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HSDR Evidence Synthesis Centre Topic Report

Factors which facilitate or impede patient engagement with pulmonary and cardiac rehabilitation: a rapid evaluation mapping review

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This report

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Tables and Figures

Abbreviations

AMI	Acute Myocardial Infarction
C	Cardiac
CAD	Coronary Artery Disease
CINAHL	Cumulative Index to Nursing & Allied Health
COPD	Chronic obstructive pulmonary disease
CR	Cardiac Rehabilitation
CV	Cardiovascular
CVD	Cardiovascular Disease
GPs	General Practitioners
HCPs	Health Care Practitioners
IT	Information Technology
KPIs	Key Performance Indicators
LTOT	Long Term Oxygen Therapy
MESH	Medical Subject Headings
MH	Mental Health
MSK	Musculoskeletal
NHSEI	NHS England and NHS Improvement
NICE	National Institute for Health and Care Excellence
GOIS	Group Opt-In Session
OR	Odds Ratio
OR	Odds Ratio
P	Pulmonary
PDSA	Plan-Do-Study-Act
PR	Pulmonary Rehabilitation
SES	Socio-economic Status
UK	United Kingdom
USA	United States of America
WHO	World Health Organisation

Abstract

Background: There is a considerable body of systematic review evidence considering the effectiveness of rehabilitation programmes on clinical outcomes. However, much less is known about effectively engaging and sustaining patients in rehabilitation. There is a need to understand the full range of potential intervention strategies.

Methods: We conducted a mapping review of UK review level evidence published 2017-2022. We searched MEDLINE, EMBASE and CINAHL and conducted a narrative synthesis. Included reviews reported factors affecting commencement, continuation or completion of cardiac or pulmonary rehabilitation, or an intervention to facilitate these. Study selection was undertaken independently by two reviewers.

Results: In total we identified twenty review papers which met our inclusion criteria. There was a bias towards reviews considering cardiac rehabilitation, with these numbering sixteen. An additional 11 unpublished interventions were also identified through internet searching of key websites.

The reviews included 60 identifiable UK primary studies that considered factors which affected attendance at rehabilitation; 42 considered cardiac rehabilitation and 18 considering pulmonary rehabilitation. They reported on factors from the patient point of view as well as the views of professionals involved in referral or treatment. It was more common for factors to be reported as impeding attendance at rehabilitation rather than facilitating it. We grouped the factors into patient perspective (support, culture, demographics, practical, health, emotions, knowledge/beliefs, and service factors) and professional perspective (knowledge: staff and patient, staffing, adequacy of service provision, and referral from other services (including support and wait times). We found considerably fewer reviews (n=3) looking at interventions to facilitate participation in rehabilitation.

Although most of the factors affecting participation were reported from a patient perspective, most of the identified interventions were implemented in order to address barriers to access in terms of the provider perspective. Therefore the majority of access challenges identified by patients would not be addressed by the identified interventions. The more recent, unevaluated interventions implemented during the COVID-19 pandemic may have the potential to act on some of the patient barriers in access to services; including travel and inconvenient timing of services.

Conclusions: The factors affecting commencement, continuation or completion of cardiac or pulmonary rehabilitation consist of a web of complex and interlinked factors taking into consideration the perspectives of the patients and the service providers. The small number of published interventions we identified which aim to improve access are unlikely to address the majority of these factors; especially those identified by patients as limiting their access. Better understanding of these factors will allow future interventions to be more evidence based with clear objectives as to how to address the known barriers in order to improve access.

Limitations: Time limitations constrained the consideration of study quality and precluded the inclusion of additional searching methods such as citation searching and contacting key authors. This may have implications for the completeness of the evidence base identified.

Future work: High quality effectiveness studies of promising interventions to improve attendance at rehabilitation, both overall, and for key patient groups, should be the focus moving forward.

Funding and registration: This report presents independent research funded by the National Institute for Health Research (NIHR). The views and opinions expressed by authors in this publication are those of the authors and do not necessarily reflect those of the NHS, the NIHR, NETSCC, the HSDR programme or the Department of Health. The study protocol is registered with PROSPERO [CRD42022309214]

Plain English Summary

Whilst we know quite a lot about what makes rehabilitation for heart (cardiac) or lung (pulmonary) conditions effective, less is known about how to engage people with these services and encourage them to continue to attend. We have looked at what studies have already been done to summarise the factors which affect whether someone chooses to attend rehabilitation, and what is being tried to improve rates of attendance. We were particularly interested in people who are less likely to attend for rehabilitation. We searched in research databases for studies published since 2017 which included UK patients and services.

We found 17 relevant summary papers which included a total of 52 UK studies. Most of these looked at the factors which affect attendance at rehabilitation, with far fewer studies considering ways to improve attendance. There were more studies looking at rehabilitation for cardiac than pulmonary conditions. Whether someone attended rehabilitation was affected by factors such as whether they felt supported, cultural and personal factors, practical factors such as travel and access, plus patient health, emotions, knowledge and beliefs about rehabilitation services. From a staff perspective knowledge (staff and patient), staffing levels, level of service provision, and referral from other services were believed to affect attendance. We found a few studies where changes had been made to try to improve access including a number of studies of online delivery of rehabilitation services during Covid-19. Our summary of the factors which affect attendance at rehabilitation may be helpful to inform services about what changes they should make in the future to improve levels of attendance.

