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Digital interventions for the management of chronic obstructive pulmonary disease (Protocol)

Janjua S, Threapleton CJD, Prigmore S, Disler RT

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Digital interventions for the management of chronic obstructive pulmonary disease.
Cochrane Database of Systematic Reviews 2019, Issue 1. Art. No.: CD013246.
DOI: 10.1002/14651858.CD013246.

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[Intervention Protocol]

Digital interventions for the management of chronic obstructive pulmonary disease

Sadia Janjua[1], Christopher JD Threapleton[2], Samantha Prigmore[3], Rebecca T Disler[4]

[1]Cochrane Airways, Population Health Research Institute, St George's, University of London, London, UK. [2]Clinical Pharmacology, St George's, University of London, London, UK. [3]Respiratory Medicine, St George's University Hospitals NHS Foundation Trust, London, UK. [4]Department of Rural Health, Faculty of Medicine, Dentistry and Health Sciences, The University of Melbourne, Melbourne, Australia

Contact address: Sadia Janjua, Cochrane Airways, Population Health Research Institute, St George's, University of London, London, SW17 0RE, UK. sjanjua@sgul.ac.uk.

Editorial group: Cochrane Airways Group.
Publication status and date: New, published in Issue 1, 2019.

Citation: Janjua S, Threapleton CJD, Prigmore S, Disler RT. Digital interventions for the management of chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews* 2019, Issue 1. Art. No.: CD013246. DOI: 10.1002/14651858.CD013246.

ABSTRACT

This is a protocol for a Cochrane Review (Intervention). The objectives are as follows:

We will assess the benefits and harms of digital interventions for the management of chronic obstructive pulmonary disease. As a second objective, we will use the Behaviour Change Technique taxonomy to describe and explore intervention content.

BACKGROUND

Description of the condition

Chronic obstructive pulmonary disease (COPD) is a progressive, chronic lung disease that is preventable and treatable. It is characterised by persistent respiratory symptoms and limited airflow due to airway or alveolar abnormalities (or both) resulting from significant exposure to noxious particles or gases; causes include tobacco smoking, and environmental factors such as exposure to biomass fuel and air pollution (World Health Organization 2018; COPD Foundation 2018).

Diagnosis of COPD is considered when an individual has symptoms including dyspnoea, cough or sputum production (or both), and is confirmed by means of spirometry demonstrating persistent airflow limitation, i.e. presence of post-bronchodilator forced expiratory volume in the first second (FEV1)/forced vital capacity (FVC) of less than 70% (GOLD 2018).

Despite optimisation of treatments, some patients with COPD continue to experience debilitating symptoms that impact functional status and quality of life. Disease severity is associated with frequency of exacerbations and the presence of other coexisting conditions, such as cardiovascular disease, musculoskeletal impairment, or diabetes (Vestbo 2013).

Non-communicable or chronic diseases have been shown to contribute to more than half of deaths globally (Benziger 2016). The World Health Organization had predicted that COPD would be amongst the top causes of death by 2030; the recent Global Burden of Disease (GBD) study showed that COPD caused three million deaths in 2016 (with a prevalence of 251 million cases of COPD globally), which already makes it the third leading cause of death (World Health Organization 2018). Although most in-

formation about COPD deaths comes from high-income countries, it is known that 90% of deaths from COPD occur in low- to middle-income countries (World Health Organization 2018). COPD represents 2.6% of the entire global burden of disease (Global Burden of Disease 2015), but it is still a growing global epidemic as the condition is under-recognised, under-diagnosed, and under-treated (Quaderi 2018)

The burden of COPD on individuals is high, particularly in low- to middle-income countries due to poverty and greater exposure to smoking and environmental factors, including outside and household air pollution (Quaderi 2018). It is expected that this burden will increase in the coming decades due to continued exposure to risk factors, population growth, and ageing (López-Campos 2016).

There is an increasing burden of disease not only on individuals and their carers, but also an economic burden on healthcare systems; this is affected by factors such as severity of COPD symptoms (e.g. frequent exacerbations leading to hospitalisation) and the presence of other morbidities (e.g. cardiovascular disease), which occur in 30% to 57% of people with COPD (Udsen 2017).

