

A digital, self-management behaviour change intervention for people with Chronic Obstructive Pulmonary Disease: Cohort study

Liam Knox, Rachel Rahman, Gareth Norris, Carol-Anne Davies, Kimberley Littlemore, Claire Hurlin, Sam Rice, Sarah Hicks, Keir Lewis

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Abstract

Background: People with Chronic Obstructive Pulmonary Disease (pwCOPD) experience a range of limitations, which have a significant effect on their health. Self-management and pulmonary rehabilitation (PR) are key treatments for pwCOPD, however, barriers often limit their uptake and adherence. To overcome these barriers, a digital self-management intervention called PocketMedic (PM) was developed and evaluated in pwCOPD alongside, and in addition, to PR.

Objective: To use a parallel-group design to investigate the effectiveness of PocketMedic at increasing self-management in comparison, and in addition, to standard PR

Methods: 53 participants were recruited to one of three groups: PM and PR, PM, or PR. Data was collected at baseline and 7 weeks (after the interventions had finished). Questionnaires on health-related quality of life, self-management knowledge, and disease knowledge were collected. MANOVAs and ANOVAs were used to analyse the data.

Results: The analyses found that the improvements from those receiving PM were not statistically significantly different to those receiving PR, indicating that PM may replicate the benefits underpinning self-management behaviours seen by those attending PR. However, there were no additional benefits when participants received PM and PR in combination.

Conclusions: PM may be a useful treatment to support COPD self-management, especially when barriers prevent pwCOPD receiving traditional services such as PR. The quantitative results suggest that PM may be less beneficial when delivered alongside PR. Feedback from participants indicated that they would prefer to receive PM whilst they were on the waiting-list for PR, to support them during this time and alleviate the apprehensions associated with attending PR. Implications, limitations, and suggestions for future research are discussed. Clinical Trial: Trial registry name: ClinicalTrials.gov

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Original Manuscript

A digital, self-management behaviour change intervention for people with Chronic Obstructive Pulmonary Disease: Cohort study

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Dr Liam Knox submitted this study in part fulfilment toward a Ph.D. in Health Psychology from Aberystwyth University, awarded in 2019. Dr Knox conducted this research whilst affiliated with Aberystwyth University and Hywel Dda University Health Board, however, is now solely affiliated with The University of Sheffield.

Keywords

Chronic Obstructive Pulmonary Disease, Self-management, Telehealth, PocketMedic, Pulmonary Rehabilitation.

Abstract

Introduction

People with Chronic Obstructive Pulmonary Disease (pwCOPD) experience a range of limitations, which have a significant effect on their health. Self-management and pulmonary rehabilitation (PR) are key treatments for pwCOPD, however, barriers often limit their uptake and adherence. To overcome these barriers, a digital self-management intervention called PocketMedic (PM) was developed and evaluated in pwCOPD alongside, and in addition, to PR.

Methods

53 participants were recruited to one of three groups: PM and PR, PM, or PR. Data was collected at baseline and 7 weeks (after the interventions had finished). Questionnaires on health-related quality of life, self-management knowledge, and disease knowledge were collected. MANOVAs and ANOVAs were used to analyse the data.

Results

The analyses found that the improvements from those receiving PM were not statistically significantly different to those receiving PR, indicating that PM may replicate the benefits underpinning self-management behaviours seen by those attending PR. However, there were no additional benefits when participants received PM and PR in combination.

Discussion

PM may be a useful treatment to support COPD self-management, especially when barriers prevent pwCOPD receiving traditional services such as PR. The quantitative results suggest that PM may be less beneficial when delivered alongside PR. Feedback from participants indicated that they would prefer to receive PM whilst they were on the waiting-list for PR, to support them during this time and alleviate the apprehensions associated with attending PR. Implications, limitations, and suggestions for future research are discussed.

Trial registration details

Trial registry name: ClinicalTrials.gov

URL: <https://clinicaltrials.gov/ct2/show/NCT03263754>

Registration number: NCT03263754

Introduction

People with Chronic Obstructive Pulmonary Disease (pwCOPD) experience a range of daily-living limitations that have a significant effect on health-related quality of life (HRQoL)¹. Regular symptoms include dyspnoea, sputum production and coughing², and anxiety and depression are also common³. Although pwCOPD are extensive healthcare users⁴, the majority of their time is spent outside of health services⁵. Therefore, knowing how to self-manage their condition is important for pwCOPD; thus, supporting regular self-management and increasing HRQoL have been identified as crucial objectives for healthcare providers⁶.

For pwCOPD, self-management behaviours include a range of activities such as regular exercise, taking medication, and attending healthcare appointments⁷; however, these behaviours are often neglected by pwCOPD^{1, 8, 9}. Self-management interventions combine educational components with

behaviour change techniques to engender long-term change¹⁰ and have been associated with multiple beneficial outcomes, such as increased HRQoL and cost-savings for health providers¹¹⁻¹⁴. Despite their effectiveness, these programmes are often time-intensive for both pwCOPD and healthcare staff^{12, 14-16}.