Scientific summary

Introduction:

There is a considerable body of systematic review evidence considering the effectiveness of rehabilitation programmes on clinical outcomes, comparing one mode of delivery with another e.g. community versus centre based rehabilitation, or considering the relative effectiveness of rehabilitation using new technologies. However, much less is known about what is effective in terms of engaging patients in rehabilitation and sustaining that engagement over time. Despite increasing awareness of the factors which influence engaging with and sustaining rehabilitation, a lack of understanding of these factors (particularly in relation to differential effects for different populations) continues to impact on implementation of rehabilitation programmes. Existing reviews

do not focus on understanding what might work for populations with lower uptake. Therefore, there is a need to map the evidence across both pulmonary and cardiac rehabilitation to understand the full range of potential intervention strategies.

We conducted a time-constrained mapping review of factors which facilitate or impede engagement (commencement, continuation and completion) with Pulmonary and Cardiac Rehabilitation. The review searched for evidence at the systematic review level.

This review addresses three related sub-questions;

- What are the factors that impede or facilitate engagement (commencement, continuation or completion) in rehabilitation by patients with heart disease or chronic lung disease?
- Which intervention components, evaluated or innovative, have been proposed to increase engagement in rehabilitation and which factors do they propose to address?
- What evidence is there for the effectiveness of such interventions as documented at a review level?

An important sub-text of these questions relates to health inequalities and differential uptake. Evidence suggests that inequalities that are already present are further exacerbated due to intrinsic features of rehabilitation programmes[17,50,63,83].

Methods:

For inclusion a review must have reported factors affecting commencement, continuation or completion of cardiac or pulmonary rehabilitation, or an intervention that aims to increase the commencement, continuation or completion of rehabilitation. We included systematic reviews which reported factors identified from a UK context published within the last five years (2017-2022). Reviews which focused on the clinical effectiveness of rehabilitation, or compare modes of rehabilitation (e.g. physical activity versus other), or location of rehabilitation (e.g. community versus hospital) were considered to be outside the scope of this review.

We conducted a single search process to retrieve both systematic reviews of intervention effectiveness (i.e. quantitative) and of factors impacting upon engagement (i.e. qualitative). The search privileged the main subject headings for the two focal topics of interest: Cardiac Rehabilitation [MESH] and Lung Diseases / rehabilitation* OR Pulmonary Disease, Chronic Obstructive / rehabilitation. The main subject headings were combined with free-text terms and synonyms for engagement, uptake, completion, barriers and facilitators. The searches on MEDLINE, EMBASE and CINAHL used filters to retrieve references to review publications.

Further web based searches were also conducted to facilitate the inclusion of recent initiatives that are not yet reported in the systematic review literature. Sources of recent initiatives included the databases of the King's Fund and Health Services Management Centre, alongside brief internet based searches.

Study selection was undertaken independently by two reviewers. Following piloting of a test set each record was screened by two of the three reviewers. In cases of uncertainty each was cross referred to the third reviewer. Data synthesised from quantitative studies was determined by the

reporting characteristics of the included reviews. Interventions have been tabulated alongside the summary results of included reviews. Data relating to PROGRESS-plus variables were also extracted where reported. The review includes published and formally evaluated projects and programmes together with recent initiatives awaiting evaluation.

Results:

Included reviews: The total number of hits from our searches was 566, of which 518 were excluded at the title and abstract stage, leaving 48 which were considered as full papers for inclusion in the review. In total we identified twenty papers which met the inclusion criteria for the review and could contribute to answering one of the research questions. Although individual quality appraisal was not undertaken the reviews all met minimum standards for conducting and reporting systematic reviews. Of these, two had no identifiable disaggregated data for the UK studies they included (Mamataz 2021[50], Supervia 2017[78]). These two reviews (both of cardiac rehabilitation have been include in the review level analysis as they are relevant, but do not contribute any data at the primary study level). For the remaining 18 reviews, disaggregated data on at least one UK primary study was identified. There was a bias towards reviews considering cardiac rehabilitation, with these numbering fifteen; only five reviews considered pulmonary rehabilitation. Seventeen reviews included qualitative data from studies which reported on factors which facilitate or impede attendance at rehabilitation from patient (n=9) or provider/system (n=6) perspectives, or considered both perspectives (n=2). Three reviews reported on interventions to improve referral, uptake, adherence and/or completion of rehabilitation.

Population: In terms of defining the population under interest, most reviews which considered cardiac rehabilitation did not limit their included studies to any particular stage of, or setting for the rehabilitation. Only three reviews included studies only from one specific stage of rehabilitation which included phase one cardiac rehabilitation patients (acute), phase 2 cardiac rehabilitation (subacute), and rehabilitation either at the intake appointment or at 6 weeks post hospital discharge.

Location: Eight reviews mentioned the location of rehabilitation which specifically included outpatient clinics, patients post hospital discharge, in patients programmes, homebased and centre based programmes in hospital or outpatient, or after an acute care hospitalization (which included home or hospital based rehabilitation). One review considered virtual education delivery of cardiac rehabilitation programmes via online platforms.