Six per cent of the total healthcare budget in the European Union is spent on COPD, and the condition accounts for more than half the cost of treating respiratory diseases (Forum of International Respiratory Societies 2017). There is a direct correlation between severity of COPD, the number of coexisting conditions, and increasing cost of care (GOLD 2018). More efficient care interventions are required that will help to improve outcomes for people with COPD and reduce the economic burden on healthcare systems.

Description of the intervention

Management of symptoms can be difficult for patients who have more severe COPD and multi-morbidity. Comorbidities, such as cardiovascular disease, depression, anxiety and pain, can limit day-to-day activities and mask symptoms of deterioration (Barnett 2012). Patients may also find it difficult to distinguish between exacerbations and a "bad day" or generally "feeling unwell", which can limit the effectiveness of, for example, self-management interventions (Bucknall 2012). Digital technology can help to improve care for people with long-term conditions such as COPD by providing health information that is easily accessible, and may help with management and delivery of healthcare services (Mosa 2012).

Digital technology (digital health or 'e-health') encompasses a broad variety of technologies and tactics to deliver virtual medical, health, and educational services. Rather than being a specific intervention, this approach provides a means of enhancing care delivery and education (Centre for Connected Health Policy 2018; Velardo 2017). Digital technology can be divided into four distinct domains:

1. live video-conferencing (synchronous): a two-way interaction between a person and provider using telecommunication technology;
2. store-and-forward (asynchronous) transmission of patient data through an electronic communication system (e.g. email or electronic medical record);
3. remote patient monitoring (RPM): the collection of personal health data in one location, transmitted through electronic communication technologies to a provider in a different location;
4. mobile health (m-Health), which includes the use of mobile communication devices (e.g. smart phones and tablet computers) to deliver targeted messages and education such as health alerts, healthy behaviour and behaviour change messaging through general packet radio service (GPRS), third and fourth generation mobile communications (3G and 4G systems), global positioning systems (GPS) and Bluetooth technology (World Health Organization 2011).

How the intervention might work

Due to the heterogeneous nature of disease progression, fluctuation of symptoms and high symptom burden, COPD can have a substantial impact on patients' wellbeing and functional status (Agusti 2010; Donaldson 2005; Kessler 2011). In addition, hospital admissions and readmissions pose significant burden on healthcare services, and as populations age and live longer with chronic conditions, there is a need to explore more efficient approaches to healthcare delivery (McLean 2011).

Approaches to management may include the patients themselves as they adopt activities to manage their condition, including essential skills such as: problem solving; decision making; resource utilisation; forming a partnership between patient and healthcare provider; taking action; and self tailoring (Lorig 2003b). Such management interventions can "help patients to acquire and practice the skills they need to carry out disease specific medical regimens, guide changes in health behaviour and provide emotional support to enable patients to control their disease" (Lenferink 2017; Nici 2014). Often, patients require the support of the healthcare professional in order to reduce the impact of COPD (Jonsdottir 2013). Self-support interventions, for example, have been targeted to help people with more severe COPD as there is more opportunity to improve quality of life, hospital admissions and dyspnoea (Lenferink 2017). However, these resource-intensive programmes only reach a small proportion of the target population (Spruit 2013).

Early diagnosis and management activities may help to prevent or slow down the progression of disease and associated symptoms (e.g. exacerbations), improve quality of life, and reduce burden on the individual and costs to the healthcare service (e.g. hospital admissions) (Seemungal 2009; Williams 2014). Digital interventions have the potential to connect the patient with the healthcare

professional to enable enhanced management of their condition (Williams 2014). For example, McLean and colleagues found that interventions such as teleheathcare had a positive impact on quality of life and hospitalisations (McLean 2011). A recent review by McCabe and colleagues found that mobile technology may improve quality of life and activity levels (McCabe 2017).