Outside of specialist programmes, self-management training is also a central component alongside structured, supervised exercise, within pulmonary rehabilitation (PR)^{17, 18}. PR is a multidisciplinary, group programme recognised as one of the most effective interventions available for pwCOPD^{2, 17, 18}. However, attendance and adherence to PR is historically low¹⁹⁻²¹, with a disruption to usual routine, distance to the course, and a lack of transportation being identified as common barriers²⁰. Additionally, access to PR is also a traditional problem, with some areas not able to provide the programme^{21, 22}.

To overcome the time-intensive and accessibility problems associated with current self-management and PR programmes, this study used a digital, film-based, self-management intervention called PocketMedic and a parallel-group design to investigate its effectiveness at increasing self-management in comparison, and in addition, to standard PR. This intervention is not intended to replace PR but is considered here as a potentially beneficial adjunct to the programme – providing materials that pwCOPD can use outside of PR – or an alternative when barriers restrict PR attendance. A diabetes version of PocketMedic has been utilised as an adjunct to healthcare previously, finding positive results²³. Two hypotheses were formed 1) pwCOPD receiving solely PocketMedic would have increases in self-management knowledge, disease knowledge, and HRQoL, comparable to those receiving solely PR; 2) pwCOPD receiving PocketMedic in addition to PR would have larger increases in self-management knowledge, disease knowledge, and HRQoL, compared to those receiving solely PR or solely PocketMedic.

Methodology

Study design

This study used a parallel-group, cohort design receiving a favourable ethical opinion from the NHS research ethics council Wales 7 (16/WA/0130). The project had three conditions: pwCOPD received both PocketMedic and PR (PM+PR), only PocketMedic (PM), or only PR (PR).

This study also measured the ability of PocketMedic and PR to increase self-determined, self-management motivation, alongside semi-structured interviews. These findings have been published separately²⁴; however, where qualitative feedback regarding PocketMedic was provided, this will be used to support the interpretation of the current study's findings within the discussion.

Participants

Participants were recruited from Hywel Dda University Health Board (HDUHB), Wales; a semi-rural health region serving three counties, Carmarthenshire, Ceredigion, and Pembrokeshire. All participants provided written informed consent. Consenting participants from Carmarthenshire who were due to attend PR were allocated to PM+PR or PR in cohorts. Consenting participants from Ceredigion were allocated to PM (because PR was not available in this county at the time of this study). No one was recruited from Pembrokeshire.

Participants had to be eligible to attend PR, even if they did not receive this as part of their intervention. To attend PR for COPD within HDUHB, everyone must conform to the GOLD definition of COPD²; ≥ 40 years old, 10 pack-years smoking history, and spirometry less than 80% predicted.

Of the 55 pwCOPD who consented, two withdrew from the study due to mental health reasons. Table 1 displays the demographics for the remaining 53 participants in the clinical trial. Figure 1 shows how participants moved through the study.

PM+PR	PM	PR
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	(n = 28)	(n = 7)	(n = 18)
Age	66.0 (5.54)	68.1 (10.9)	65.3 (7.10)
Gender, n			
<i>Male</i>	15	6	11
<i>Female</i>	13	1	7
Smoking Status, n			
<i>Current smoker</i>	3	2	1
<i>Non-smoker</i>	3	0	0
<i>Ex-smoker</i>	15	5	14
<i>Missing</i>	7	0	3
Amount smoked per day (cigarettes)	20.3 (18.2)	26.4 (17.0)	25.4 (10.2)

Table 1: Participant demographics for each of the three research conditions.

