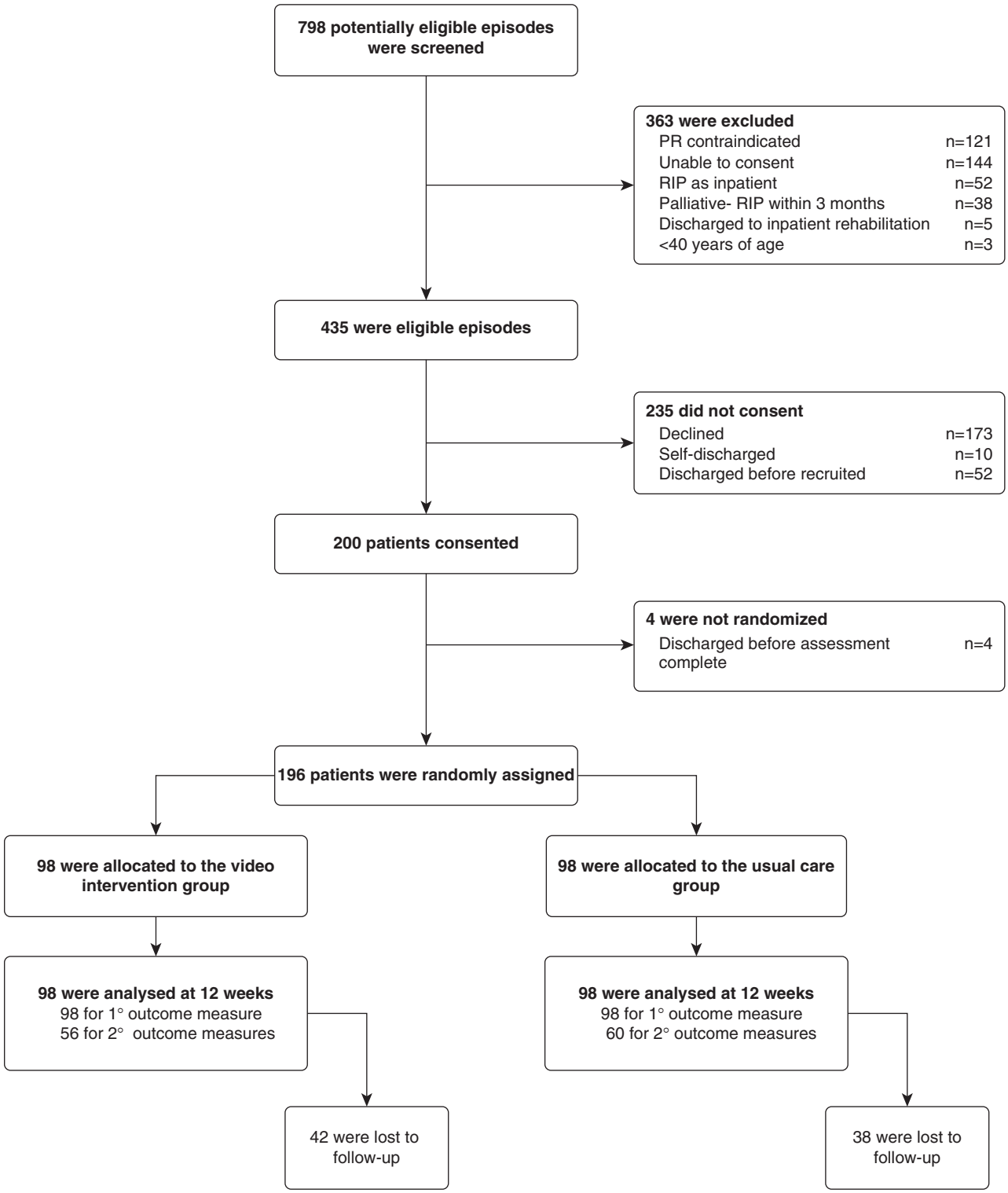

Figure 1. The CONSORT (Consolidated Standards of Reporting Trials) flowchart is shown. PR = pulmonary rehabilitation; RIP = rest in peace.

