



## Research

# Pulmonary rehabilitation referral and participation are commonly influenced by environment, knowledge, and beliefs about consequences: a systematic review using the Theoretical Domains Framework

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## KEY WORDS

Pulmonary rehabilitation  
Chronic obstructive pulmonary disease (COPD)  
Barriers  
Facilitators  
Participation



## ABSTRACT

**Question:** What are the barriers and enablers of referral, uptake, attendance and completion of pulmonary rehabilitation for people with chronic obstructive pulmonary disease (COPD)? **Design:** Systematic review of qualitative or quantitative studies reporting data relating to referral, uptake, attendance and/or completion in pulmonary rehabilitation. **Participants:** People aged >18 years with a diagnosis of COPD and/or their healthcare professionals. **Data extraction and analysis:** Data were extracted regarding the nature of barriers and enablers of pulmonary rehabilitation referral and participation. Extracted data items were mapped to the Theoretical Domains Framework (TDF). **Results:** A total of 6969 references were screened, with 48 studies included and 369 relevant items mapped to the TDF. The most frequently represented domain was 'Environment' (33/48 included studies, 37% of mapped items), which included items such as waiting time, burden of illness, travel, transport and health system resources. Other frequently represented domains were 'Knowledge' (18/48 studies, including items such as clinician knowledge of referral processes, patient understanding of rehabilitation content) and 'Beliefs about consequences' (15/48 studies, including items such as beliefs regarding role and safety of exercise, expectations of rehabilitation outcomes). Barriers to referral, uptake, attendance or completion represented 71% (n = 183) of items mapped to the TDF. All domains of the TDF were represented; however, items were least frequently coded to the domains of 'Optimism' and 'Memory'. The methodological quality of included studies was fair (mean quality score 9/12, SD 2). **Conclusion:** Many factors – particularly those related to environment, knowledge, attitudes and behaviours – interact to influence referral, uptake, attendance and completion of pulmonary rehabilitation. Overcoming the challenges associated with the personal and/or healthcare system environment will be imperative to improving access and uptake of pulmonary rehabilitation. **Trial registration:** PROSPERO CRD42015015976. [Cox NS, Oliveira CC, Lahham A, Holland AE (2017) Pulmonary rehabilitation referral and participation are commonly influenced by environment, knowledge, and beliefs about consequences: a systematic review using the Theoretical Domains Framework. *Journal of Physiotherapy* 63: 84–93]

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## Introduction

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death worldwide,<sup>1</sup> and contributes substantially to annual healthcare expenditure.<sup>2</sup> Key management strategies for people with COPD target symptom reduction and minimisation of disease progression. Pulmonary rehabilitation is recognised as a core component of COPD management,<sup>3</sup> and has been repeatedly shown to improve outcomes that matter to patients, such as dyspnoea, exercise tolerance and quality of life.<sup>3</sup> Pulmonary rehabilitation programs reduce the frequency of acute exacerbations,<sup>4</sup> and may decrease healthcare costs for COPD through reduced hospital admissions and length of stay.<sup>5</sup>

Although there is strong evidence supporting the merits of pulmonary rehabilitation for people with COPD, it is estimated

that <5% of eligible people receive pulmonary rehabilitation annually.<sup>6,7</sup> This low rate of delivery is due, in part, to poor referral rates, limited availability of and access to services, and patient-related factors.<sup>6,8</sup> In addition, many who are referred to pulmonary rehabilitation fail to attend or complete it. A participant is considered to *attend* pulmonary rehabilitation if they present for at least one of the scheduled exercise and education sessions. However, to be considered as *completing* a course of pulmonary rehabilitation, participants need to attend a pre-determined number of sessions (eg, 70%) to have received a sufficient dose of rehabilitation.<sup>9</sup> Thus, participants who attend a program may still be classified as non-completers. Of those referred to pulmonary rehabilitation, as many as half will never present for their first rehabilitation assessment (ie, lack of *uptake*)<sup>10</sup> and up to one-third will not complete the full course of pulmonary rehabilitation.<sup>10</sup>

Previous studies have identified factors that may impede an individual's ability to undertake pulmonary rehabilitation<sup>10</sup> or factors that predict the likelihood of non-completion.<sup>11</sup> Such factors include poor access to transport, lack of perceived benefit from the program,<sup>12</sup> and system-related barriers, such as insufficient programs and inadequate numbers of qualified health professionals, particularly in rural and regional areas.<sup>13,14</sup> In order to overcome identified barriers to pulmonary rehabilitation referral and participation, as well as to capitalise on factors that facilitate pulmonary rehabilitation participation, changes to systems, policies and patient/provider behaviours may be needed. To date, however, there has not been a systematic assessment of the factors that underpin these barriers and facilitators to pulmonary rehabilitation referral and participation.