Primary studies: From the included reviews, a total of 60 UK primary studies were identifiable which were relevant to the review questions. Of the 60 identifiable primary studies that considered factors which affected attendance at rehabilitation 42 considered cardiac rehabilitation, with the remaining 12 considering pulmonary rehabilitation. Over half of the papers reported on factors from the patient point of view (n=23), with 17 considering the views of professionals involved in referral or treatment. It was more common for factors to be reported as impeding attendance at rehabilitation rather than facilitating it (despite the fact that most factors could be reported as their inverse). We grouped the reported factors as those which were from a patient perspective (including support, culture, demographics, practical, health, emotions, knowledge/beliefs, and service factors) and professional perspective (knowledge: staff and patient, staffing, adequacy of service provision, and referral from other services (including support and wait times).

Intervention reviews: In total, three reviews identified interventions; two which considered cardiac rehabilitation and one of pulmonary rehabilitation**.** The two reviews of cardiac rehabilitation (Matata 2017[53]; Santiago de Araujo Pio 2019[77]) included the same UK study (McPaul et al. 2007[54]). However there were no statistics details for the UK study by Matata et al. (2017[53]). Whereas in Santiago de Araujo Pio (2019[77]), the intervention was reported to study the effects of home visits versus telephone follow-up by an occupational therapist on CR attendance.

The review by Early et al. (2018a[8]) was the only review to address pulmonary rehabilitation (PR). They included six UK-based studies as a part of a narratively synthesised systematic review. The review aimed to establish the effectiveness of interventions to improve referral to and uptake of PR in patients with COPD when compared to standard care, alternative interventions, or no intervention. Four studies reported statistically significant improvements in referral (range 3.5%–36%), and two studies reported statistically significant increases in uptake (range 18%–21.5%).

Balance of factors: In considering our typology of factors which improve or impede attendance at cardiac and/or pulmonary rehabilitation, it is interesting to note that most of the identified interventions were implemented in order to address barriers to access in terms of provider perspective. This was particularly true of the studies identified by Early et al. (2018a[8]) which considered access to pulmonary rehabilitation. A better understanding of the access challenges from the patient perspective may facilitate interventions to address the service provision challenges they experience more effectively. Only two interventions to improve attendance at cardiac rehabilitation were identified. However these did better address some of the patient barriers to access including improving support and motivation to exercise, and overcoming issues with travel to cardiac rehabilitation. Overall however, the majority of access challenges identified by patients would not be addressed by the identified interventions. This reflects the very small number of patient access interventions identified.

Effectiveness: One small study on an intervention to improve attendance at cardiac rehabilitation suggested a positive effect (McPaul 2007[54]), although the change was not statistically significant. For pulmonary rehabilitation, two intervention studies reported an increase in referral rates (Roberts et al 2015[99], Hopkinson et al 2012[97]) but a third was not effective (Graves et al 2010[29]).

Unpublished interventions: Through additional website searching, we identified 11 recent, unpublished interventions not reported in the systematic review literature. Nine consisted of online delivery of cardiac rehabilitation (n=7) or pulmonary rehabilitation (n=2) during the COVID-19 pandemic. These interventions may have the potential to act on some of the patient barriers around access to services, including travel and inconvenient timing of services. One further intervention for cardiac rehabilitation trained staff in communication skills to encourage more patients to exercise, which may impact on patients knowledge and beliefs about rehabilitation. The final pulmonary rehabilitation intervention (developing a toolkit to increase inclusivity) may have the potential to impact on some of the demographic and cultural patients barriers identified in the factors literature.

Discussion:

Implications for service delivery:

Services should in particular, consider the barriers imposed for some patients by cultural and demographic factors which may require additional effort to:

- make service alterations to improve engagement with specific patient groups (e.g. females, ethnic minorities)
- consider the implications of group exercise on creating reluctance to attend for some individuals
- provide patient educational interventions to alter perceptions of rehabilitation and ensure that patients have a good understanding of what it involves and how it is appropriate for their needs
- provide staff training around engagement with specific patient groups, communication to encourage exercise and to better explain both the content and benefits of rehabilitation
- consider the impact of location and timing of service provision on attendance, including whether the continued provision of online services may be appropriate in some instances.

As variations between the factors reported as impacting on cardiac or pulmonary rehabilitation are not due to fundamental differences in the patient reported factors (except those related to the specific condition e.g. smokers reluctance for COPD rehabilitation), specialities can learn from each other in terms of potential interventions to improve attendance

Implications for research:

The existing review level literature on the factors which impact on attendance for rehabilitation of both pulmonary and cardiac conditions would benefit from a greater focus on what could be done to facilitate attendance as at the moment, the evidence has a negative focus. Research into interventions to improve attendance at rehabilitation, both overall, and for key patient groups, should be the focus moving forward. In developing interventions to improve access to an engagement with rehabilitation services the perspectives of both the patients and the services providers should be considered.

Conclusions:

The factors affecting commencement, continuation or completion of cardiac or pulmonary rehabilitation consist of a web of complex and interlinked factors taking into consideration the perspectives of the patients and the service providers. Although most of the factors affecting participation were reported from a patient perspective, most of the identified interventions were implemented in order to address barriers to access in terms of the provider perspective. Therefore the majority of access challenges identified by patients would not be addressed by the identified interventions. Better understand of these factors will allow future interventions to be more evidence based with clear objectives as to how to address the known barriers in order to improve access.