Other studies have shown that digital interventions have led to changes in management of COPD (Jolly 2018). However, some studies have questioned whether these interventions may increase patients' dependence on healthcare professionals (Fairbrother 2013), and others have questioned whether digital interventions as a whole do indeed contribute to enhanced management in COPD (Hanlon 2017). Furthermore, uptake of digital interventions may be limited to people with a high level of familiarity with the internet and mobile technology, and therefore has the potential to worsen healthcare inequality.

Why it is important to do this review

With rapid uptake and easy access, digital technology may be considered as a potential platform for managing COPD. For example, mobile health may help patients in self-management, which could have a positive impact on health behaviours (e.g. encouragement to walk, or education of when to start a rescue pack). Such technologies may encourage patient engagement (Sobnath 2017), and reduce the burden on healthcare systems.

One Cochrane Review investigated computer and mobile technology compared to face-to-face or written support (or both) for people with COPD (McCabe 2017). The review authors found that although there were significant improvements in health-related quality of life and levels of activity in people with COPD, they could not make strong conclusions about mobile technology in assisting, supporting and sustaining self-management due to limited evidence. We anticipate that there will be more trials since the publication of the Cochrane Review (McCabe 2017), therefore it is important to identify potentially relevant studies that may give us more up-to-date answers about whether digital interventions can assist, for example, with supported self management of COPD. As we have had the involvement of a COPD patient group in the development of this review topic and also another linked review on telehealthcare interventions (Janjua 2018), we consider these topics to be important to address. We will also use the behaviour change technique (BCT) taxonomy (Kebede 2017), which has not been used in McCabe 2017, to classify digital interventions and explore the impact of the intervention on behaviour change.

OBJECTIVES

We will assess the benefits and harms of digital interventions for the management of chronic obstructive pulmonary disease. As a second objective, we will use the Behaviour Change Technique taxonomy to describe and explore intervention content.

METHODS

Criteria for considering studies for this review

Types of studies

We will include randomised controlled trials (RCTs) only. We will include cluster randomised trials, but will only meta-analyse data from such trials if they have been adjusted to account for clustering (or we can adjust them ourselves). We will include cross-over trials, but will only meta-analyse data from such trials if we can obtain outcome data from before the cross-over, as we cannot exclude a carry-over effect. We will include studies reported in full text, those published as an abstract only and unpublished data. We will include studies from primary care and hospital settings.

Types of participants

We will include adults (aged 18 years and over) who have a diagnosis of chronic obstructive pulmonary disease (COPD) according to established criteria (e.g. Global Initiative for Obstructiv Lung Disease (GOLD) staging (GOLD 2018), European Respiratory Society (ERS) , or American Thoracic Society (ATS) criteria (Qaseem 2011). We will include adults with any comorbidities, providing the digital intervention is aimed at the management of COPD.

Types of interventions

We will include the following comparisons.

1. Digital technology (e.g. m- Health) intervention plus routine supported self-management (e.g. input from a healthcare professional) versus routine supported self-management alone
2. Digital technology (e.g. m- Health) intervention versus other self-management intervention or routine/usual care/ control treatment

We will include the following digital technology interventions.

1. Short messaging services (SMS) (e.g. for reminders, education, motivation or prevention)
2. Mobile phones, personal digital assistants, MP3, medical device connected to phone by cord or wirelessly
3. Smartphone applications or applications on a smart device (e.g. 'myCOPD' or other smartphone-based applications).
4. Web or internet-based interventions (e.g. online training programmes consisting of educational modules that patients can access, web-based portals for individualised programmes accessed by both patient and healthcare professional, interventions that

support access to decision support between the patient and healthcare professionals).

We will not include telehealthcare interventions as this group will be covered in a linked review (Janjua 2018). These interventions include, for example, remote patient monitoring by collecting data by a health provider at a different location to the patient, or store-and-forward (asynchronous) transmission of patient data through an electronic communication system).

We will analyse data from the above comparisons and intervention groups separately.

We will report outcomes using the following time point categories:

1. equal to or more than three months to less than six months;
2. equal to or more than six months to less than 12 months;
3. equal to or more than 12 months.

We will include studies in which the intervention is part of a complex multi-component integration care intervention, but we will not include these studies in meta-analyses for the above prespecified comparisons.