The Theoretical Domains Framework (TDF) is an integrative framework that synthesises a number of behaviour change theories that can be used to help explain issues relating to implementation of best practice evidence in healthcare settings.<sup>15</sup> The TDF helps to consolidate and simplify data and theories relating to a specific behaviour into a set of theoretical domains.<sup>16</sup> In order to achieve this, information relating to a specific behaviour determinant is categorised into any relevant domain(s) of the TDF (Box 1). Any given determinant of behaviour may function as a barrier or facilitator (or both) to the performance of the behaviour in question, and as such may be mapped to the TDF on more than one occasion. The TDF can be used as a framework for analysis of the implementation of practice guidelines<sup>17,18</sup> and to identify issues in the delivery of evidence-based practice and the uptake of prescribed healthcare recommendations by patients.<sup>15</sup> Originally comprising 12 domains to explain behaviour change,<sup>16</sup> a recent validation of this framework refined the explanatory domains, resulting in a total of 14 theoretical domains.<sup>15</sup> This refined TDF includes constructs relating to 'Knowledge', 'Skills', 'Beliefs about consequences' and 'Social influences', as well as 'Intentions' and

'Goals'.<sup>15</sup> Analysis of the literature relating to referral, uptake, attendance and completion of pulmonary rehabilitation using the TDF allows for grouping of barriers and facilitators to pulmonary rehabilitation participation to be classified by the type of behaviour involved. The constructs comprising the TDF provide a basis from which to create understanding of the behaviours associated with referral, uptake, attendance and completion of pulmonary rehabilitation. This knowledge may identify some immediate strategies with which to facilitate behaviour change with respect to pulmonary rehabilitation referral and participation. This knowledge may also help guide the development and testing of novel, targeted intervention strategies that facilitate behaviour change in these clinician and patient populations.<sup>16</sup>

In summary, the aim of this systematic review was to use the TDF to understand the constructs that influence referral of people with COPD to pulmonary rehabilitation, and their subsequent participation. Therefore, the specific research question for this systematic review was:

What are the constructs that influence referral to, uptake of, attendance at, and completion of pulmonary rehabilitation by people with COPD?

## Method

### Identification and selection of studies

A search of electronic databases, from their inception, was conducted in February 2015, with updates in January 2016 and July 2016. The search strategy combined terms related to COPD with those related to *rehabilitation* or *exercise training*, plus terms related to *barriers*, *facilitators*, *attendance*, *adherence* or *attitudes*. The search strategy was adapted to each of the following databases: Medline, CINAHL, PubMed and PsycINFO. The search strategy for Medline is presented in Appendix 1 (see the eAddenda for Appendix 1).

Two authors independently identified potentially relevant literature, based on title and abstract. In accordance with the inclusion criteria, references were assigned as 'include', 'exclude' or 'unclear'. Full-text articles were retrieved for all studies classified as 'include' or 'unclear'. Two reviewers examined the full-text articles. Consensus as to final included articles was reached by discussion, with a third author available for arbitration; however, this was not required. The inclusion criteria are presented in Box 2. Studies were excluded if they were: review articles, unavailable in full text, related to telerehabilitation, or related to maintenance programs undertaken after completion of a course of pulmonary rehabilitation.

### Assessment of the characteristics of the studies

#### Quality

Quality was rated using a scale previously used in assessing studies of patient-related barriers to pulmonary rehabilitation uptake and attendance (Box 3).<sup>10</sup> This scale is a composite of

**Box 1.** Fourteen domains of the Theoretical Domains Framework and their definitions. Adapted from Huijg<sup>19</sup> and Cane.<sup>15</sup>

**Knowledge:** An awareness of the existence of something  
**Skills:** Ability or proficiency attained through practice  
**Social and professional role/identity:** Behaviours and personal qualities displayed in a work or social setting  
**Beliefs about capabilities:** Acceptance of the truth, reality, or validity about an ability, talent or facility that a person can put to constructive use  
**Optimism:** Confidence that outcomes will be for the best and/or goals will be met  
**Beliefs about consequences:** Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation  
**Reinforcement:** Increasing the likelihood of a response through the existence of a dependent relationship between the stimulus and response  
**Intentions:** A conscious decision to perform a behaviour or act in a particular way  
**Goals:** Mental representation of desired outcomes to be achieved  
**Memory, attention and decision processes:** The ability to retain information, focus selectively and choose between multiple alternatives  
**Environmental context and resources:** Circumstances of a person's situation or environment that promote (or impede) the development of skills or behaviours  
**Social influences:** Interpersonal processes that influence and individual to change their behaviour or thinking  
**Emotion:** A complex reaction, drawing on experience, behaviour, and physiological components that allow an individual to attempt to deal with a significant event/issue  
**Behavioural regulation:** Anything aimed at managing or changing objectively observed or measured actions

**Box 2.** Inclusion criteria.

**Design**

- Quantitative or qualitative studies
- English-language publication

**Participants**

- Adults with a confirmed diagnosis of COPD
- Healthcare professionals working with adults with COPD

**Data extracted**

- Qualitative or quantitative data relating to referral to pulmonary rehabilitation or non-attendance or non-completion of pulmonary rehabilitation

COPD = chronic obstructive pulmonary disease.

**Box 3. Quality assessment criteria.**

- Is the research question clearly stated?
- Are the criteria for selecting the sample clearly defined?
- Is the method of recruitment clear?
- Are the characteristics of the sample adequately described?
- Is the final sample adequate and appropriate?
- Was the method for collecting data adequately described?
- Were the data collected systematically?
- Was the relationship between the researcher and the participants explicit?
- Were the methods used in the data analysis appropriate and designed to minimise bias?
- Is evidence provided in support of the analysis?
- Is there evidence to establish validity?
- Were the conclusions drawn appropriate given the results?

several previously published scales and it allows the assessment of both qualitative and quantitative studies. It assesses reporting quality, external validity, measurement bias, purposive sampling and coding.<sup>10</sup> Two reviewers independently assessed the quality of each included study. In cases of disagreement, consensus was reached by discussion, with arbitration by a third author, if necessary. Each item on the scale was scored as 'Yes' (1), 'Unclear' (0.5) or 'No' (0), with a cumulative quality score out of a maximum 12 points recorded for each included study.