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programme or the Department of Health. The study protocol is registered with PROSPERO [CRD42022309214]

Introduction

Cardiac and pulmonary rehabilitation programmes vary, but usually consist of the key components of exercise, education, relaxation, and emotional support. There is a considerable body of systematic review evidence considering the effectiveness of rehabilitation programmes on clinical outcomes[1,2], comparing one mode of delivery with another e.g. community versus centre based rehabilitation[3], or considering the relative effectiveness of rehabilitation using new technologies[4]. However, much less is known about what is effective in terms of engaging patients in rehabilitation and sustaining that engagement over time[5].

Therefore, despite increasing awareness of the factors which influence engaging with and sustaining rehabilitation - including those related to environment, knowledge, attitudes and behaviours[6], a lack of understanding of these factors (particularly in relation to differential effects for different populations) continues to impact on implementation of rehabilitation programmes[7]. There is a need to map the evidence across both pulmonary and cardiac rehabilitation to understand the full range of potential intervention strategies; as existing reviews tend to be specific to a patient group, and do not focus on understanding what might work for populations with lower uptake[8].

This review seeks to understand not only the factors that impede or facilitate engagement (also reported as participation) (commencement, continuation or completion) in rehabilitation, but also what interventions exist to address these specific factors and whether they have been shown to be effective in increasing access to, and continued engagement in rehabilitation; particularly for those patients at greater risk of not accessing services.

Objectives

The review addresses three related sub-questions;

- What are the factors that impede or facilitate engagement (commencement, continuation or completion) in rehabilitation by patients with heart disease or chronic lung disease?
- Which intervention components, evaluated or innovative, have been proposed to increase engagement in rehabilitation and which factors do they propose to address?
- What evidence is there for the effectiveness of such interventions as documented at a review level?

An important sub-text of these questions relates to health inequalities and differential uptake. Evidence suggests that inequalities that are already present are further exacerbated due to intrinsic features of rehabilitation programmes[17,50,63,83].

Methods

Mapping review methodology

Following the methodology of James et al. 2016[9], we undertook a mapping review of systematic review level evidence which considers the factors which facilitate or impede engagement (commencement, continuation or completion) with pulmonary and cardiac rehabilitation. According to Booth (2016)[10], "a mapping review aims at categorizing, classifying, characterizing patterns, trends or themes in evidence production or publication" (p. 14). Grant and Booth (2009)[11] add that the point in conducting a mapping review is to "map out" and thematically understand the pre-existing research on a particular topic including assessing any gaps that could be addressed by future research. Mapping reviews are especially useful for topics where there is a lot of pre-existing literature, for investigating if there are gaps in the literature Booth (2016)[10]

Eligibility criteria

We included systematic reviews which reported factors identified from a UK context, whether separately or within a wider systematic review. All included reviews are systematic reviews with a recognisable degree of systematicity. All included reviews have been published within the last five years (2017-2022) and they include a minimum of one UK-based study. Reviews which did not include UK primary studies were excluded. Where possible UK-specific data from primary studies conducted in the UK has been identified upon extraction and subsequent data presentation. Where UK specific data could not be disaggregated, systematic reviews were considered for inclusion on a case by case basis and in considering the number of UK focused reviews identified.

For inclusion a systematic review must have reported:

- Cardiac or pulmonary rehabilitation
- Rehabilitation in any context. Rehabilitation is defined as “a set of interventions designed to optimize functioning and reduce disability in individuals with health conditions in interaction with their environment[12]”.
- Factors affecting commencement, continuation or completion of rehabilitation, including self-referral into rehabilitation; or an intervention that aims to increase the commencement, continuation or completion of rehabilitation

We included systematic reviews published within the last five years due to time constraints and to ensure data was timely and did not reflect prior service provision. However, the period covered by the primary studies reported in the review is much greater (as outline in the results section below).

Systematic reviews which focused on the clinical effectiveness of rehabilitation, or compare modes of rehabilitation (e.g. physical activity versus other), or location of rehabilitation (e.g. community versus hospital) were considered to be outside the scope of this mapping review.

Search strategy

We conducted a single search process to retrieve systematic reviews of both intervention effectiveness (i.e. quantitative) and of factors impacting upon engagement (i.e. qualitative). Sources searched include specific resources that focused on systematic reviews and other systematically conducted reviews (e.g. scoping and mapping reviews) and general resources where systematic reviews filters were run against search results (Table 1). This project was conceived as a time-constrained mapping review and restriction of the databases searched was according to best evidence on database coverage. Using Embase as a supplement to PubMed covers 78% of publications and 88% of Cochrane-eligible effectiveness studies[13]. Similarly, a combination of PubMed and CINAHL (two commonly recommended databases for qualitative reviews) retrieves 82% of the publications[13]. Table 1. shows the databases searched in February 2022.

Table 1. Databases searched

Review-Specific Sources	**General databases**
Cochrane Reviews (via Wiley)	EMBASE (via Ovid)
Epistemonikos (maintained by Epistemonikos foundation)	MEDLINE (via Ovid)
	CINAHL (via EBSCO)

The search privileged the main subject headings for the two focal topics of interest:

Cardiac Rehabilitation [MESH]

and

Lung Diseases / rehabilitation* OR Pulmonary Disease, Chronic Obstructive / rehabilitation

The rationale for this was (i) systematic reviews are more likely to be indexed with main subject headings and (ii) the focus on qualitative aspects and overall effectiveness was less likely to match to granular subject headings. There are also no validated search filters for Cardiac or Pulmonary Rehabilitation.

