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Use of the Behaviour Change Wheel to develop an intervention to promote physical activity following pulmonary rehabilitation in patients with COPD

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Abstract

Background: Pulmonary rehabilitation is a programme of exercise and education that has benefits on breathlessness, exercise capacity and quality of life in COPD. However, these benefits do not necessarily translate to an increase in daily physical activity and long-term behaviour change. Previous interventions to promote physical activity following pulmonary rehabilitation have had limited efficacy.

Aim: This paper reports the systematic and comprehensive development of an intervention to promote physical activity following pulmonary rehabilitation for patients with COPD, using the Behaviour Change Wheel (BCW).

Methods: The eight steps outlined in the BCW were followed to develop an intervention, facilitated by stakeholder discussions to consider and evaluate the intervention's affordability, practicability, effectiveness and cost-effectiveness, acceptability, side-effects and safety and equity (APEASE).

Results: The final intervention targeted patients' capability, opportunity and motivation, incorporating four intervention functions delivered via four policy categories and thirteen Behaviour Change Techniques (BCTs). The final intervention included 12-month support through provision of a pedometer and step diary, and addition of patients to a WhatsApp group populated by fellow pulmonary rehabilitation graduates and a 'WhatsApp leader'.

Conclusion: The BCW enabled a systematic and comprehensive development of a novel, multicomponent intervention to promote physical activity following a community pulmonary rehabilitation programme in patients with COPD.



Introduction

Chronic obstructive pulmonary disease (COPD) is a common and preventable condition, characterised by persistent respiratory symptoms and airflow limitation that is caused by significant exposure to noxious particles or gases (GOLD, 2019). People with COPD have significantly lower levels of daily physical activity compared with age-matched healthy individuals (GOLD, 2019). This relates to an avoidance of physical activity often related to exertional dyspnoea which leads to increasing inactivity, muscle weakness and reduced exercise capacity. Physical inactivity is associated with reduced quality of life, increased risk of hospitalisation and mortality (Benzo et al., 2010; Garcia-Aymerich, Lange, Serra, Schnohr, & Antó, 2008; Garcia-Aymerich et al., 2008; Garcia-Rio et al., 2012; Gimeno-Santos et al., 2014; Pitta et al., 2006). As such, physical activity is an important behaviour in COPD management (GOLD, 2019).

Pulmonary rehabilitation is defined as “a comprehensive intervention based on a thorough patient assessment followed by patient-tailored therapies that include, but are not limited to, exercise training, education, and behaviour change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviour” (Spruit et al., 2013).

The key benefits of pulmonary rehabilitation include clinically important improvements in physical capacity for patients with COPD (McCarthy et al., 2015). However, this doesn't necessarily translate to an increase in daily physical activity and long-term behaviour change (Spruit et al., 2013). Previous interventions to promote physical activity following pulmonary rehabilitation have had limited efficacy and have only resulted in modest, short-term increases in physical activity (Cindy Ng, Mackney, Jenkins, & Hill, 2012; Lahham, McDonald, & Holland, 2016). Behaviour change following pulmonary rehabilitation is a complex phenomenon and it is therefore crucial to develop interventions using evidence and theory-based methods (Robinson, Williams, Curtis, Bridle, & Jones, 2018).

The Medical Research Council (MRC) framework for complex interventions states that intervention development should be a systematic process, based on coherent and relevant theory and the best available evidence (Craig et al., 2008). It does not, however, specify particular theory to follow. Other frameworks, such as Mindspace (Institute for Government, the Cabinet Office, 2010) and Intervention Mapping (Bartholomew, Parcel, Kok, Gottlieb, & Fernández, 2011) can provide intervention development guidance. However, the comprehensiveness of these frameworks are limited, for example they are not necessarily linked to a model of behaviour change and/or applicable to a broad range of behaviour (Michie, van Stralen, & West, 2011). The Behaviour Change Wheel (BCW) (Michie et al., 2011) was developed to address these limitations.