**Data extraction**

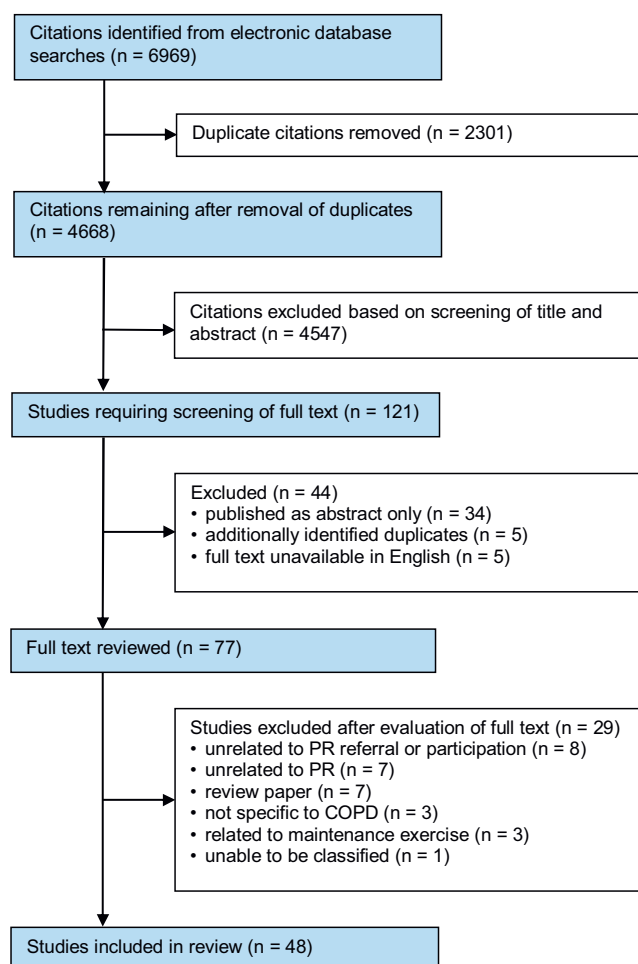
Two reviewers undertook data extraction independently. A standardised data collection form was developed to encompass details of the study design, participants, methods, outcome measures and results. Data extraction varied by type of study, to capture all relevant numerical, categorical and textual data. Concordance in data extraction was achieved through discussion.

Data extraction and analysis occurred in two stages. In the first instance, individual units of data ('items') from included papers were categorised, or *mapped*, against the 14 domains of the revised TDF.<sup>15</sup> The 14 domains of the revised TDF were defined according to Cane et al<sup>15</sup> (as published in Huijg et al)<sup>19</sup> (Box 1). Where clarification of the definition of a domain(s) was required to map an extracted data item, questionnaire content developed by Huijg et al<sup>19</sup> was used to guide the decision-making process. All raw data were mapped to the TDF, including participant quotations from qualitative studies, quantitative data from surveys and interventional studies, and descriptions of results provided by authors in the results sections of included studies.<sup>17</sup>

The second stage of the analysis comprised a frequency analysis.<sup>17</sup> The cumulative frequency of domain identification across all included studies was calculated, and the most and least frequently reported domains were identified. For each included paper, the number of items mapped (including repeat items) and the number of individual domains represented were identified. All mapped items were *coded* as either barriers or facilitators to pulmonary rehabilitation and reported by total number, as well as relative to domain.

**Results****Flow of studies through the review**

The literature search retrieved a total of 6969 potentially relevant references, of which 2301 were duplicates. On screening of title and abstract, a further 4547 references were excluded. Retrieval of full text was attempted for 121 studies. Of these, 73 were not available in full text or were excluded for other reasons. One potential study was published as a letter to the editor;



**Figure 1.** Flow of studies through the review.

COPD = chronic obstructive pulmonary disease, PR = pulmonary rehabilitation.

however, additional data were unable to be obtained in order to classify the study according to the inclusion/exclusion criteria.<sup>20</sup> Forty-eight studies were included for the final analysis (Figure 1).

**Characteristics of included studies**

Participants in the included studies were people with COPD (23 studies),<sup>11,21–42</sup> healthcare professionals (18 studies),<sup>43–60</sup> or, occasionally, combined samples of patients and healthcare professionals (7 studies).<sup>61–67</sup> Twelve of the included studies used qualitative methods,<sup>21,25,27,31,34,35,37,42,50,53,55,62</sup> 18 used quantitative methods,<sup>11,22–24,26,28–30,32,36,38,39,41,44,51,61,65,66</sup> 14 were survey based,<sup>40,43,45–49,56–60,63,67</sup> and four used a combination of both qualitative and quantitative methodology.<sup>33,52,54,64</sup> The included studies were globally representative, with 22 originating in Europe, 13 conducted in countries of the Asia-Pacific region, 11 from North America and one study carried out in each of Africa and the Middle East. The earliest published included study was from 1999,<sup>40</sup> and the most recent from 2016.<sup>24,43,54,68</sup> The characteristics of included studies are presented in Table 1 (see the eAddenda for Table 1).

The methodological quality of the included studies is presented in Table 2. In general, methodological quality was fair, with scores ranging from 2 to 12 (mean 9, SD 2). The criteria that were met least often were those relating to stating the relationship of the researcher to the participant, and providing evidence of efforts to establish validity. The criteria that were met most often were explicit statement of the research questions (47/48), appropriate conclusions relative to the results (43/48), and adequate description of the data-collection method (43/48).