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 yr, completer). Seven patients had no prior understanding of PR: "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 yr, completer). Patients also thought that the video, rather than a leaflet or verbal information, was a better format for information to be

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
Sex, M, *n* (%)	95 (49)	49 (50)	46 (47)	0.668
Age, yr	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 dyspnea scale 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	15,170 (7,213)	15,783 (7,508)	14,550 (6,886)	0.234
Smoking status, *n* (%)				0.598
Never	4 (2)	1 (1)	3 (3)	
Former	138 (70)	70 (71)	68 (69)	
Current	54 (28)	27 (28)	27 (28)	
Pack-years history, yr	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, noninvasive 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, d	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

Definition of abbreviations: 4MGS = 4-m gait speed; BMI = body mass index; COPD = chronic obstructive pulmonary disease; MRC = Medical Research Council; PR = pulmonary rehabilitation.
Data reported as mean (SD) or median (25th percentile–75th percentile) unless stated otherwise. Independent *t* test (or Mann-Whitney for nonnormally distributed data) or chi-square test was used to compare groups. Reprinted from Reference 17.

retained: "A video stays in your head. You can see the exercises. Piece of paper doesn't" (female, aged 62 yr, 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 yr, 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 yr, decliner).

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 d, *n* (%)	73 (37)	33 (34)	40 (41)	0.370
Secondary outcomes				
Referral to PR received within 28 d 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 d, *n* (%)	107 (55)	52 (53)	55 (56)	0.911
Change in CAT from discharge to 90 d	−3.6 (7.6)	−2.9 (7.7)	−4.3 (7.4)	0.212
Change in 4MGS from discharge to 90 d, m/s	0.24 (0.26)	0.25 (0.26)	0.23 (0.26)	0.568

Definition of abbreviations: 4MGS = 4-m gait speed; CAT = chronic obstructive pulmonary disease assessment test; PR = pulmonary rehabilitation.
Data reported as mean (SD) unless stated otherwise. Independent *t* tests or chi-square tests were used to compare groups. The PR program offers two supervised sessions per week for 8 weeks (i.e., 16 sessions).

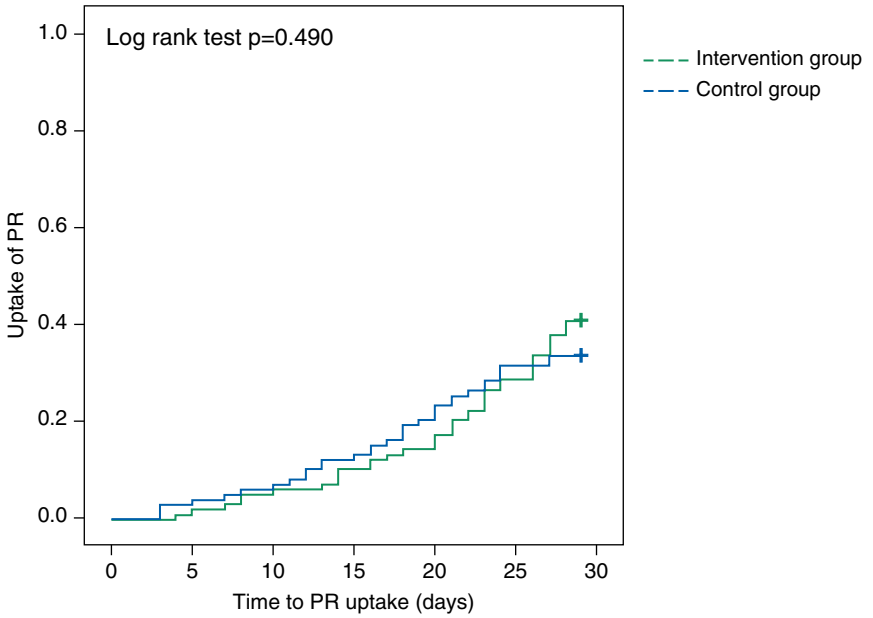

Figure 2. Kaplan-Meier curve demonstrating uptake of pulmonary rehabilitation (PR) within 28 days of discharge after hospitalization for an acute exacerbation of chronic obstructive pulmonary disease according to group allocation.