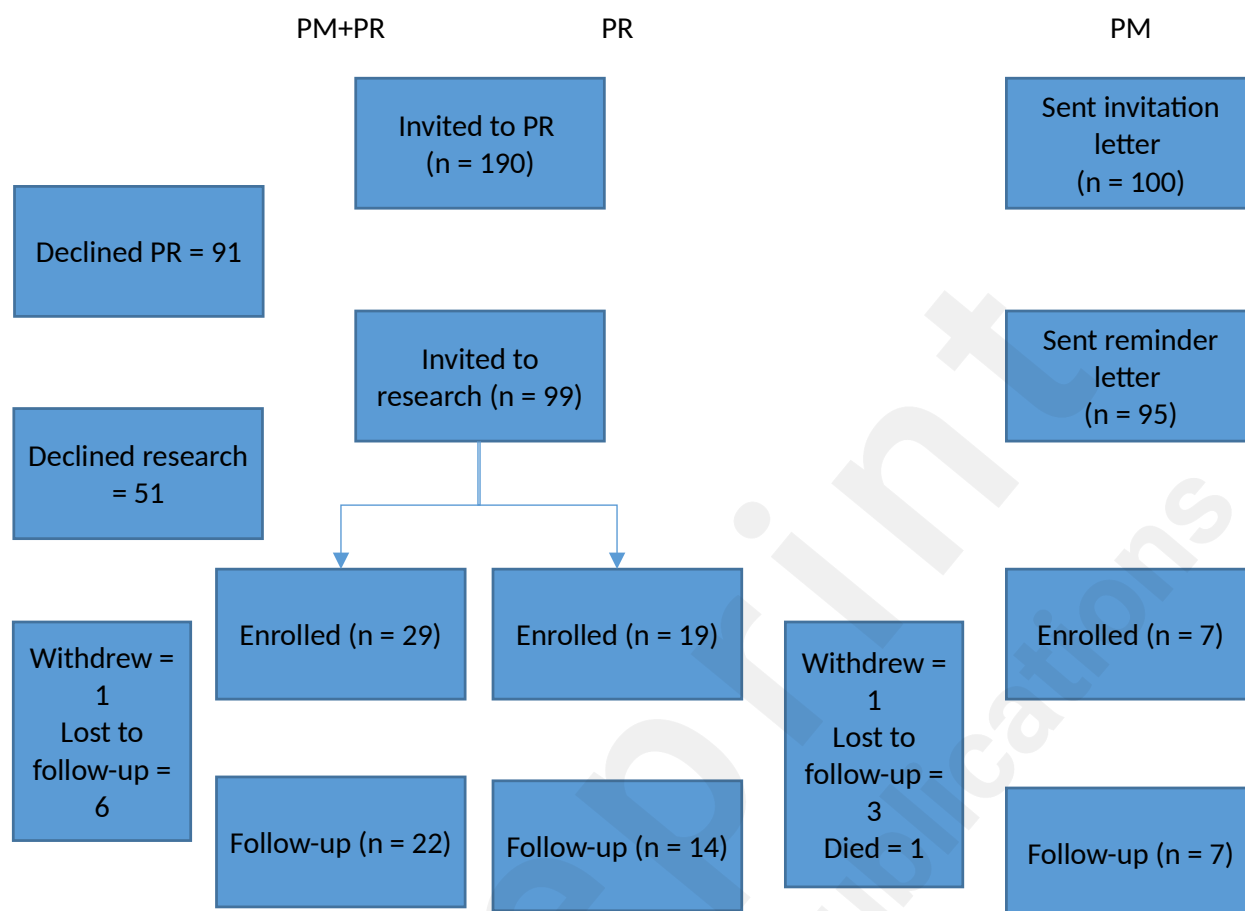


Figure 1: Number of participants at each stage of the study.

PocketMedic

PocketMedic is a digital, film-based intervention designed with the intention to increase health outcomes in pwCOPD by improving self-management motivation and knowledge. This is accomplished by delivering educational components and utilising the principles of self-determination theory (SDT)^{25, 26} to better support people to engage with their self-management. Specifically, techniques within the films were designed with the intention to increase the satisfaction of the three basic psychological needs (autonomy, competence, and relatedness), through providing participants with meaningful rationales and choice, addressing obstacles for change, and identifying available support. A recent study has provided support for the use of SDT to predict outcomes in pwCOPD²⁷. Ten digital films, lasting approximately five minutes each, could be watched by participants online using a smart phone, tablet, or computer, at a time and place that suited them. The films showed a mix of healthcare professionals and pwCOPD discussing the illness and providing information on how to self-manage effectively. PocketMedic covers a range of topics including breathlessness, physical activity, and wellbeing. The films were available to participants for 7 weeks and could be re-watched at any time if desired. Supplementary file one provides a title and brief description of each of the films used in this study.

Pulmonary rehabilitation

Knox et al.²⁸ describes in detail how HDUHB delivers PR, which is in line with best practice and

current guidelines¹⁷. Briefly, approximately 7-10 participants (per cohort) attended twice-weekly sessions for 7 weeks. An experienced occupational therapist, physiotherapist, and assistant exercise instructor delivered the course, which consisted of structured exercise for 1-1.5 hours, followed by a 20-40 minute educational talk, which included topics such as smoking cessation, mental health, and dietary education.

Data collection

Participants completed questionnaires at baseline and at 7 weeks (after the intervention(s) had finished). Questionnaires measured HRQoL, as assessed by the COPD Assessment Test (CAT)²⁹, self-management knowledge, as assessed by the Understanding COPD questionnaire (UCOPD)³⁰, and disease knowledge, as assessed by the Bristol COPD Knowledge Questionnaire (BCKQ)³¹. The CAT is negatively scored, with higher scores indicating a worse HRQoL. The UCOPD and BCKQ are positively scored.

Adherence was operationalised as the number of PocketMedic films watched or PR sessions attended by participants. A maximum of ten films could be viewed and 14 sessions attended.

Analysis

All quantitative data were analysed using SPSS. ANOVAs and Chi-square tests were used to identify any possible baseline differences between the three research conditions. A MANOVA was conducted to test the hypotheses using the test statistic that maximised statistical power, due to the relatively small sample size. In case of a significant MANOVA, separate ANOVAs for each dependent variable were implemented. Pairwise t-tests, using the Sidak or Games-Howell correction, were used for post-hoc analyses. All tests used an alpha-level of .05.

Approximately half of participants allocated to receive PocketMedic did not watch any of the digital health films, and therefore sub-group analyses were also conducted focusing solely on those who engaged with the intervention to remove any concealing effects non-engaging participants may have had on the results. Similar techniques have been used in previous self-management intervention evaluations³². The sub-group analyses results are presented in their own section below to avoid confusion.