**Table 2**  
Methodological quality of included studies (n = 48).

Study	Criteria												Total
	Research question clear	Sample selection criteria clear	Recruitment method clear	Sample characteristics described	Sample appropriate	Data collection method described	Systematic data collection	Researcher-patient relationship clear	Appropriate data analysis methods	Evidence supports analysis	Validity established	Appropriate conclusions	
Alsubaiei <sup>43</sup>	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	U	8.5
Arnold <sup>21</sup>	Y	Y	Y	Y	U	Y	Y	N	Y	Y	N	Y	9.5
Azarisman <sup>22</sup>	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	11
Bjoernshave <sup>23</sup>	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	10
Bourbeau <sup>44</sup>	Y	Y	Y	Y	N	Y	Y	N	Y	Y	N	Y	9
Bowen <sup>46</sup>	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	11
Brown <sup>24</sup>	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	11
Bulley <sup>25</sup>	Y	Y	N	Y	N	Y	U	Y	Y	Y	Y	Y	9.5
Busch <sup>26</sup>	Y	Y	Y	Y	Y	Y	Y	X	Y	Y	N	Y	10
Camp <sup>60</sup>	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	U	Y	10.5
Condon <sup>41</sup>	Y	Y	Y	N	U	Y	N	N	N	N	Y	Y	6.5
Decramer <sup>45</sup>	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	10
Desalu <sup>47</sup>	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	11
Fischer <sup>28</sup>	Y	Y	Y	Y	U	Y	Y	N	Y	Y	N	Y	9.5
Fischer <sup>27</sup>	Y	Y	Y	Y	N	Y	Y	N	Y	Y	N	U	8.5
Foster <sup>61</sup>	Y	N	N	U	U	Y	U	N	U	U	Y	U	6
Garrod <sup>29</sup>	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	U	N	9.5
Glaab <sup>48</sup>	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	9
Glaab <sup>49</sup>	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	10
Graves <sup>30</sup>	N	N	N	N	U	Y	N	N	N	U	N	N	2
Guo <sup>62</sup>	Y	Y	U	U	U	Y	Y	N	Y	Y	Y	Y	9.5
Harris <sup>50</sup>	Y	Y	N	N	U	Y	Y	N	Y	Y	Y	Y	8.5
Harris <sup>31</sup>	Y	Y	N	Y	N	U	U	N	U	Y	Y	Y	7.5
Harrison <sup>42</sup>	Y	Y	Y	Y	U	Y	Y	Y	Y	Y	Y	Y	11.5
Hassanein <sup>32</sup>	Y	N	Y	Y	U	U	U	N	Y	Y	N	N	6.5
Hayton <sup>11</sup>	Y	Y	X	Y	Y	Y	Y	N	Y	Y	Y	Y	10
Hernandez <sup>63</sup>	Y	Y	N	Y	Y	U	Y	N	Y	N	N	Y	7.5
Jochmann <sup>67</sup>	Y	N	Y	U	U	Y	N	N	Y	Y	Y	Y	8
Johnston <sup>51</sup>	Y	Y	Y	Y	U	Y	Y	N	Y	Y	Y	Y	10.5
Johnston <sup>52</sup>	Y	N	N	Y	U	N	U	Y	U	N	N	Y	5.5
Johnston <sup>54</sup>	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	11
Johnston <sup>64</sup>	Y	U	Y	U	Y	Y	Y	N	Y	Y	Y	Y	10
Johnston <sup>33</sup>	Y	Y	Y	Y	Y	Y	U	N	U	Y	Y	Y	10
Johnston <sup>55</sup>	Y	Y	Y	Y	U	Y	Y	N	Y	Y	Y	Y	10.5
Johnston <sup>53</sup>	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	10
Kaufmann <sup>65</sup>	Y	Y	N	Y	Y	Y	U	Y	Y	Y	N	U	9
Keating <sup>34</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	12
Lewis <sup>35</sup>	Y	Y	Y	N	U	Y	Y	Y	Y	Y	Y	Y	10.5
Li <sup>36</sup>	Y	N	Y	Y	Y	Y	U	N	Y	Y	N	Y	8.5
Moore <sup>37</sup>	Y	Y	Y	N	U	Y	Y	U	Y	Y	U	Y	9.5
Motegi <sup>59</sup>	Y	Y	Y	N	N	U	U	N	U	N	N	Y	5.5
Perez <sup>56</sup>	Y	Y	Y	Y	U	Y	Y	N	Y	Y	N	Y	9.5
Rutschmann <sup>57</sup>	Y	Y	Y	Y	U	Y	U	N	Y	Y	N	Y	9
Selzler <sup>38</sup>	Y	Y	Y	Y	Y	Y	U	N	Y	Y	N	Y	9.5
Tang <sup>66</sup>	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	11
Walker <sup>39</sup>	Y	U	N	N	U	N	U	N	Y	N	N	Y	4.5
Yawn <sup>58</sup>	Y	Y	Y	Y	U	N	U	Y	Y	Y	N	Y	9
Young <sup>40</sup>	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	11

N = no = 0 points, U = unclear = 0.5 points, X = not applicable = 0 points, Y = yes = 1 point.

Ten studies reported outcome data that were not able to be mapped to any domain of the TDF.<sup>22,36,41,44,45,47,48,57,65,67</sup> These studies primarily described patterns of adherence to guideline recommendations or clinical practice in a specific geographic region, reporting only the raw number of individuals referred to or prescribed pulmonary rehabilitation<sup>45,47,48,57,65,67,69</sup> or the proportion of participants who undertook pulmonary rehabilitation.<sup>22,41</sup> These studies did not provide any qualifying statements or context regarding referral practices or pulmonary rehabilitation uptake, thus preventing the data from being able to be assigned to a specific TDF domain. One included study<sup>57</sup> reported the percentage of physicians who never refer to pulmonary rehabilitation; however, no specific reasons for lack of referral were noted.