The BCW has been used in the development and evaluation of interventions including modifying physical activity behaviour in COPD and there have been calls for further adoption of this framework within intervention development in the area (Cavalheri, Straker, Gucciardi, Gardiner, & Hill, 2016; Williams et al., 2017). To our knowledge, the BCW has not yet been used to develop interventions for promoting physical activity in the post-pulmonary rehabilitation setting. This paper describes the application of the BCW in the development of an intervention to promote physical activity following pulmonary rehabilitation in patients with COPD.



Methods

Settings

Pulmonary rehabilitation service in Lincolnshire Community Health Services NHS Trust is an 8-week programme delivered to patients with chronic respiratory disorders who are symptomatic and functionally limited by their condition (MRC score 2 or more) or had a recent hospitalisation (e.g. acute exacerbation of COPD). The programme includes eight weeks of twice weekly, 1-hour exercise and education sessions. The exercise component of the programme includes activities requiring minimal equipment (e.g. 'sit to stand' exercises using a chair) so that these can be performed at home during and following pulmonary rehabilitation. The educational component contains information on various topics, such as benefits of regular physical activity, management of exacerbations and breathlessness.

Once patients complete pulmonary rehabilitation, they are discharged and referred back to primary care with no formal follow-up or support to maintain the benefits of pulmonary rehabilitation.

Design

The BCW was applied to the development of an intervention to promote physical activity following pulmonary rehabilitation in patients with COPD. The intervention was developed in accordance with three key stages of the BCW (Michie, Atkins, & West, 2014). Briefly, stage 1 includes understanding the behaviour; stage 2 includes the identification of intervention options, for example intervention functions and the policy categories which may deliver these and, finally, stage 3 includes the identification of content and implementation options.

Stage 1

Stage 1 included four steps, step 1: defining the problem in behavioural terms; step 2: selection of the target behaviour; step 3: specifying the target behaviour and step 4: identification of what needs changing via the model of behaviour that forms the core of the BCW, known as the COM-B (Michie et al., 2014). Specifically, based on the results of a qualitative systematic review, reporting the facilitators and barriers to physical activity following pulmonary rehabilitation in COPD (Robinson et al., 2018) (Table 1), step 4 involved conducting a behavioural analysis using COM-B. This model has three components which represent sources of behaviour: capability (psychological and physical); opportunity (social and physical) and motivation (reflective and automatic). This method identified the sources of behaviour that were involved in physical activity following pulmonary rehabilitation and resulted in a 'behavioural diagnosis'.

Stage 2

Stage 2 included two steps, step 5 (the identification of intervention functions) and step 6 (identification of policy categories).

Decision making at steps 5 and 6 were informed by the matrix of links, which is a table within the BCW framework for moving between steps (Michie et al., 2014). For example, in stage 2, the matrix of links is a table that reports the intervention functions that are likely to bring about change to specific behavioural sources. In addition, similar to previous studies (Webb, Foster, & Poulter, 2016), application of the APEASE criteria and discussions with stakeholders, including patient groups such as Lincoln Breathe Easy, health care professionals and academic experts in behaviour change (see more information in Figure 1), facilitated the development of an intervention that was acceptable to all in the local setting (Lincolnshire). The APEASE criteria assesses aspects of affordability,

practicability, effectiveness and cost-effectiveness, acceptability, side-effects and safety, and equity of interventions options (Michie et al., 2014).

Identification of intervention functions in step 5, i.e. the functions that an effective intervention is likely to serve, were based on the behavioural sources (COM-B components) selected in Step 4 as needing to change. The research team chose from nine possible functions, including: education; persuasion; incentivisation; coercion; training; restriction; environmental restructuring; modelling and enablement.

Identification of policy categories in step 6, i.e. how the intervention functions will be implemented, was based on the intervention functions selected in Step 5. The research team chose from seven possible policy categories, including communications/marketing; guidelines; fiscal measures; regulation; legislation; environmental/social planning and service provision (Michie et al., 2014).