Types of outcome measures

Primary outcomes

1. Impact on health behaviours, such as physical activity (e.g. step count), smoking cessation (we will choose continuous abstinence over point prevalence and validated abstinence over self-report), weight loss.
2. Self-efficacy for managing chronic disease (as reported by trialists).
3. Quality of life (e.g. St. George's Respiratory Questionnaire).
4. Exacerbations (as defined by trialists; depending on the data available, we will extract the number of participants experiencing one or more exacerbation, or the exacerbation rate, or both).

Secondary outcomes

1. Adverse events/side effects.
2. Anxiety and depression (e.g. Hospital Anxiety and Depression Scale).
3. Patient satisfaction (as defined by trialists).
4. Hospitalisation utilisation (as defined by trialists; depending on the data available, we will extract either the number of participants who require hospitalisations (e.g. emergency department presentations, readmissions, and length of stay), or the hospitalisation rate, or both).

Reporting one or more of the outcomes listed here in the study is not an inclusion criterion for the review. Such studies will be included and described, but will not contribute data to any analyses performed.

Search methods for identification of studies

Electronic searches

We will identify studies from the Cochrane Airways Trials Register, which is maintained by the Information Specialist for the group. The Cochrane Airways Trials Register contains studies identified from several sources:

1. monthly searches of the Cochrane Central Register of Controlled Trials (CENTRAL), through the Cochrane Register of Studies Online (crso.cochrane.org);
2. weekly searches of MEDLINE Ovid SP 1946 to date;
3. weekly searches of Embase Ovid SP 1974 to date;
4. Monthly searches of PsycINFO Ovid SP 1967 to date;
5. Monthly searches of CINAHL EBSCO (Cumulative Index to Nursing and Allied Health Literature) 1937 to date;
6. Monthly searches of AMED EBSCO (Allied and Complementary Medicine);
7. handsearches of the proceedings of major respiratory conferences.

Studies contained in the Trials Register are identified through search strategies based on the scope of Cochrane Airways. Details of these strategies, as well as a list of handsearched conference proceedings, are provided in Appendix 1. See Appendix 2 for the search terms we will use to identify studies for this review.

We will search the following additional sources, with appropriately adapted search terms:

1. US National Institutes of Health Ongoing Trials Register ClinicalTrials.gov (clinicaltrials.gov);
2. World Health Organization International Clinical Trials Registry Platform (apps.who.int/trialsearch);
3. IEEE Xplore Digital Library.

We will search the Cochrane Airways Trials Register and additional sources from inception to present, with no restriction on language of publication.

Searching other resources

We will check the reference lists of all primary studies and review articles for additional references. We will search relevant manufacturers' websites for study information.

We will search for errata or retractions from included studies published in full text on PubMed and report the date this was done within the review.

Data collection and analysis

Selection of studies

Two review authors (SJ, CT) will screen the titles and abstracts of the search results independently and code them as 'retrieve'

(eligible or potentially eligible/unclear) or 'do not retrieve'. We will retrieve the full-text study reports of all potentially eligible studies and two review authors (SJ, CT) will independently screen them for inclusion, recording the reasons for exclusion of ineligible studies. We will resolve any disagreement through discussion or, if required, we will consult a third person/review author (RD). We will identify and exclude duplicates and collate multiple reports of the same study so that each study, rather than each report, is the unit of interest in the review. We will record the selection process in sufficient detail to complete a PRISMA flow diagram and 'Characteristics of excluded studies' table (Moher 2009).

Data extraction and management

We will use Microsoft Excel software to create a data collection form for study characteristics and outcome data; we will pilot the form on at least one study in the review. One review author (SJ) will extract the following study characteristics from included studies.

1. Methods: study design, total duration of study, details of any 'run-in' period, number of study centres and location, study setting, withdrawals and date of study.
2. Participants: number (N), mean age, age range, gender, severity of condition, diagnostic criteria, baseline lung function, smoking history, inclusion criteria and exclusion criteria.
3. Interventions: intervention (including adherence), comparison, who delivers the intervention (e.g. general practitioner or specialist COPD practitioner).
4. Outcomes: primary and secondary outcomes specified and collected, and time points reported.
5. Notes: funding for studies and notable conflicts of interest of trial authors.