The main subject headings were combined with free-text terms and synonyms for engagement, uptake, completion, barriers and facilitators. The searches on MEDLINE, EMBASE and CINAHL used filters to retrieve references to review publications. The searches were limited to English Language and peer-reviewed publications from 2017-2022. The search strategy for Ovid MEDLINE is included in Appendix 1. This search once developed, was translated to the other databases. Records were managed in Endnote and a database of included studies with selection decisions is available.

The focus on UK developments also allowed for the inclusion of recent initiatives that are not reported in the peer reviewed literature at the systematic review level (due to being conducted too recently). These were identified through additional internet based searches. Sources searched to find recent initiatives in April 2022 included the databases of the King's Fund and the Health Services Management Centre, alongside brief internet based searches.

Study selection

Study selection was undertaken independently by two reviewers. Following piloting of a test set each record was screened by two of the three reviewers. In cases of uncertainty each was cross referred to the third reviewer.

A "light touch" data extraction process was undertaken. This included review characteristics, number of included studies and proportion of UK studies. Where disaggregated data for UK primary studies was reported in the reviews this was extracted individually on a study by study basis alongside the review level data. Top level themes were extracted for the qualitative syntheses and a summary of results and outcomes were extracted from the abstracts of included quantitative reviews where they included sufficient data. Where required for clarity, the full text of the papers were also scrutinised.

Interventions were characterised using a version of TiDIER-Lite[14] as pioneered by the team, using descriptive data from study characteristics. The TiDIER-Lite characteristics described the interventions in terms of the following questions:

- What

  By Whom?
- Where?
- To what intensity?
- How often?

Extraction were undertaken using purpose-designed forms. The factors identified were initially characterised (where it was possible to differentiate) as:

- Factors facilitating commencement
- Factors impeding commencement
- Factors facilitating completion
- Factors impeding completion

Data relating to PROGRESS-plus variables[15] were also extracted where reported. These included: Place of residence, Race, Occupation, Gender, Religion, Education, Socioeconomic status, Social capital, personal characteristics associated with discrimination (e.g. age, disability), features of relationships (e.g. smoking parents, excluded from school), time-dependent relationships (e.g. leaving the hospital, respite care, any temporary disadvantage).

Outcomes and prioritization

Extracted data includes both programme outcomes (e.g. completion of the programme, rates of withdrawal or dropout etc., satisfaction) and clinical outcomes. The results of primary outcomes of

interest have been presented. However, other relevant outcomes have also been mapped as part of the analysis of reviews. Data on the characteristics of participants upon initiation (demographic and clinical characteristics) has been a particular focus of data presentation.

Risk of bias in individual studies

Given that the purpose of the mapping exercise is to describe factors identified as important in connection with engagement, no quality assessment will be required for the qualitative reviews. The quality of the quantitative reviews has been briefly summarised, based on the aggregative quality of the included studies. Quality assessment of the included reviews has not been undertaken except when reconciling conflicting evidence to facilitate interpretation.

Data synthesis

Data synthesised from quantitative studies was determined by the reporting characteristics of the included reviews. Interventions have been tabulated alongside the summary results of included reviews.

Formal subgroup analyses were not undertaken, however, studies were coded against ethnic minority composition and any other salient features from the PROGRESS-Plus classification[15]. Studies or study populations meeting these features have been separately analysed and reported in comparison to the characteristics and results for a non-specific population.

The time-constrained characteristics of this review prohibit formal analysis of meta-biases as they relate to aspects of reporting and publication bias. However, the review includes published and formally evaluated projects and programmes together with recent initiatives awaiting evaluation. In particular, the team has sought to prevent pro-innovation bias – the unconscious favouring of new initiatives that have not undergone formal evaluation[16].

There is no formal requirement to complete GRADE or GRADE-CERQual assessments of the strength of evidence as recommendations will not be made. The focus was on presenting a descriptive map of factors, intervention components and intervention effects.

Results

REVIEW LEVEL DATA

Included reviews summary:

The total number of hits from our searches was 566, of which 518 were excluded at the title and abstract stage, leaving 48 which were considered as full papers for inclusion in the review (Figure 1). In total we identified twenty papers which met the inclusion criteria for the review and could contribute to answering one of the research questions (Table 2.) Full extraction data for each included review is available on request from the lead author. Of the 20 review papers, two had no identifiable disaggregated data for the UK studies they included (Mamataz 2021[50], Supervia 2017[78]). These two reviews (both of cardiac rehabilitation) have been included in the review level analysis as they meet the inclusion criteria for the review, but they do not contribute any data at the primary study level). For the remaining 18 reviews, disaggregated data on at least one UK primary study was identified. In addition a further 28 reviews were excluded after consideration at the full paper stage (Appendix 2, Table 8.). The reasons for exclusion include no UK primary studies (n=11 reviews), primary study locations not reported (n=2) and other (n=15) which included papers which were not reviews, not about rehabilitation and duplicates.

The included reviews (published between 2017 and 2021) included a wide variety of search date ranges, the earliest search date being 1984 and the latest including publications up to 2021. There was a bias towards reviews considering cardiac rehabilitation, with these numbering fifteen; only five reviews considered pulmonary rehabilitation. Seventeen reviews included qualitative data from studies which reported on factors which facilitate or impede attendance at rehabilitation from patient (n=9) or provider/system (n=6) perspectives, or considered both perspectives (n=2). Three reviews reported on interventions to improve referral, uptake, adherence and/or completion of rehabilitation.