Results

One-way ANOVAs and Chi-square tests were conducted on participant demographics and baseline variables to identify any differences between participants in the three research conditions (see tables 1 and 2).

Measure	PM+PR (n = 28)	PM (n = 7)	PR (n = 18)
HRQoL	27.7 (6.21)	28.6 (3.60)	27.1 (5.15)
Self-management knowledge			
<i>About COPD</i>	69.6 (14.8)	59.0 (24.1)	66.1 (14.3)
<i>Managing symptoms of COPD</i>	63.1 (14.2)	53.5 (21.7)	53.7 (22.0)
<i>Accessing help and support</i>	43.2 (18.5)	38.2 (20.8)	44.4 (18.9)
<i>Total</i>	61.2 (10.3)	52.2 (17.0)	56.5 (15.2)
Disease knowledge	47.9 (14.9)	35.7 (8.50) * ¹	50.3 (9.59) * ¹

Table 2: Baseline descriptive statistics for each of the three research conditions. *¹ denote statistically significant differences at $p=.039$ described below.

Only the variable disease knowledge showed a significant difference between groups at baseline ($F(2, 38) = 3.53$, $p = .040$). Post-hoc, pairwise t-tests were implemented using the Games-Howell correction, finding statistically significant differences between participants receiving PM compared to those receiving PR group ($MD = -14.5$, 95% CI $[-.51, 28.6]$, $p = .040$). This indicates that on

average those receiving solely PM had lower disease knowledge at baseline.

Table 3 displays average PocketMedic and/or PR adherence for each of the three research conditions. Due to only 51.4% of participants receiving PM+PR or PM watching one or more of the digital health films, average PocketMedic adherence having excluded non-engagers was also calculated.

	PM+PR (n = 28)	PM (n = 7)	PR (n = 18)
PocketMedic adherence	2.93 (4.06)	7.0 (4.12)	-
PocketMedic adherence (only engagers)	n = 12, 6.83 (3.35)	n = 6, 8.17 (2.99)	-
PR adherence	10.33 (4.76)	-	9 (4.40)

Table 3: Intervention adherence data for each of the three research conditions. Participants could watch a maximum of 10 PocketMedic films and attend 14 PR sessions (dependent on their research condition).

To investigate whether access to PocketMedic was associated with increases in self-management knowledge, disease knowledge, and HRQoL, a repeated measures MANOVA was conducted. Using Pillai's trace, there was no significant interaction effects between the three research conditions in any of the variables between baseline and follow-up ($V = 0.77$, $F(14, 42) = 1.89$, $p = .056$). However, when the research condition was held constant, there was a significant effect for the within group variable of time ($V = 0.81$, $F(7, 20) = 12.1$, $p < .001$). Bartlett's test of sphericity was significant ($\chi^2 = 388$, $df = 27$, $p < .001$) and therefore the following ANOVAs used the Greenhouse-Geisser correction. The univariate tests found significant effects of time (baseline/post) for all the included variables: HRQoL ($F(1, 26) = 20.1$, $p < .001$), UCOPD: About COPD ($F(1, 26) = 18.2$, $p < .001$), UCOPD: Managing symptoms of COPD ($F(1, 26) = 10.3$, $p = .004$), UCOPD: Accessing help and support ($F(1, 26) = 21.6$, $p < .001$), UCOPD: total ($F(1, 26) = 28.0$, $p < .001$), and Disease knowledge ($F(1, 26) = 58.9$, $p < .001$). All average scores at follow-up indicated more beneficial health states compared to those at baseline (see Table 4).

Unexpectedly, despite the original MANOVA indicating that there were no significant differences between the conditions, the follow-up ANOVAs showed a significant interaction effect between the conditions and time-points for the variable of disease knowledge ($F(2, 26) = 0.14$, $p = .003$). However, pairwise, post-hoc t-tests using the Sidak correction found no significant differences between the research conditions (PM + PR vs. PM: MD = -0.88, 95% CI [-17.2, 15.4], $p = .999$; PM + PR vs. PR: MD = -2.63, 95% CI [-15.6, 10.3], $p = .940$; PM vs. PR: MD = -1.75, 95% CI [-18.9, 15.4], $p = .992$).

Measure	PM+PR		PM		PR	
	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up
HRQoL	27.7 (6.43)	23.6 (4.99)	28.2 (4.32)	21.4 (3.91)	26.2 (5.57)	24.7 (6.75)
Self-management knowledge						
About COPD	66.8 (13.9)	76.5 (14.6)	65.1 (23.9)	72.9 (21.4)	65.3 (13.6)	68.6 (7.77)
Managing symptoms of COPD	60.3 (15.2)	66.5 (24.6)	47.4 (23.4)	66.7 (23.6)	54.4 (12.59)	62.5 (13.2)
Accessing help and support	49.5 (16.4)	56.7 (21.9)	34.0 (23.9)	62.5 (20.4)	41.8 (14.0)	59.8 (9.89)
Total	60.4 (11.3)	68.1 (17.1)	51.3 (20.2)	68.5 (21.3)	55.8 (6.93)	64.3 (7.53)

Disease knowledge	46.8	60.8	38.4	70.9	52.2	60.6
	(15.2)	(19.0)	(8.74)	(6.22)	(8.68)	(9.04)

Table 4: Baseline and follow-up descriptive statistics for all research measures for each of the three conditions.