Two review authors (SJ, CT) will independently extract outcome data from included studies. We will note in the 'Characteristics of included studies' table if outcome data were not reported in a usable way. We will resolve disagreements by consensus or by involving a third person/review author (RD). One review author (SJ) will transfer data into the Review Manager 5 file (RevMan 2014). We will double-check that data are entered correctly by comparing the data presented in the systematic review with the study reports. A second review author (CT) will spot-check study characteristics for accuracy against the study report.

Assessment of risk of bias in included studies

Two review authors (SJ, CT) will assess risk of bias independently for each study, using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). We will resolve any disagreements by discussion or by involving another review author (RD). We will assess the risk of bias according to the following domains:

1. random sequence generation;
2. allocation concealment;
3. blinding of participants and personnel;
4. blinding of outcome assessment;
5. incomplete outcome data;
6. selective outcome reporting;
7. other bias.

We will judge each potential source of bias as high, low or unclear and provide a quote from the study report together with a justification for our judgement in the 'Risk of bias' table. We will summarise the 'Risk of bias' judgements across different studies for each of the domains listed. We will consider blinding separately for different key outcomes where necessary (e.g. for all-cause mortality, the risk of bias represented by unblinded outcome assessment may be very different than for a patient-reported pain scale). Where information on risk of bias relates to unpublished data or correspondence with a trialist, we will note this in the 'Risk of bias' table.

When considering treatment effects, we will take into account the risk of bias for studies that contribute to that outcome.

Assessment of bias in conducting the systematic review

We will conduct the review according to this published protocol and justify any deviations from it in the 'Differences between protocol and review' section of the systematic review.

Measures of treatment effect

We will analyse dichotomous data as odds ratios (ORs) and continuous data as the mean difference (MD) or standardised mean difference (SMD). If data from rating scales are combined in a meta-analysis, we will ensure they are entered with a consistent direction of effect (e.g. lower scores always indicate improvement).

We will undertake meta-analyses only where this is meaningful; that is, if the treatments, participants and the underlying clinical question are deemed similar enough by review authors for pooling to make sense.

We will describe skewed data narratively (for example, as medians and interquartile ranges for each group).

Where multiple trial arms are reported in a single study, we will include only the relevant arms. If two comparisons (e.g. treatment A and treatment B versus usual care) are combined in the same meta-analysis, we will either combine the active arms or halve the control group to avoid double-counting.

If adjusted analyses are available (ANOVA or ANCOVA) we will use these as a preference in our meta-analyses. If both change-from-baseline and endpoint scores are available for continuous data, we will use change-from-baseline unless there is low correlation between measurements in individuals. We will report outcomes at the following time points: equal to or more than three months to less than six months, equal to or more than six months to less than 12 months, and equal to or more than 12 months. If studies

report post-treatment follow-up we will extract these data and report them narratively.

We will use intention-to-treat (ITT) or 'full analysis set' analyses where they are reported (i.e. those where data have been imputed for participants who were randomly assigned but did not complete the study) instead of completer or per protocol analyses.

Unit of analysis issues

For dichotomous outcomes, we will use participants, rather than events, as the unit of analysis (e.g. number of patients admitted to hospital, rather than number of admissions per patient). However, if rate ratios are reported in a study, we will analyse them on this basis. We will only meta-analyse data from cluster-RCTs if the available data have been adjusted (or can be adjusted) to account for the clustering.

Dealing with missing data

We will contact investigators or study sponsors in order to verify key study characteristics and obtain missing numerical outcome data where possible (e.g. when a study is identified as an abstract only). Where this is not possible, and the missing data are thought to introduce serious bias, we will take this into consideration in the GRADE rating for affected outcomes.

Assessment of heterogeneity

We will use the I^2 statistic to measure heterogeneity among the studies in each analysis according to the guidance in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). If we identify substantial heterogeneity (I^2 of 40% or more) we will report it and explore the possible causes by undertaking pre-specified subgroup analysis.