Stage 3

Stage 3 included two steps, step 7: the identification of Behaviour Change Techniques (BCTs) (active ingredients of the intervention) and step 8: the identification of the mode of delivery. Similar to stage 2, these steps were also informed by the matrix of links and discussions with stakeholders (see Figure 1 and 2) with application of the APEASE criteria.

In step 7, the research team selected BCTs based on the intervention functions selected. For each intervention function, the BCW guide lists the most and less frequently used BCTs according to the Behaviour Change Taxonomy version 1 (BCTv1) (Michie et al., 2013). This was used to facilitate the selection of relevant BCTs.

For step 8, the research team selected modes of intervention delivery (e.g. individuals or groups of people, face to face or online) based on the previous steps (intervention functions and policy categories). The research team sourced and trialled specific intervention components (e.g. devices), summarised in Figure 2.

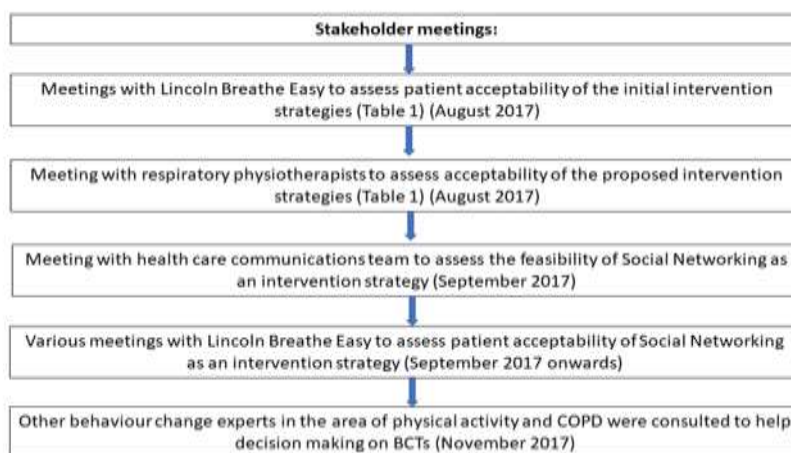


Figure 1: Stakeholder discussions to inform intervention development in steps 5-8

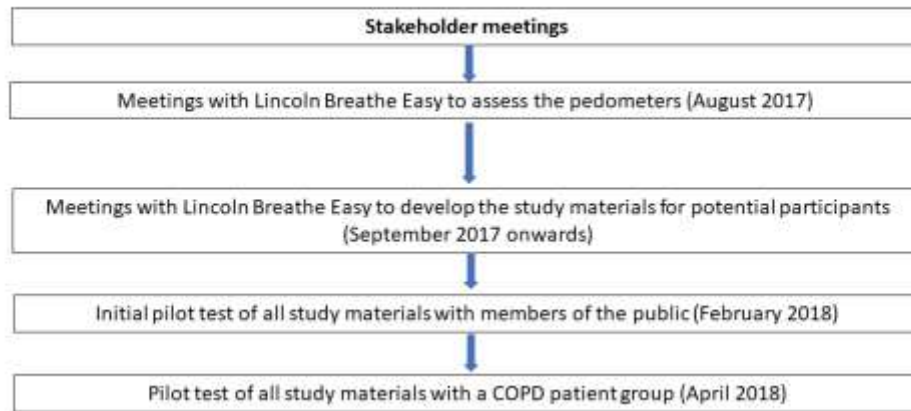


Figure 2: Stakeholder discussions to inform intervention development in step 8

Results

Stage 1

Physical activity was identified as the behaviour to target within this intervention. Physical activity is important for the health and well-being of people with COPD following pulmonary rehabilitation, and research suggests that individuals do not maintain physical activity after pulmonary rehabilitation (Spruit et al., 2013). This was therefore chosen as the specific target behaviour.