Sub-group analysis

The sub-group analysis excluding participants who did not watch any of the PocketMedic digital health films was repeated using the same MANOVA and ANOVAs described above.

Using Roy's largest root, significant main effects were found for both time ($\theta = 9.50$, $F(7, 12) = 16.3$, $p < .001$) and research condition ($\theta = 1.79$, $F(7, 13) = 3.33$, $p = .029$). Bartlett's test of sphericity was again significant ($\chi^2 = 257$, $df = 27$, $p < .001$); therefore, the following ANOVAs used the Greenhouse-Geisser correction. Univariate analyses found significant differences between the two time-points for all the included variables: *HRQoL* ($F(1, 18) = 21.5$, $p < .001$), *UCOPD: About COPD* ($F(1, 18) = 14.8$, $p < .001$), *UCOPD: Managing symptoms of COPD* ($F(1, 18) = 37.0$, $p < .001$), *UCOPD: Accessing help and support* ($F(1, 18) = 46.8$, $p < .001$), *UCOPD: total* ($F(1, 18) = 71.2$, $p < .001$), and *Disease knowledge* ($F(1, 18) = 44.7$, $p < .001$). All average scores at follow-up indicated more beneficial health states compared to those at baseline. Disease knowledge was the only variable to show a significant interaction effect between the three conditions and two time-points ($F(2, 18) = 6.02$, $p = .010$); with HRQoL and self-management knowledge total outside the required level of significance ($F(2, 18) = 3.31$, $p = .060$ and $F(2, 18) = 3.37$, $p = .057$, respectively). However, post-hoc, pairwise t-tests conducted on the variable of disease knowledge using the Sidak correction again found no significant differences between the three research conditions (PM + PR vs. PM: MD = 2.60, 95% CI [-17.7, 22.9], $p = .982$; PM + PR vs. PR: MD = 0.85, 95% CI [-16.4, 18.1], $p = .999$; PM vs. PR: MD = -1.75, 95% CI [-20.1, 16.6], $p = .993$).

Discussion

This study aimed to investigate whether a digital, film-based, self-management intervention could improve self-management knowledge, disease-knowledge, and HRQoL in pwCOPD, by comparing it to, and alongside, a well-established PR programme. The quantitative analyses indicated that the improvements from those receiving PM were not significantly different to those receiving PR, resulting in the first hypothesis being accepted. This indicates that PocketMedic may replicate some of the benefits underpinning self-management behaviours seen by those attending PR. However, there were no additional benefits when participants received PM+PR, resulting in the second hypothesis being rejected.

The lack of statistically significant differences between those receiving solely PocketMedic and those receiving solely PR does support the potential to deliver PocketMedic independently. Travel and transport, in addition to a disruption to usual routine, have been highlighted as barriers to PR adherence²⁰. Participant feedback indicated that a particular strength of the intervention was the ability to watch the health films whenever and wherever the participant wished, in addition to being able to re-watch them if something was missed. The film format was also considered engaging and could provide information in a clearer manner compared to written leaflets. Therefore, the ability of a technology-delivered intervention to deliver significant benefits to self-management knowledge and understanding, potentially on par with PR, which can overcome these barriers, could prove beneficial³³. This is supported by one of the key principles of the 'A Healthier Wales' healthcare policy being a reduction in geographical heterogeneity in the services provided³⁴. Due to rurality and low staffing preventing PR being delivered fully across HDUHB, PocketMedic may be a viable, effective, and suitable alternative, whilst recognising the additional benefits that PR may offer through the structured, supervised exercise component.

There were some conflicting statistics associated with the variable of disease knowledge, with an original MANOVA in addition to post-hoc t-tests indicating no statistically significant differences

between groups and an ANOVA reporting the reverse. Subsequently, the sub-group MANOVA and ANOVA found significant differences between the groups for disease knowledge, which was not replicated by the post-hoc t-tests. However, the analysis of baseline variables did indicate a significant difference between the groups for disease knowledge; where, participants receiving PM had considerably lower levels of knowledge compared to the other two conditions. Therefore, it is possible that the contradictory statistics could be because of this baseline difference. Alternatively, the low sample size may have had an effect on the conflicting statistics; therefore, future research should replicate this study with a larger sample.

The results of this study indicate that both PocketMedic and PR were effective at increasing self-management knowledge, disease knowledge, and HRQoL; corroborating previous literature regarding self-management interventions and PR^{14, 18, 31, 35}. However, the analyses showed that PM+PR did not result in a cumulative effect on the outcome measures. Although one possible interpretation is that there is a maximum level these variables can be improved in a 7-week period, collected feedback suggested that PocketMedic did not provide participants with anything additional to the PR learning, and as a result, some participants stopped watching the health films altogether. Therefore, this feedback supports the interpretation that delivering PocketMedic alongside PR is not an effective way to distribute the health films. Several participants suggested that the interventions should be delivered independent of one another, with the consensus being that receiving PocketMedic before PR would be most beneficial. If delivered to people on a PR waiting list, this would enable pwCOPD to receive self-management support at a time where they have limited treatment options, alongside alleviating some of their concerns regarding the exercise components of PR. Fears of increased dyspnoea due to exercise have been reported as a barrier to PR previously³⁶, therefore, an intervention to reduce these fears may increase attendance. Additionally, the UK PR audit found that 31% of those invited to PR failed to attend the initial assessment^{21, 37}, representing the highest dropout throughout the entire programme. Therefore, prescribing an intervention before PR could decrease this non-uptake and result in positive benefits for pwCOPD and healthcare services.