Figure 1. The process of study selection

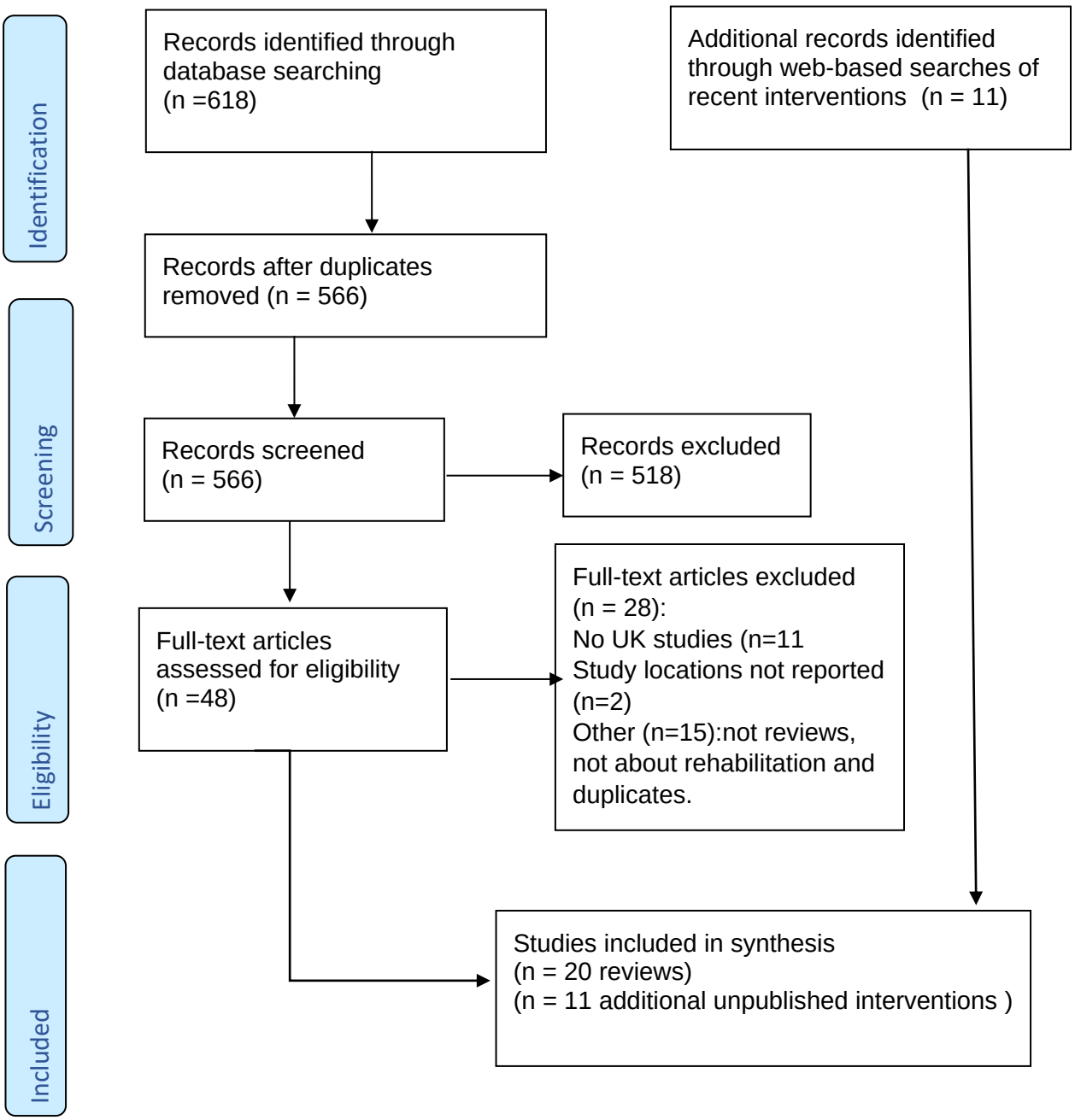

Table 2. Summary data of reviews including UK studies

Study Author location	C / P	Approach	Commencement, Adherence (continuation or completion),	Search date range	Pub^{n} date range	Included UK studies	UK primary study results [factors or intervention data]
Campkin 2017[17], Canada	C	Factors, patient views	C+A "Initiation and continued participation"	Database inception – May 2015	2000-2014	Sriskantharaja 2007[18] Farooqi 2000[19] Galdas 2012[20] Shaw 2012[21] Cole 2013[22] Dunn 2014[23]	Sriskanthariajah 2007: Health fears, social support improve participation. Negative cultural/religious views of exercise (seen as selfish) decreased participation. Farooqi 2009: Cultural factors (language barriers, mixed gender facilities) dissuaded participation. Galdas 2012: Concerns regarding personal safety and environment (weather conditions) reduced participation. Attentive staff improved adherence. Shaw 2012: Negative emotion (unable to establish self-worth), social pressure, and inconvenient class times reduced adherence. Cole 2013: Fear (consequences of not attending) improved adherence. Dunn 2014: Self-confidence (rehab not intimidating) and peer support (sense of togetherness) improved adherence.
Daw 2021[37], UK	C	Factors, professional views and system factors	Unclear: "Delivery"	Not reported	2010-2020	Dalal 2012[38]	Dalal 2012: Improves "delivery of services": Skill mix of staff; Tailored guidelines; Different modes of delivery Impedes "delivery of services": Poor evidence base;