The behavioural diagnosis concluded that psychological capability, reflective motivation, automatic motivation, physical and social opportunity need to change for the target behaviour (physical activity maintenance) to occur (Table 2). The only behavioural source that was not deemed to require change was physical capability. Both previous literature and stakeholder discussions suggested that patients upon completion of pulmonary rehabilitation would be in a position of increased physical capacity and hence physically capable to maintain physical activity after pulmonary rehabilitation.

Stage 2

Based on the COM-B components that required targeting, all nine intervention functions were available for selection. However, only four intervention functions were considered acceptable and likely to serve the intervention, including education, environmental restructuring, enablement and persuasion. Incentivisation, coercion and restriction were excluded as they were not considered suitable functions (i.e. did not meet APEASE criteria) for this intervention, e.g. there was uncertainty about the equity of incentivisation and its effectiveness for modifying physical activity in a COPD population. Based on the intervention functions selected, all seven policy categories were available for selection. However, only four policy categories were selected to implement these intervention functions and considered acceptable, including guidelines, service provision, communication and environmental/social planning. The other four policy categories were excluded as they were not considered to meet the APEASE criteria, e.g. fiscal measures and legislation would not be possible, or appropriate, to use in this context.



Stage 3

Based on the four chosen intervention functions in step 5 (education, environment restructuring, enablement and persuasion), there were a total of 25 listed BCTs which were reported as frequently used, and a total of 63 BCTs reported as less frequently used BCTs. Of these BCTs, 13 were considered appropriate to stakeholders and selected to be included in the intervention (Table 3). These included social support (unspecified 3.1, practical 3.2, emotional 3.3), instruction on how to perform a behaviour 4.1, behavioural practice/rehearsal 8.1, self-monitoring of behaviour 2.3, credible source 9.1, written persuasion about capabilities 15.1, focus on past successes 15.3, prompts and cues 7.1, restructuring the social environment 12.2, social reward 10.4 and feedback on behaviour 2.2. All other BCTs were excluded as they were not considered to meet the APEASE criteria. For example, goal setting: behaviour (1.1) and graded tasks (8.7) were not considered acceptable to stakeholders due to health and safety concerns i.e. the chance of patients over-exerting themselves and not having a healthcare professional nearby.

Based on the existing literature, stakeholder discussions and APEASE criteria, potential intervention components to utilise the selected BCTs included adding patients to a WhatsApp group populated by fellow pulmonary rehabilitation graduates and a 'WhatsApp leader' (volunteer from a patient support group), providing patients with a pedometer and, finally, providing patients with a step diary for 52 weeks following pulmonary rehabilitation. Stakeholders considered 52 weeks as an appropriate intervention duration, as it was able to target long-term behaviour change and provide support to a population who suffer exacerbations and whose symptoms are likely to vary (GOLD, 2019; Lopez-Campos, Calero, & Quintana-Gallego, 2013; Watz et al., 2014).

The intervention was introduced to groups of patients, face to face, during pulmonary rehabilitation. Stakeholders agreed that patients would benefit from the support of the research team and health care professionals within in a familiar setting. This also enabled patients to meet the WhatsApp leader and to practice communicating with their peers (other COPD patients) via WhatsApp. Following pulmonary rehabilitation, the WhatsApp leader delivered WhatsApp messages via the internet to groups of individuals. The WhatsApp leader was considered a suitable person to deliver messages to the WhatsApp group, as they have experiences living with, or with someone, with COPD and therefore understand both the facilitators and barriers to physical activity.

Social networking was considered an appropriate intervention strategy, as patients valued social support but were restricted by barriers such as transport and cost that limited face to face contact with others (Robinson et al., 2018). Social networking was chosen as a method to overcome these barriers. An outline of the final intervention, including the implementation of each BCT and mode of delivery is provided in Table 4.

Discussion

Main findings

This paper described the development of an intervention to promote physical activity following pulmonary rehabilitation in COPD. This included provision of a pedometer and step diary, and the addition of patients to a WhatsApp group populated by fellow pulmonary rehabilitation graduates and a 'WhatsApp leader' for a duration of 52 weeks following pulmonary rehabilitation.