Figure one shows the number of participants throughout the project and illustrates the lack of response from those invited to PR. Although a 31% non-uptake rate has been reported previously³⁷, this study found that 48% of pwCOPD invited to PR did not attend the initial assessment. HDUHB serves a wide, rural geographical area, with only one out of its three counties regularly delivering PR. Therefore, given that travel and transport are both negative predictors of PR attendance and adherence²⁰, this could explain the heightened non-attendance rate. The acceptance rate for the research was also relatively low. Overall, 28% of those invited consented to the study; however, there was only a 4% response rate for the PM condition, which used a postal consent process. This is significantly worse than the average of 20% reported widely in other studies using similar methods³⁸. Although several strategies were implemented to increase the acceptance rate across the three research conditions, such as a six-month extension, the sample size remains a limitation of this project and therefore the authors do suggest care in interpreting these results. However, one of the justifications for conducting this research in pwCOPD is that self-management motivation in this condition is poor, evidenced by low adherence to treatment^{39, 40}. Therefore, although unfortunate, it is not surprising that there were recruitment issues within this study, because such issues are also evident throughout other areas of care for pwCOPD⁴¹.

This poor uptake was also found towards PocketMedic, with only 51.4% of all participants who received the intervention watching any of the health films. However, when looking at each group individually, participants receiving PM+PR had an uptake rate of 42.9%, compared to 85.7% for those receiving PM. Additionally, on average, people receiving PM watched 80% of the films, which is a higher adherence rate compared to the PR adherence for people receiving PM+PR (71%) and those receiving PR (64%). Therefore, participants who had access to another intervention (i.e. PR) were less likely to engage with PocketMedic, whereas those who only received the health films had a

high uptake and adherence rate. Thus, if PocketMedic is delivered independent of PR, the uptake and adherence may meet standard published thresholds of acceptability⁴².

Conclusion

In conclusion, this study provides novel contributions relevant to the care of pwCOPD, such as the finding that although the interventions were effective separately, there were no cumulative benefits when the interventions were prescribed together. The lack of differences between the research groups does support the independent prescription of a technology-delivered, SDT-based, COPD self-management intervention, especially where environments prevent traditional programmes from functioning fully. Participant feedback did support that prescribing PocketMedic to pwCOPD before PR would be most beneficial. To the author's knowledge, no previous study has evaluated an intervention that combines self-management, digital delivery, SDT, and pwCOPD. Future research should investigate the safety and effectiveness of such an intervention within a larger sample size; however, this study does provide a proof of concept for increasing self-management knowledge, disease knowledge, and HRQoL in pwCOPD through PocketMedic.

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Declaration of interest

KL is one of the founders of PocketMedic, however, was not involved in the collection or analysis of data. All other authors declare that they have no conflicts of interest.

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Data availability statement

Due to not having ethical permission, we unfortunately are unable to supply the data for this study. However, the authors welcome all questions regarding the study and will provide as much information as is ethically permissible.

References

1. Russell S, Ogunbayo O, Newham J, et al. Qualitative systematic review of barriers and facilitators to self-management of chronic obstructive pulmonary disease: Views of patients and healthcare professionals. *NPJ Prim Care Resp Med* 2018; 28. DOI: 10.1038/s41533-017-0069-z.
2. Singh D, Agusti A, Anzueto A, et al. Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Lung Disease: the GOLD science committee report 2019. *Eur Respir J* 2019; 53 2019/03/09. DOI: 10.1183/13993003.00164-2019.
3. Phan T, Carter O, Waterer G, et al. Determinants for concomitant anxiety and depression in people living with chronic obstructive pulmonary disease. *J Psychosom Res* 2019; 120: 60-65. DOI: <https://doi.org/10.1016/j.jpsychores.2019.03.004>.
4. Dhamane AD, Moretz C, Zhou Y, et al. COPD exacerbation frequency and its association with

health care resource utilization and costs. *Int J Chron Obstruct Pulmon Dis* 2015; 10: 2609-2618. 2015/12/15. DOI: 10.2147/copd.S90148.

5. National Health Service England. Five Year Forward View. 2014.

6. Kielmann T, Huby G, Powell A, et al. From support to boundary: a qualitative study of the border between self-care and professional care. *Patient Educ Couns* 2010; 79: 55-61. 2009/08/28. DOI: 10.1016/j.pec.2009.07.015.

7. National Institute for Health and Care Excellence. Chronic obstructive pulmonary disease in over 16s: diagnosis and management. 2018.

8. Kantorowski A, Wan ES, Homsy D, et al. Determinants and outcomes of change in physical activity in COPD. *ERJ Open Research* 2018; 4: 00054-02018. DOI: 10.1183/23120541.00054-2018.