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 emphasize the social aspects of PR.

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 yr, 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 yr, 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 yr, 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-codesigned education video shown on the day of hospital discharge had no effect upon patient uptake of posthospitalization PR. Furthermore, the intervention did not increase referral or completion rates. Although a significant proportion was 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 posthospitalization PR (9) and guidelines recommendation (8, 10), observational studies have consistently shown low patient uptake and completion. Jones and colleagues (12) demonstrated that only 30% of patients were referred for early PR after acute exacerbation of COPD, with <10% of eligible patients completing PR after a hospital admission for an exacerbation. An analysis of Medicare beneficiaries showed that only 4,225 (1.9%) of 223,832 individuals hospitalized with acute exacerbation of COPD in 2012 received PR within 6 months of the index hospital admission (13). In a retrospective analysis of Veterans Health Administration and Medicare data of patients hospitalized with COPD between 2007 and 2011, only 1.5–2% were revealed to have attended at least one session of PR (23).

Given that PR 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 PR, Jones and colleagues (14) were only able to identify one quasirandomized controlled trial, which was assessed to be at high risk of bias. No studies were identified in the specific posthospitalization PR setting (14). In a subsequent systematic review, which was not limited to randomized controlled trials, Early and colleagues (24) were able to identify five studies that included uptake of PR as an outcome. 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 posthospitalization setting were identified (24).

A strength of the current study was that this was the first randomized controlled trial to test an intervention designed to increase uptake of PR in the postexacerbation 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 (18), which included an information leaflet about posthospitalization PR. Previous studies have observed that effective and consistent delivery of a COPD discharge bundle is associated with an increase in PR referrals (18). The outcome assessors were blinded, as was the statistician, who was blinded to group allocation throughout the data analysis. In addition, the trial included a qualitative element that identified potential refinements to the intervention content and timing of delivery.

A further strength relates to the intervention being codesigned 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 posthospitalization PR, as poor patient knowledge and engagement have consistently been observed to be major barriers to uptake (15, 25, 26). Experience-based codesign, a quality improvement approach that enables staff and patients (or other service users) to codesign 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 (27, 28), including PR (29). The qualitative feedback was positive, with patients commenting that the video was well presented, a good length, and that the information provided was clear.

There were several limitations to the study. This was a 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, hospitalized patients into research studies, and therefore a potential limitation of the study is the generalizability of the trial population. We also observed that a proportion of participants did not attend the face-to-face visit at 3 months. However, data for the primary and main secondary outcome measures (PR uptake, referral, and completion) were available for all trial participants. Missing data for physical performance and health-related quality of life measures were also imputed. Owing to the number lost to follow-up, we were unable to systematically collect data on reasons for nonuptake 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 PR uptake in the video intervention group. First, the video was provided without additional counseling, as the intervention was designed to be low cost, easily implementable, and not burdensome on staff time. With hindsight, a greater focus on behavioral aspects, for example, with health coaching (30), may have enhanced the benefits of showing the video. Previous studies that have used device-based interventions with minimal counseling have also been unsuccessful in changing the behavior of patients with COPD (31). 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 PR, with a positive knockon 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 favorably with previous data from the same setting; Jones and colleagues observed PR referral and uptake rates of 31% and 24%, respectively, despite consistent delivery of a COPD discharge bundle (12). Third, the high PR 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 PR may have modified their behavior in response to being observed during the trial. Fourth, the barriers to posthospitalization PR uptake are complex (15, 32), 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 PR. Finally, the qualitative component of the study highlighted that a proportion of the intervention group (6 of 15 of those interviewed) had no recall of seeing the video at hospital discharge. A previous observational study showed that 57% of patients awaiting discharge after an exacerbation had cognitive impairment, with 20% considered to have pathologic impairment of processing speed (33). 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 (e.g., in the postdischarge 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 posthospitalization PR with the video intervention. However, given that 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 behavioral intervention designed to educate patients, staff, or carers.

Conclusions

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

Author disclosures are available with the text of this article at www.atsjournals.org.

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