Assessment of reporting biases

If we are able to pool more than 10 studies, we will create and examine a funnel plot to explore possible small-study and publication biases.

Data synthesis

We will use a random-effects model and perform a sensitivity analysis with a fixed-effect model.

'Summary of findings' table

We will create a 'Summary of findings' table using the following outcomes: impact on health behaviours, self-efficacy for managing chronic disease, quality of life, and exacerbations. We will use the five GRADE considerations (risk of bias, consistency of effect, imprecision, indirectness and publication bias) to assess the quality of the body of evidence as it relates to the studies that contribute data for the prespecified outcomes. We will use the methods and recommendations described in Section 8.5 and Chapter 12 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011), using GRADEpro GDT software (GRADEpro GDT). We will justify all decisions to downgrade the quality of studies in the footnotes of the table, and we will make comments to aid the reader's understanding of the review where necessary.

We will produce an additional table to describe the Behaviour Change Techniques used in the included studies (Kebede 2017).

Subgroup analysis and investigation of heterogeneity

We plan to carry out subgroup analyses based on the following factors.

1. Severity of COPD (mild to moderate versus moderate to severe)
2. Mean number of previous exacerbations in the proceeding year (zero to one, or more than one)
3. Ethnicity/social economic status
4. Cognitive function (presence or absence of cognitive impairment, e.g. Mini-Mental State Examination (Folstein 1975) score of more than 26)

We will use the following outcomes in subgroup analyses.

1. Quality of life
2. Number of exacerbations
3. Self-efficacy for managing chronic disease
4. Impact on health behaviours

We will use the formal test for subgroup interactions in Review Manager 5 (RevMan 2014).

Sensitivity analysis

We plan to carry out a sensitivity analyses, in which we remove studies with high risk of bias in one or more domains from the primary outcome analyses. We will also compare the results using the fixed-effect model and the random-effects model.

ACKNOWLEDGEMENTS

The Background and Methods sections of this protocol are based on a standard template used by Cochrane Airways.

Kristin Carson-Chahhoud is the Editor for this review and commented critically on the review.

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* *Indicates the major publication for the study*

APPENDICES

Appendix 1. Sources and search methods for the Cochrane Airways Trials Register

Electronic searches: core databases

Database	Frequency of search
CENTRAL (the Cochrane Library)	Monthly
MEDLINE (Ovid)	Weekly
Embase (Ovid)	Weekly
PsycINFO (Ovid)	Monthly
CINAHL (EBSCO)	Monthly
AMED (EBSCO)	Monthly

Handsearches: core respiratory conference abstracts

Conference	Years searched
American Academy of Allergy, Asthma and Immunology (AAAAI)	2001 onwards
American Thoracic Society (ATS)	2001 onwards
Asia Pacific Society of Respirology (APSR)	2004 onwards
British Thoracic Society Winter Meeting (BTS)	2000 onwards
Chest Meeting	2003 onwards
European Respiratory Society (ERS)	1992, 1994, 2000 onwards
International Primary Care Respiratory Group Congress (IPCRG)	2002 onwards
Thoracic Society of Australia and New Zealand (TSANZ)	1999 onwards

MEDLINE search strategy used to identify studies for the Cochrane Airways Trials Register