9. Korpershoek Y, Bos-Touwen ID, de Man-van Ginkel JM, et al. Determinants of activation for self-management in patients with COPD. *Int J Chron Obstruct Pulmon Dis* 2016; 11: 1757-1766. DOI: 10.2147/COPD.S109016.

10. Effing TW, Vercoulen JH, Bourbeau J, et al. Definition of a COPD self-management intervention: International Expert Group consensus. *Eur Respir J* 2016; 48: 46-54. 2016/04/15. DOI: 10.1183/13993003.00025-2016.

11. Benzo RP, Abascal-Bolado B and Dulohery MM. Self-management and quality of life in chronic obstructive pulmonary disease (COPD): The mediating effects of positive affect. *Patient Educ Couns* 2016; 99: 617-623. 2015/12/04. DOI: 10.1016/j.pec.2015.10.031.

12. Turner A, Anderson J, Wallace L, et al. Evaluation of a self-management programme for patients with chronic obstructive pulmonary disease. *Chron Respir Dis* 2014; 11: 163-172. 2014/07/02. DOI: 10.1177/1479972314539979.

13. Khmour MR, Agus AM, Kidney JC, et al. Cost-utility analysis of a pharmacy-led self-management programme for patients with COPD. *Int J Clin Pharm* 2011; 33: 665-673. DOI: 10.1007/s11096-011-9524-z.

14. Zwerink M, Brusse-Keizer M, van der Valk PD, et al. Self management for patients with chronic obstructive pulmonary disease. *Cochrane Database Syst Rev* 2014: Cd002990. 2014/03/26. DOI: 10.1002/14651858.CD002990.pub3.

15. Baker E and Fatoye F. Patient perceived impact of nurse-led self-management interventions for COPD: A systematic review of qualitative research. *International Journal of Nursing Studies* 2019; 91: 22-34. DOI: <https://doi.org/10.1016/j.ijnurstu.2018.12.004>.

16. Richardson J, Loyola-Sanchez A, Sinclair S, et al. Self-management interventions for chronic disease: a systematic scoping review. *Clin Rehabil* 2014; 28: 1067-1077. 2014/05/03. DOI: 10.1177/0269215514532478.

17. Bolton CE, Bevan-Smith EF, Blakey JD, et al. British Thoracic Society guideline on pulmonary rehabilitation in adults: accredited by NICE. *Thorax* 2013; 68: ii1. DOI: 10.1136/thoraxjnl-2013-203808.

18. McCarthy B, Casey D, Devane D, et al. Pulmonary rehabilitation for chronic obstructive pulmonary disease. *Cochrane Database Syst Rev* 2015: Cd003793. 2015/02/24. DOI: 10.1002/14651858.CD003793.pub3.

19. Jongepier L and Barlow R. Pulmonary rehabilitation (PR) capacity, uptake and completion rate in the East of England. *European Respiratory Journal* 2016; 48: PA3584. DOI: 10.1183/13993003.congress-2016.PA3584.

20. Keating A, Lee A and Holland AE. What prevents people with chronic obstructive pulmonary disease from attending pulmonary rehabilitation? A systematic review. *Chron Respir Dis* 2011; 8: 89-99. 2011/05/21. DOI: 10.1177/1479972310393756.

21. Steiner M, Holzhauer-Barrie J, Lowe D, et al. Pulmonary rehabilitation: steps to breathe

better. National chronic obstructive pulmonary disease (COPD) audit programme: clinical audit of pulmonary rehabilitation services in England and Wales 2015. *National clinical audit report* 2016.

22. Yohannes AM and Connolly MJ. Pulmonary rehabilitation programmes in the UK: a national representative survey. *Clin Rehabil* 2004; 18: 444-449. 2004/06/08. DOI: 10.1191/0269215504cr736oa.

23. Rice S, Cranch H, Littlemore K, et al. A pilot service-evaluation examining change in HbA1c related to the prescription of internet-based education films for type 2 diabetes. *Primary Care Diabetes* 2017; 11. DOI: 10.1016/j.pcd.2017.02.002.

24. Knox L, Rahman R, Norris G, et al. Understanding the Impact of COPD and Self-Management Interventions: A Self-Determination Theory Perspective. *Psychology, Health & Medicine* 2025; In print.

25. Deci EL and Ryan RM. *Intrinsic Motivation and Self-Determination in Human Behavior*. 1985.

26. Deci EL and Ryan RM. Motivation, personality, and development within embedded social contexts: An overview of self-determination theory. *The Oxford handbook of human motivation*. Oxford University Press, 2012, p. 85-107.

27. Knox L, Norris G, Lewis K, et al. Using self-determination theory to predict self-management and HRQoL in moderate-to-severe COPD. *Health Psychology and Behavioral Medicine* 2021; 9: 527-546. DOI: 10.1080/21642850.2021.1938073.

28. Knox L, Dunning M, Davies C-A, et al. Safety, feasibility, and effectiveness of virtual pulmonary rehabilitation in the real world. *Int J Chron Obstruct Pulmon Dis* 2019; 14: 775-780. DOI: 10.2147/COPD.S193827.