### Summary of items mapped to the TDF across all domains

A total of 369 items were mapped to the TDF and the extracted data for each domain of the TDF is summarised in Table 3, with greater detail for each of the 14 domains presented in Tables 4 to 17 (see the eAddenda for Tables 4 to 17).

The TDF domain with the highest number of representations across all included studies was 'Environmental context and resources' (33/48 included studies). This was followed by 'Knowledge' (18/48 included studies) and 'Beliefs about consequences' (15/48 included studies). The least often represented domains were: 'Social and professional role and identity' and

'Goals', each with 2/48 included studies; and 'Optimism' (confidence that desired outcomes will be achieved)<sup>19</sup> and 'Memory' (the ability to retain information, selectively focus or choose between alternatives),<sup>19</sup> each with 3/48 included studies. There were no domains unrepresented. More than two-thirds of items mapped to the TDF related to the patient situation ( $n = 250$ , 68%), with relatively few items pertaining to healthcare professionals ( $n = 70$ , 19%) or the patient-healthcare professional dyad ( $n = 29$ , 8%). Fewer than 10% of all mapped items related to the healthcare system or external factors such as weather. Barriers to pulmonary rehabilitation referral, uptake, attendance or completion were identified more often than facilitators, representing 71% ( $n = 183$ ) of all items mapped to the TDF domains specific to these constructs (Figure 2). A total of 29% ( $n = 75$ ) of items mapped to the TDF represented factors seen to facilitate referral, uptake, attendance or completion of pulmonary rehabilitation.

### Results by construct

#### Referral

Eleven domains of the TDF reflected items relating to the process of referral to pulmonary rehabilitation. A total of 61 items (17% of all mapped items) were identified as relating to the referral process, the majority of which were mapped to the domain of 'Knowledge' ( $n = 23$ , 38%). Of the items mapped to the 'Knowledge' domain relating to referral practices, more than half were

**Table 3**  
TDF domains mapped for each included study ( $n = 48$ ).<sup>a</sup>

Study	Domains													
	Knowledge	Skills	Social and professional role/identity	Beliefs about capabilities	Optimism	Beliefs about consequences	Reinforcement	Intentions	Goals	Memory, attention and processes	Environmental context resources	Social influences	Emotion	Behaviour
Alsubaiei <sup>43</sup>														
Arnold <sup>21</sup>														
Bjoernshave <sup>23</sup>														
Bowen <sup>46</sup>														
Brown <sup>24</sup>														
Bulley <sup>25</sup>														
Busch <sup>26</sup>														
Camp <sup>60</sup>														
Fischer <sup>28</sup>														
Fischer <sup>27</sup>														
Foster <sup>61</sup>														
Garrod <sup>29</sup>														
Glaab <sup>49</sup>														
Graves <sup>30</sup>														
Guo <sup>62</sup>														
Harris <sup>50</sup>														
Harris <sup>31</sup>														
Harrison <sup>42</sup>														
Hassanein <sup>72</sup>														
Hayton <sup>11</sup>														
Hernandez <sup>63</sup>														
Johnston <sup>51</sup>														
Johnston <sup>52</sup>														
Johnston <sup>54</sup>														
Johnston <sup>64</sup>														
Johnston <sup>33</sup>														
Johnston <sup>55</sup>														
Johnston <sup>53</sup>														
Keating <sup>34</sup>														
Lewis <sup>35</sup>														
Moore <sup>37</sup>														
Motegi <sup>59</sup>														
Perez <sup>36</sup>														
Selzler <sup>38</sup>														
Tang <sup>26</sup>														
Walker <sup>39</sup>														
Yawn <sup>38</sup>														
Young <sup>40</sup>														
Total	18	6	2	13	3	15	10	4	2	4	33	15	9	11

<sup>a</sup> Ten studies did not map to any domains.<sup>22,44,41,45,47,48,67,65,36,57</sup>



**Figure 2.** Barriers and facilitators to referral, uptake, attendance or completion of pulmonary rehabilitation across the domains of the TDF.

n = number of items mapped to the domain across all studies.

Red shading = barrier, Green shading = facilitator. Proportion shaded in each colour represents the relative proportion of responses for barriers versus facilitators.

perceived as barriers to pulmonary rehabilitation referral (n = 14, 61%). Knowledge in the TDF relates to the awareness of something,<sup>19</sup> where such knowledge may be procedural or task specific.<sup>15</sup> The 52 items mapped to this domain included healthcare professionals being unaware of who or how to refer to pulmonary rehabilitation, and patients being unaware of why they were referred, what would occur at pulmonary rehabilitation or the value of the program for their health outcomes.

Factors ascribed to the 'Environmental, context and resources' domain that related to referral were: influence of the referring doctor (positive or negative), waiting list time, and administrative burden in making a referral. This domain relates to the circumstances of a person's situation or environment that promote (or impede) the development of skills or behaviours,<sup>19</sup> and may encompass factors including resources and materials,

organisational culture, critical events and environmental stressors.<sup>15</sup> This highlights that issues beyond the physical environment impact referral to pulmonary rehabilitation.