Condition search

1. exp Asthma/
2. asthma$.mp.
3. (antiasthma$ or anti-asthma$).mp.
4. Respiratory Sounds/
5. wheez$.mp.
6. Bronchial Spasm/
7. bronchospas$.mp.
8. (bronch$ adj3 spasm$).mp.
9. bronchoconstrict$.mp.
10. exp Bronchoconstriction/
11. (bronch$ adj3 constrict$).mp.
12. Bronchial Hyperreactivity/
13. Respiratory Hypersensitivity/
14. ((bronchial$ or respiratory or airway$ or lung$) adj3 (hypersensitiv$ or hyperreactiv$ or allerg$ or insufficiency)).mp.
15. ((dust or mite$) adj3 (allerg$ or hypersensitiv$)).mp.
16. or/1-15
17. exp Aspergillosis, Allergic Bronchopulmonary/
18. lung diseases, fungal/
19. aspergillosis/
20. 18 and 19
21. (bronchopulmonar$ adj3 aspergillosis).mp.
22. 17 or 20 or 21
23. 16 or 22
24. Lung Diseases, Obstructive/
25. exp Pulmonary Disease, Chronic Obstructive/
26. emphysema$.mp.
27. (chronic$ adj3 bronchiti$).mp.
28. (obstruct$ adj3 (pulmonary or lung$ or airway$ or airflow$ or bronch$ or respirat$)).mp.
29. COPD.mp.
30. COAD.mp.
31. COBD.mp.
32. AECB.mp.
33. or/24-32
34. exp Bronchiectasis/
35. bronchiect$.mp.
36. bronchoect$.mp.
37. kartagener$.mp.
38. (ciliary adj3 dyskinesia).mp.
39. (bronchial$ adj3 dilat$).mp.
40. or/34-39
41. exp Sleep Apnea Syndromes/
42. (sleep$ adj3 (apnoea$ or apnoea$)).mp.
43. (hypopnoea$ or hypopnoea$).mp.
44. OSA.mp.
45. SHS.mp.
46. OSAHS.mp.
47. or/41-46
48. Lung Diseases, Interstitial/
49. Pulmonary Fibrosis/
50. Sarcoidosis, Pulmonary/
51. (interstitial$ adj3 (lung$ or disease$ or pneumon$)).mp.

52. ((pulmonary$ or lung$ or alveoli$) adj3 (fibros$ or fibrot$)).mp.
53. ((pulmonary$ or lung$) adj3 (sarcoid$ or granulom$)).mp.
54. or/48-53
55. 23 or 33 or 40 or 47 or 54

Filter to identify RCTs

1. exp "clinical trial [publication type]"/
2. (randomised or randomised).ab,ti.
3. placebo.ab,ti.
4. dt.fs.
5. randomly.ab,ti.
6. trial.ab,ti.
7. groups.ab,ti.
8. or/1-7
9. Animals/
10. Humans/
11. 9 not (9 and 10)
12. 8 not 11

The MEDLINE strategy and RCT filter are adapted to identify studies in other electronic databases.

Appendix 2. Search strategy to identify relevant studies from the Cochrane Airways Trials Register

Search line	Search term	Comments
#1	MESH DESCRIPTOR Pulmonary Disease, Chronic Obstructive EXPLODE ALL AND INSEGMENT	
#2	MeSH DESCRIPTOR Bronchitis, Chronic AND INSEGMENT	
#3	(obstruct*) near3 (pulmonary or lung* or airway* or airflow* or bronch* or respirat*) AND INSEGMENT	
#4	COPD:MISC1 AND INSEGMENT	MISC1=field in record where reference has been coded for condition i.e. COPD
#5	(COPD OR COAD OR COBD OR AECOPD):TI,AB,KW AND INSEGMENT	
#6	#1 OR #2 OR #3 OR #4 OR #5	Combines all population (COPD) terms
#7	MESH DESCRIPTOR Telemedicine EXPLODE ALL AND INSEGMENT	Index term includes remote consultation
#8	telehealth* or tele-health* AND INSEGMENT	
#9	telemedicine* or tele-medicine* AND INSEGMENT	

(*Continued*)