29. Jones PW, Harding G, Berry P, et al. Development and first validation of the COPD Assessment Test. *Eur Respir J* 2009; 34: 648-654. 2009/09/02. DOI: 10.1183/09031936.00102509.

30. O'Neill B, Cosgrove D, MacMahon J, et al. Assessing education in pulmonary rehabilitation: the Understanding COPD (UCOPD) questionnaire. *Copd* 2012; 9: 166-174. 2012/03/14. DOI: 10.3109/15412555.2011.644601.

31. White R, Walker P, Roberts S, et al. Bristol COPD Knowledge Questionnaire (BCKQ): testing what we teach patients about COPD. *Chronic respiratory disease* 2006; 3: 123-131.

32. Bucknall C, Miller G, Lloyd S, et al. Glasgow supported self-management trial (GSuST) for patients with moderate to severe COPD: randomised controlled trial. *Bmj* 2012; 344.

33. Wootton R. Twenty years of telemedicine in chronic disease management – an evidence synthesis. *Journal of Telemedicine and Telecare* 2012; 18: 211-220. DOI: 10.1258/jtt.2012.120219.

34. Welsh Government. *A healthier Wales: long term plan for health and social care*. 2018.

35. Bringsvor HB, Langeland E, Oftedal BF, et al. Effects of a COPD self-management support intervention: a randomized controlled trial. *Int J Chron Obstruct Pulmon Dis* 2018; 13: 3677-3688. DOI: 10.2147/COPD.S181005.

36. Harris D, Hayter M and Allender S. Improving the uptake of pulmonary rehabilitation in patients with COPD: qualitative study of experiences and attitudes. *Br J Gen Pract* 2008; 58: 703-710. 2008/10/02. DOI: 10.3399/bjgp08X342363.

37. Steiner M, Holzhauer-Barrie J, Lowe D, et al. Pulmonary Rehabilitation: Time to breathe better. *National Chronic Obstructive Pulmonary Disease (COPD) audit programme: resources and organisation of pulmonary rehabilitation services in England and Wales* 2015.

38. Roberts PJ, Roberts C, Sibbald B, et al. Increasing response rates to postal questionnaires. Effect of incentives on response rates must be considered. *Bmj* 2002; 325: 444. 2002/08/31.

39. Bourbeau J and Bartlett SJ. Patient adherence in COPD. *Thorax* 2008; 63: 831-838. DOI: 10.1136/thx.2007.086041.

40. Sheldon KM, Williams G and Joiner T. Self-determination theory in the clinic: Motivating

physical and mental health. *Self-determination theory in the clinic: Motivating physical and mental health*. New Haven, CT, US: Yale University Press, 2003, p. viii, 208-viii, 208.

41. Restrepo RD, Alvarez MT, Wittnebel LD, et al. Medication adherence issues in patients treated for COPD. *Int J Chron Obstruct Pulmon Dis* 2008; 3: 371-384. 2008/11/11. DOI: 10.2147/copd.s3036.

42. Charlesworth G, Burnell K, Hoe J, et al. Acceptance checklist for clinical effectiveness pilot trials: a systematic approach. *BMC Medical Research Methodology* 2013; 13: 78. DOI: 10.1186/1471-2288-13-78.



Supplementary file one

Film title	Description
Introducing COPD	GP Dr Jane Gilbert explains COPD with the help of a sponge! Significant health improvements can be gained by making lifestyle changes, taking medication, and performing self-management.
Managing things yourself	Lawrence and Sandra share their experiences of living with COPD. Lawrence demonstrates some breathing exercises and shares practical advice.
Don't talk to me about fitness	On the sofa, walking down the garden, or out with the dog – there are lots of ways to start exercising. Derrick and Alwyn know what it's like to feel breathless and share their experiences, but the bottom line is that anything you can do will help.
Understanding breathlessness	“Breathlessness is the number one complaint and fear of those with COPD”. Dr Jane Gilbert acknowledges the anxiety among people with COPD. Susie remembers how she used to panic when she felt breathless but is pleased to report that she can now control it herself.
Welcome to pulmonary rehabilitation	A gentle introduction to a PR course and why it is so important.
Coping with COPD	“Half of the battle is your mental attitude”. People living with COPD share their strategies for coping with the ups and downs of daily life, from getting out in the car, to seeing friends, and surfing the internet.
Sleep	Alwyn, Susie, Derrick, and Lawrence talk about their experiences of sleeping and what works for them.
The proof is in the pudding	People with COPD and their families describe how a PR course has changed their lives.
COPD and medication	A whole armoury of medication is available to those affected by COPD. Dr Jane Gilbert talks about what is on offer and people living with COPD share their experiences.
Pace yourself	It can be hard to adjust to a new pace of life. Susie found that a PR course really made a difference to her everyday life.

Supplementary Files

Untitled.

URL: <http://asset.jmir.pub/assets/69e346af780feede9e2b646dbda32309.pptx>

Multimedia Appendixes

PocketMedic film titles.

URL: <http://asset.jmir.pub/assets/d3312aa7db9fc44a629bac1b4466bbbd.docx>