							Non tailored guidelines; Lack of resources; Lack of commissioning; Blurred roles; Lack of patient pathways
Fowokan 2020[39], Canada	C	Factors, system factors	Commencement ("referral and uptake")	Database inception-December 2019	1997-2019	Buttery 2014[40] Houghton1997[41]	Buttery 2014: Being younger improved attendance (uptake and maintenance). Houghton 1997: Being female impeded attendance (uptake and maintenance).
Hall 2017[42], Australia	C	Factors, patient views	Commencement ("implementation")	January 2003-December 2014	2004-2012	Kilonzo and O'Connell 2011[43] Proudfoot 2007[44] Smith 2007[45]	Kilonzo 2011: Patients: Individualised information provided, and given time to be understood improves commencement. Professionals: "views differed". Proudfoot 2007: Lack of staff and funding impedes commencement. Smith 2007: Younger age (less interested) impedes commencement.
Jahandideh 2018[46], Australia	C	Factors, system factors	C+A ("Initiation and sustained engagement")	Database inception-13 January 2017	1998-2018	Bennett1999[47] Sniehotta 2010[48] Jolly 2007[49]	Bennett 1999: Outcome expectancies (no definition: relates to whether expecting success) predicted intention to engage in a healthy diet and regular exercise. Sniehotta 2010: Action planning (precise plan about where and when patients planned to CR) improved uptake. Jolly 2007: no relevant data included.
Mamataz 2021[50], Canada	C	Factors, patient views (female)	A ("Adherence")	Database inception-May 2020	2002-2020	Asbury 2007[51] Madison 2010[52]	No disaggregated data for UK studies.
Matata 2017[53], UK	C	Interventions to improve	C+A ("Enrolment or adherence")	Database inception-May 2017	2003-2012	McPaul 2007[54]	McPaul 2007: Home visit interview with an occupational therapist instead of a phone call.

		uptake/adherence					
McHale 2020[55], UK	C	Factors, patient views	C ("engagement")	January 1990-December 2017	2004-2017	Clark 2004[56] Cooper 2005[57] Herber 2017[58] Hird 2004[59] Jones 2007[60] Robertson 2010[61] McCorry 2009[62] Shaw 2012[21]	Clark 2004 : Embarrassment about group/public exercise, misunderstood the role of exercise in rehab, cardiac misconceptions (perception of condition severity), perceptions of fitness and lack of post event communication and advice impedes attendance. Faith in body, fitness, willing to support others, believed exercise important to recovery increased attendance. Cooper 2005: Beliefs about course content, perceptions of exercise, the benefits of CR and CR knowledge influenced attendance decisions. Some viewed CR as important to recovery, others misunderstood the role of exercise. Cardiac misconceptions were present and negatively influenced attendance. Herber 2017: Personal factors, programme factors and practical factors influenced participation. Barriers were: participants perceived themselves unsuitable and lack of knowledge and/or misconceptions about CR. Hird 2004: Impedes engagement: Transport problems. Family commitments. Increases engagement: wanting to reach previous exercise levels. Jones 2007: Impedes engagement: Participation in alternative exercise, other health problems, lack of motivation (esp. for females), age appropriateness of rehab considered low.

							McCorry 2009: Impedes engagement: Not recognising health benefits of exercise / rehab. Professionals viewing medication more important than rehab. Robertson 2010: Engagement affected by: emotionality relating to body prior to cardiac event, male identity, self-confidence in physical ability. Shaw 2012: Increases participation: Feeling positive about CR. Impedes: Believe active enough already, other health problems, feeling unsupported in class, competing demands, self confidence in physical ability, perceive CR as not appropriate.
Resurreccio´n 2017[63], Spain	C	Factors, patient views (female)	C+A ("non participation and dropping out")	Database inception-September 16 2016	1992-2013	Cooper 2005[57] MacInnes 2005[64] Sherwood 2011[65] Chauhan 2010[66]	Cooper 2005: Barriers to non-participation : lack of family and social support. Barriers to non-participation: embarrassment (due to group format). Barriers to non-participation and drop out: work conflicts, employment restrictions. MacInnes 2005: Barriers to non-participation: self-reported health problems (in women), health beliefs (heart attacks cannot be prevented). Sherwood 2011: Barriers to non-participation: health beliefs (beliefs that women could manage or solve their heart problem by themselves), time constraints, feelings of embarrassment (due to group format), communication difficulties (language). Chauhan 2010: Barriers (drop out): self-reported health problems, religious reasons. Barriers (non-

							participation): transport (not having suitable transport), negative experiences with health system.
Rowley 2018[67], UK	C	Factors Adherence to rehab (duration)	A ("Adherence/ completion")	Date range varied for different conditions not clearly reported.	2002-2016	Duda 2014[68] Edwards 2013[69] Littlecott 2014[70] Murphy 2012[71] Anokye 2012[72] Hanson 2013[73] Mills 2013[74] Rouse 2011[75] Webb 2016[76]	All UK studies (not all disaggregated data): Longer length schemes (20+ weeks) had higher adherence to physical activity prescribed, than those of shorter length (8–12 weeks). Primary studies factors: Edwards 2013: Participants with risk of CVD more likely to adhere to the full programme than those with mental health conditions. High deprivation were more likely to complete the programme. Hanson 2013: Leisure site attended was a significant predictor of uptake and length of engagement. More successful for over 55s, and less successful for obese participants. Mills 2013: Those with CVD, more likely to attend and adhere, compared to pulmonary disorders Link between age and attendance. Webb 2016: Community-based exercise increased adherence (vs. continuously monitored exercise Programme). Littlecott 2014: Individuals with CVD risk in the control group participated in more PA per week than those in the intervention group with CHD risk factor