#10	telemanagement or tele-management AND INSEGMENT	
#11	telecare* or tele-care* AND INSEGMENT	
#12	telematic* AND INSEGMENT	
#13	telepharmacy or tele-pharmacy AND INSEGMENT	
#14	telenurs* or tele-nurs* AND INSEGMENT	
#15	tele-homecare or telehomecare AND INSEGMENT	
#16	teleconsultation or tele-consultation AND INSEGMENT	
#17	(remote* or distant or distance) NEAR (consult* or monitor* or care or treat* or therap*) AND INSEGMENT	
#18	(mobile* or digital*) NEXT health* AND INSEGMENT	
#19	ehealth or e-health AND INSEGMENT	
#20	mhealth or m-health AND INSEGMENT	
#21	MESH DESCRIPTOR Technology EXPLODE ALL AND INSEGMENT	
#22	MESH DESCRIPTOR Telephone EXPLODE ALL AND INSEGMENT	includes cell phones & answering services
#23	MESH DESCRIPTOR Videoconferencing EXPLODE ALL AND INSEGMENT	includes web casts/podcasts
#24	MESH DESCRIPTOR Electronic Mail EXPLODE ALL AND INSEGMENT	
#25	MESH DESCRIPTOR Text Messaging EXPLODE ALL AND INSEGMENT	
#26	MESH DESCRIPTOR Software EXPLODE ALL AND INSEGMENT	includes web browsers, video games & mobile applications
#27	MESH DESCRIPTOR Software EXPLODE ALL AND INSEGMENT	includes smartphones
#28	MESH DESCRIPTOR Computers, Handheld EXPLODE ALL AND INSEGMENT	
#29	MESH DESCRIPTOR Computer-Assisted Instruction AND INSEGMENT	

(*Continued*)

#30	MESH DESCRIPTOR Decision Making, Computer-Assisted EXPLODE ALL AND INSEGMENT	
#31	MESH DESCRIPTOR Wireless Technology AND INSEGMENT	
#32	MESH DESCRIPTOR Internet EXPLODE ALL AND INSEGMENT	
#33	(internet* or computer* or web* or online*):ti,ab,kw AND INSEGMENT	
#34	(telephone or phone*):ti,ab,kw AND INSEGMENT	
#35	(sms or mms or texting or text messag*):ti,ab,kw AND INSEGMENT	
#36	(video* or skype*):ti,ab,kw AND INSEGMENT	
#37	(email or e-mail or electronic mail):ti,ab,kw AND INSEGMENT	
#38	interactive* or telecommunication* AND INSEGMENT	
#39	wireless* or bluetooth* AND INSEGMENT	
#40	smartphone* or cellphone* AND INSEGMENT	
#41	(iphone* or ipod* or podcast* or ipad* or android* or blackberr* or palm pilot*):ti,ab,kw AND INSEGMENT	
#42	(pda* or personal digital assistant*):ti,ab,kw AND INSEGMENT	
#43	(tablet* or hand-held*) near3 (device or computer) AND INSEGMENT	
#44	social* near3 (media* or network*) AND INSEGMENT	
#45	smart watch or smartwatch AND INSEGMENT	
#46	wearable*:ti,ab,kw AND INSEGMENT	
#47	#7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45 OR #46	combines all m-health & technology intervention terms

(*Continued*)

#48	#47 AND #6	combine population & intervention terms

CONTRIBUTIONS OF AUTHORS

RD provided conceptual and clinical advice, and drafted the background and methods of the protocol. For the full review, RD will arbitrate conflicts, perform analysis and interpretation, and approve the final draft.

SJ drafted the background and methods of the protocol. For the full review, SJ will perform sifting, data extraction, 'Risk of bias' assessment and write-up.

CT drafted the background and methods of protocol. For the full review, CT will perform sifting, data extraction, 'Risk of bias' assessment and write-up.

SP critically reviewed the protocol. For the full review, SP will perform analysis and interpretation, and will approve the final draft.

DECLARATIONS OF INTEREST

CT is employed part-time by a National Institute for Health Research (NIHR) Programme Grant to complete work on this review and is an academic clinical fellow in pharmacology.

SJ is employed full-time as a systematic reviewer by an NIHR Programme Grant to complete work on this review.

RD has no conflict of interest and is employed full-time as a Senior Research Fellow within an academic unit.

SP has received payment for lectures, including speaking services from Boerhinger Ingelhiem, NAPP, Novartis, Pfizer, Nutricia, Astra Zeneca, and TEVA and travel expenses from Nutricia, Astra Zeneca, and TEVA. SP has no conflicts of interests related to the review.

SOURCES OF SUPPORT

Internal sources

- The authors declare that no such funding was received for this systematic review, Other.

External sources

- National Institute for Health Research, UK.

Cochrane Programme Grant 16/114/21: NHS priorities in the management of chronic respiratory disease