Comparison to previous literature



Previous interventions to promote physical activity for people with COPD have utilised some of the intervention components adopted within this study and thus reflect the BCTs within this intervention. For example, pedometers and/or step diaries (adding objects to the environment 12.5; Self-monitoring of behaviour 2.3) have been provided to COPD patients to increase their steps (Arbillaga-Etxarri et al., 2018; Demeyer et al., 2017; Geidl et al., 2017) and patients have also been encouraged to use social media for social support (social support: unspecified 3.1; practical 3.2; emotional 3.3) (Wan et al., 2017). However, many of those interventions were not specifically targeting long-term physical activity following pulmonary rehabilitation (limited to three months post-pulmonary rehabilitation) (Arbillaga-Etxarri et al., 2018; Wan et al., 2017). Therefore those interventions did not target the long-term facilitators and barriers of physical activity after pulmonary rehabilitation, such as long-term social support and patient self-efficacy (Robinson et al., 2018), which this intervention aims to address.

Stakeholders considered WhatsApp as more appropriate than COPD web-based applications utilised in other interventions (Demeyer et al., 2017; Moy et al., 2015) due to it being more accessible and familiar to patients and/or their friends and relatives, and is an application which has been implemented in other interventions with a similar aim to help support health behaviour change (Alghafri et al., 2017; Cheung et al., 2015). Use of WhatsApp as an intervention component addresses calls of previous research to explore the use of instant messaging as a strategy to facilitate long-term physical activity behaviour change for patients with COPD (Moy et al., 2016; Wilson, O'Neill, Collins, & Bradley, 2015).

Strengths and limitations

A clear strength of this study is the systematic development of an intervention based on a theoretical framework, a systematic review of the literature (Robinson et al., 2018) and stakeholder engagement. Intervention development was based on stakeholders within Lincolnshire and therefore it could be argued that the intervention may be context-specific, and not be as applicable to other areas. However, the prioritisation of patient and public input involvement enabled the research team to focus on the priorities of various COPD patient groups across Lincolnshire, thus considering the views of many individuals across different settings. Various meetings with stakeholders enabled further exploration of key issues such as the selection of acceptable pedometers, mobile handsets, WhatsApp and WhatsApp guidelines. As reported in previous research (Webb et al., 2016), application of the BCW was time consuming. However, it resulted in the selection of intervention components that were informed by usability tests as well as previous literature (Mendoza et al., 2015; Nolan et al., 2017).

Whilst the BCW has been applied to the development and evaluation of interventions including modifying physical activity behaviour in COPD (Cavalheri et al., 2016; Williams et al., 2017), it has limited application in the development of interventions to promote physical activity following pulmonary rehabilitation (Cheng et al., 2017). Relatively few interventions have referred to theory (Cruz, Brooks, & Marques, 2016; Varas et al., 2018) and explicitly referred to the development of the intervention based on a behaviour change framework (Voncken-Brewster et al., 2015). There was therefore a need to utilise the BCW in the systematic development of this intervention.



With understanding that it is not possible to design a ‘one-size fits all’ intervention (Rochester & Spruit, 2017), the intervention was multi-component, and thus incorporated many BCTs. The decision to implement the intervention for 52 weeks (long term) enabled the research team to target long-term behaviour change for a population who suffer exacerbations and whose symptoms are likely to vary (GOLD, 2019; Lopez-Campos et al., 2013; Watz et al., 2014).

Conclusion

The BCW enabled a systematic and comprehensive development of a novel, multicomponent intervention to promote physical activity following pulmonary rehabilitation in patients with COPD in an NHS pulmonary rehabilitation service, facilitated by stakeholder involvement.

The next steps are to conduct a feasibility trial (NCT03660644) to assess acceptability and experiences of the intervention to a larger group of COPD patients and the potential impact of the intervention on clinical outcomes, such as physical activity.

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