#### Uptake

There were 43 (12%) mapped items relating to uptake of a pulmonary rehabilitation referral, spread across nine of the 14 domains of the TDF. 'Beliefs about consequences' and 'Environmental context and resources' were most commonly associated with uptake (or not) of pulmonary rehabilitation, with 13 (30%) and seven (16%) of the items mapped to uptake, respectively. Beliefs about consequences refers to a person's acceptance of the outcome of a given situation<sup>19</sup> and may relate to factors including their beliefs, outcome expectancies or anticipated regret.<sup>15</sup> The 32 items mapped to this domain included: a lack of



perceived benefit; lung disease that was too severe or not severe enough; fear of breathlessness; fears that exercise would exacerbate other health conditions; beliefs about the role and safety of exercise; and expectations regarding rehabilitation outcomes (see Table 9 on the eAddenda). Disruption to the patient's usual routine, burden of COPD and other health conditions were factors categorised as the 'Environmental context and resources' domain found to impact uptake of pulmonary rehabilitation.

More than three-quarters of all mapped items relating to uptake of pulmonary rehabilitation were perceived barriers. Ten items from the included studies were classified as facilitators to uptake of pulmonary rehabilitation, most often associated with positive reinforcement from healthcare professionals of pulmonary rehabilitation during the referral process.

#### *Attendance and completion*

Participation in pulmonary rehabilitation consisted of factors related to both attendance and completion, concepts that were not mutually exclusive. A total of 140 items (38%) were mapped across 11 domains relating to participation in pulmonary rehabilitation. 'Environment, context and resources' represented the most frequently mapped domain relative to participation in pulmonary rehabilitation, with 86 items. This equated to 61% of the 140 mapped items relating to participation. Sixty-nine (80%) of the 86 items were coded as barriers and 47 (55%) of the 86 mapped items related to program attendance specifically. Mapped items relating to program attendance included travel distance and burden, transport, time requirements, cost of parking and program location, while those relating to program completion included influence of baseline characteristics such as functional status, depression and current smoking status.

The 'Social influences' domain was the second most frequently represented domain relating to attendance and completion of pulmonary rehabilitation ( $n = 14$ , 10%). The social domain is classified as the interpersonal processes that influence an individual to change their behaviour or thinking<sup>19</sup> and may come about through social pressure, norms, support or identifying with a group.<sup>15</sup> These included: the enthusiasm of the referring doctor; hearing about benefits from friends, family and health professionals; cultural influences; whether there was social/family support to attend, including whether the participant lived alone; positive and negative impact of the group setting; and the value placed on other activities that would be missed if attending pulmonary rehabilitation. There was a nearly equal split between items classified as barriers and those viewed as facilitators to participation, relative to the perceived social influences of pulmonary rehabilitation.

#### *Items specific to healthcare professionals*

Identified barriers specifically relating to healthcare professionals in the provision of pulmonary rehabilitation included the availability of resources to run such programs, access to suitably qualified staff, financial support and equipment resources ('Environmental context and resources'). Facilitators to referral to pulmonary rehabilitation included knowledge of and easily accessible pulmonary rehabilitation referral procedures and programs ('Knowledge'), as well as successful previous referral of other patients ('Beliefs about consequences' and 'Knowledge').

### **Discussion**

There is a need to better understand the factors – both patient-related and healthcare system-related – that influence access, uptake, attendance and completion of pulmonary rehabilitation.<sup>70</sup> This review is the first to systematically analyse and integrate the barriers and facilitators to pulmonary rehabilitation for people with COPD using the TDF. Use of the TDF to synthesise literature is a relatively new concept,<sup>18</sup> with the advantage of providing a

framework for identifying target areas for intervention. The domain of 'Environmental, context and resources' was most strongly represented across the 48 studies, with over one-third of all items being mapped to this domain. The domains of 'Knowledge' and 'Beliefs about Consequences' were also strongly represented.

Factors relating to 'Environmental context and resources' made it the single most frequently mapped domain with respect to referral, uptake and participation in pulmonary rehabilitation. This domain was one of only two domains to reflect both barriers and facilitators across all four constructs relating to participation (referral, uptake, attendance and completion); however, it was vastly over-represented by barriers (76 versus 24% facilitators). The included studies in this review reported actual or anticipated difficulties in participation in pulmonary rehabilitation, including: staffing and resource factors, transportation, and timing of the program. Barriers such as lack of transport, limited mobility and geographic distance to a program are widely accepted limitations to pulmonary rehabilitation uptake and attendance in people with COPD.<sup>10</sup> Potential solutions to overcome these issues proposed by participants in the included studies ranged from: provision of transport or parking,<sup>62</sup> timing of pulmonary rehabilitation classes outside of work hours,<sup>34</sup> and improving service provision by using private practitioners and delivering programs in languages other than English.<sup>55</sup> Only one included study<sup>52</sup> investigated education and training for healthcare professionals as a means of increasing confidence in pulmonary rehabilitation delivery and, by extension, enabling increased service capacity. However, support from management and redistribution of resources was necessary to create opportunities for increased services.<sup>52</sup> The ongoing economic viability of such an intervention has not been tested. Other strategies will be needed to address the barriers to pulmonary rehabilitation uptake, attendance and completion, as identified by patients, including consideration of program location, timing and model of delivery.

Similar issues in program uptake, attendance and completion are experienced in cardiac rehabilitation settings. In a Cochrane systematic review of strategies to promote uptake and adherence to cardiac rehabilitation, only weak evidence for strategies to increase uptake of cardiac rehabilitation was identified, and strong conclusions on strategies to promote adherence were unable to be formed.<sup>71</sup> Strategies investigated to promote uptake of cardiac rehabilitation included motivational letters<sup>72</sup> and structured phone calls or home visit from a nurse,<sup>73</sup> while self-monitoring of physical activity and action-planning<sup>74–76</sup> demonstrated some effect on adherence; however, study quality was variable. No studies included in the Cochrane review assessed the effect of interventions targeting patient-focused barriers,<sup>71</sup> which (similar to pulmonary rehabilitation participants) encompass issues of transportation and timing of programs.<sup>77</sup> These findings reinforce the growing call for alternative models of pulmonary rehabilitation delivery to be investigated.<sup>78</sup> Alternatives, such as minimal resource and home-based pulmonary rehabilitation or telerehabilitation, if clinically effective and cost-effective, may improve equity of access and availability of pulmonary rehabilitation services to more individuals across a wider geographic area by eliminating the barrier posed by transportation.

Classification of data to the 'environment' domain of the TDF extends beyond the physical environment to include aspects of an individual's situation that may impact their circumstances.<sup>15</sup> In the case of people with COPD, the presence of co-morbidities or illness also exert an influence on uptake, attendance and completion of pulmonary rehabilitation. Ensuring people with COPD are able to access timely and appropriate medical care,<sup>79</sup> as well as being skilled in strategies for self-management,<sup>80</sup> may be a way of limiting the influence of health-related factors on pulmonary rehabilitation uptake and participation. However, the challenges of delivering both this type of care and education remain sizeable. Out-of-pocket expenses for healthcare pose a significant barrier to accessing health services for people with chronic disease,<sup>79</sup> and

self-management strategies are commonly taught in the context of a pulmonary rehabilitation program.<sup>81</sup> Increasing computer literacy and internet access in older populations<sup>82</sup> may provide an accessible option for education delivery to a wider audience, but this is yet to be determined.

'Environmental' constraints are not limited to patient-related or service delivery factors alone. While overcoming the physical environment in which pulmonary rehabilitation is delivered is likely to be challenging, overcoming the environmental limitations to pulmonary rehabilitation referral may be achieved through relatively uncomplicated interventions. Systems and structures impacting the referral process were identified as barriers to referral for pulmonary rehabilitation. Development of simple, streamlined referral systems,<sup>53,55</sup> increasing the scope of service providers who deliver pulmonary rehabilitation,<sup>50</sup> and using reminders and prompts (such as labelled mugs and coasters)<sup>61</sup> were all recognised as potential facilitators to referral to pulmonary rehabilitation. Environmental factors that limit pulmonary rehabilitation referral opportunities do not occur in isolation, but rather concurrently with limited knowledge of procedures and processes for pulmonary rehabilitation referral. This highlights that developing interventions to elicit behaviour change surrounding pulmonary rehabilitation may not be specific to a single TDF domain, but able to target multiple factors with a single approach. Improving physician knowledge of referral processes and benefits achieved by participants, along with creating opportunities for them to experience successful outcomes from a pulmonary rehabilitation referral, may serve to increase referral rate, and physician enthusiasm for pulmonary rehabilitation – a factor repeatedly identified by patients as a key facilitator to pulmonary rehabilitation uptake.

Outcome expectations form a key component of the domain relating to 'Beliefs about consequences'. A lack of perceived benefit from pulmonary rehabilitation participation was expressed regularly across the included studies, by both patients and healthcare professionals. Given that there is robust evidence for the improvements in physical functioning and quality of life achievable with pulmonary rehabilitation participation,<sup>81</sup> this lack of perceived benefit acutely highlights the failure of research knowledge to be absorbed into the wider public consciousness and specifically translated into clinical practice. This suggests that strategies to communicate the benefits of pulmonary rehabilitation to all stakeholders are urgently needed.

The American Thoracic Society/European Respiratory Society policy statement for enhancing pulmonary rehabilitation implementation, use and delivery recommends formal training in pulmonary rehabilitation for any healthcare professionals involved in the care of people with COPD, as well as promotion of pulmonary rehabilitation through social media and patient advocacy bodies as a means of increasing knowledge and awareness of the benefits, process and outcomes of pulmonary rehabilitation.<sup>78</sup> The widespread application of such policy recommendations may serve to improve awareness and acceptability of pulmonary rehabilitation and create a more positive perception of expected outcomes.

Items mapped to the 'Beliefs about consequences' domain also appear to be inextricably linked with knowledge – awareness and dissemination. Some people with COPD express fear that 'exercising or becoming short of breath would make them worse, rather than better'.<sup>62</sup> These people may develop positive expectations of pulmonary rehabilitation if sufficient information is provided to gain an understanding of the nature of their symptoms and the mechanisms by which improvements are achieved. If information regarding symptom management strategies is provided only during education sessions associated with pulmonary rehabilitation classes, this may not increase the breadth of patients with adequate knowledge of lung health management, particularly in light of the large numbers of people with COPD who are not participating in pulmonary rehabilitation. Increased provision of education about pulmonary rehabilitation and lung health at the point of referral may help to increase expectations for pulmonary

rehabilitation participation and overcome a lack of commitment to the program.<sup>35</sup> However, this is dependent upon the referring practitioner also having positive expectations of the benefits of pulmonary rehabilitation, and sufficient understanding of the evidence of its effect, in order to convey this to potential attendees. Identified facilitators of pulmonary rehabilitation uptake and attendance reaffirm this interplay between the concepts of 'Knowledge' and 'Belief about consequences'. Where patients experienced a positive interaction with their healthcare professional, who was also supportive and enthusiastic of pulmonary rehabilitation being a worthwhile endeavour, patients had greater perceived benefit of participation and favourable expectations of outcome.<sup>21,25</sup> The best manner by which to regularly convey evidence for and enthusiasm of pulmonary rehabilitation to a wide audience of referring practitioners is an area worthy of immediate investigation.

Although not among the three domains with the greatest frequency of items mapped to them overall, the domain of 'social influences' was the second most commonly mapped domain for constructs relating to attendance and completion. Conceding to social pressure, conforming with social norms and access to social support are all processes that may influence an individual's feelings or behaviour.<sup>15</sup> The multidisciplinary nature of pulmonary rehabilitation and the opportunity to associate with a group of individuals with similar needs and experiences were key components of the pulmonary rehabilitation environment that served as facilitators to participation. However, for some individuals, this same group exercise environment served as a barrier to participation. This further highlights the need to consider alternative models of pulmonary rehabilitation delivery, but raises the question of how best to enable social interaction for those individuals who seek it. Despite some evidence as to the efficacy and feasibility of home-based rehabilitation<sup>9</sup> and telerehabilitation,<sup>83,84</sup> these models of pulmonary rehabilitation may risk increasing social isolation. In other areas of chronic disease management, there is some evidence as to the benefit of peer-support or peer-mentoring programs to aid people in making lifestyle or behaviour changes. Peers with similar life experience who have successfully quit smoking are perceived to have more credibility than healthcare professionals; however, this method of peer-support has only shown limited effectiveness in achieving smoking cessation in individuals from economically and socially disadvantaged groups.<sup>85</sup> Peer support has been associated with improvements in glycaemic control, blood pressure, body mass index and physical activity participation in individuals with diabetes, however the quality and extent of evidence is limited.<sup>86</sup> Given that many individuals who would benefit from pulmonary rehabilitation are either former or current smokers, with multiple co-morbidities, the utility of peer support within this framework may be worth future consideration.

Support in the home environment may be an important factor contributing to attendance and completion of pulmonary rehabilitation. Numerous studies have identified that living alone or having limited home-based social support inhibits attendance and completion at pulmonary rehabilitation.<sup>24,40,43,61</sup> In some regions inpatient pulmonary rehabilitation is offered, which has the potential to achieve gains in exercise capacity in as little as two weeks<sup>87</sup> in a socially supported environment. However, similar to traditional outpatient programs, gains in exercise capacity and quality of life are not maintained at 12 months.<sup>87</sup> Additionally, inpatient rehabilitation programs are expensive,<sup>88</sup> counteract the desire to keep hospital stays to a minimum,<sup>89</sup> and may create social isolation for those individuals who are away from their families. The best way to tailor social support for socially isolated individuals undertaking pulmonary rehabilitation requires innovative thinking.

Despite providing a thorough framework within which to analyse behaviours relating to pulmonary rehabilitation uptake and participation, a limitation of the TDF in this instance is that all mapped items are given the same weight – regardless of size or quality of the study. This may have the effect of over-representing



or under-representing key barriers and facilitators. In addition, not all domains are mutually exclusive; for example, a person's living environment is not separate from the social contact they have in that location, such that someone who lives alone may welcome the social nature of a pulmonary rehabilitation group class, or be deterred by the company of many individuals. Likewise, the presence of other people in the home environment may support attendance at pulmonary rehabilitation, or serve to distract from it if they are not invested in the concept.

A further challenge to using the TDF for quantitative studies was the need to map items to pre-defined domains based only in information available from the text. It is possible that this may have led to misclassification of items in some cases. In an effort to overcome this, two reviewers completed data extraction and coding independently, prior to joint discussion of all results and recoding to achieve consensus, if necessary. Another limitation to this review is that only studies published in English were included, such that our results may not reflect the barriers and facilitators experienced in non-English speaking settings. However, the included studies were conducted in a large variety of settings and geographic locations, which lends to the representative nature of the included studies.

The benefits of pulmonary rehabilitation for people with COPD are well established, yet the challenges to improving availability, uptake and participation in pulmonary rehabilitation services are many. This review highlights the complex interaction between patient and healthcare system factors that influence feelings, attitudes and behaviours critical to referral uptake, attendance and completion of pulmonary rehabilitation. Domains of the TDF most frequently representing barriers and facilitators to pulmonary rehabilitation participation were 'Environment', 'Knowledge' and 'Beliefs about consequences'. Developing intervention strategies that recognise and target these key areas of behaviour change relating to pulmonary rehabilitation participation are crucial in improving the rate of uptake and access to pulmonary rehabilitation services.

**What is already known on this topic:** People with chronic obstructive pulmonary disease encounter many barriers to uptake and completion of pulmonary rehabilitation, so a low proportion of eligible people complete pulmonary rehabilitation, despite the known benefits.

**What this study adds:** This synthesis of 48 studies using the Theoretical Domains Framework demonstrates the importance of environment (eg, travel, waiting time), knowledge (eg, referral processes) and beliefs (eg, expectations of outcomes). These findings reinforce consensus recommendations for: increasing patient access to rehabilitation; advancing awareness and knowledge of pulmonary rehabilitation among clinicians and patients; and ensuring the quality of rehabilitation programs. To improve uptake of pulmonary rehabilitation services, it is critical to develop and use intervention strategies that target these key areas.

**eAddenda:** Appendix 1, Tables 1, 4 to 17 can be found online at <http://dx.doi.org/10.1016/j.jphys.2017.02.002>.

**Ethics approval:** Not applicable.

**Competing interests:** Nil.

**Source(s) of support:** Nil.

**Acknowledgements:** Nil.

**Provenance:** Not invited. Peer reviewed.

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