Santiago de Araujo Pio 2019[77], UK/Canada	C	Interventions to improve uptake/adherence	C+A ("Enrolment, adherence, completion")	2013-July 2018	1999-2016	McPaul 2007[54]	McPaul 2007: Home visit interview with an occupational therapist instead of a phone call.
Supervia 2017[78], USA	C	Factors, patient views (female)	C+A ("Referral, enrolment, completion")	Database inception-October 20 2016	1998-2016	Jolly et al 1998[79] Jolly et al 2007[49]	No disaggregated data for UK studies
Vanzella 2021a[80], Canada	C	Factors, patient views	Commencement	Database inception-April 2021	2001-2021	Devi 2014[81] Higgins 2017[82]	Devi 2014: Virtual learning in CR programmes. Enablers: manage their time (learn according to their availability), patient empowerment (improves treatment adherence, reduced stress and anxiety). Barriers: format of the delivered materials, older age. Higgins 2017: Technology as a facilitator to virtual learning. Format of the delivered materials, and sessions that were too long were barriers to participation. For older individuals the use of animation tools and websites that were easy and simple to navigate facilitated the learning process.
Vanzella 2021b[83], Canada	C	Factors, patient views (ethnicity)	C+A ("Referral, enrolment, completion")	Database inception-10 February 2020	1997-2019	Astin 2005[84] Bhattacharyya 2011[85] Chauhan 2010[66] Darr 2008[86] Jolly 2005[87] Jones 2007[60] Jolly 2009[88] Visram 2007[89]	Astin 2005: Barriers to CR enrolment: lack of family support, language. Bhattacharyya 2011: Barriers to CR enrolment: lack of family support language, culture, age psychological status, knowledge/beliefs/interest, religion and socioeconomic status; provider level: CR knowledge. Chauhan 2010: Barriers to CR enrolment: language, culture, age psychological status,

						Webster 1997[90]	knowledge/beliefs/interest, religion and socioeconomic status; provider level: CR knowledge, system-level – practical/logistical barriers. Jolly 2005: Barriers to CR enrolment: lack of family support language, system-level – practical/logistical barriers. Barriers to adherence and completion: Practical/logistical, individual perceptions. Darr 2007: Barriers to adherence and completion: Practical/logistical, language, religion, culture. Jones 2009: Barriers to adherence and completion: Practical/logistical, individual perceptions. Visram 2009: Barriers to adherence and completion: Practical/logistical, individual perceptions, language, lack of knowledge about CR programs, culture, socioeconomic status, psychological status and family support. Webster 1997: Barriers to adherence and completion: individual perceptions, lack of knowledge about CR programs, religion.
Vanzella 2021c[91], Canada	C	Factors, professional views and system factors	Adherence	Database inception-15 March 2021	1984-2018	Astin 2008[92] Leong 2004[93]	Astin 2008: Barriers to adherence: habits, cultural aspects, time constraints, lack of knowledge, financial situation. Facilitators: Family support, individual financial situation.

							Leong 2004: Facilitators to adherence (healthy eating habits): Family support, older age.
Cox 2017[24], Australia	P	Factors, patient views and professional views	C+A "Uptake and completion"	Database inception-July 2016	1999-2016	Arnold 2006[25] Bulley 2009[26] Foster 2016[27] Garrod 2006[28] Graves 2010[29] Harris 2008a[30] Harris 2008b[31] Harrison2015[32] Hayton 2013[33] Lewis 2014[34] Moore 2012[35] Walker 2011[36]	(UK studies identified from reference lists, not by review authors). Arnold 2006: Completers of PR (n = 16) interviews categorised by: - positive influence of referring practitioner - self-help - enjoying program/seeing improvement - the effect of the group. Non-completers (n = 4) identified: - social support and motivation Bulley 2009: Three key themes identified: - Desired benefit of attending PR: most participants had positive and realistic expectations - Evaluating threat of exercise: Fear of exercise deterred some from participating while determination conveyed a more positive attitude. - Attributing value to PR: information (or lack of) provided at referral had an important influence on attendance. Foster 2016: Current smokers were more evident among those who declined referral; those who accepted a referral included a higher percentage of individuals on O2; of those who declined a greater proportion lived alone, were divorced or separated. Incentives to promote PR included in-house education sessions, changes to practice protocols, and 'pop-ups' and memory aids (mugs and coasters). Garrod 2006: Quads strength (p = 0.03), smoking pack yrs. (p = 0.04), SGRQ (health status) (p = 0.02) and

							depression (p < 0.001) independently discriminated between completers and dropouts. - Depression a risk factor for dropout Graves 2010: 59% undertook PR assessment, 52% proceeded to undertake PR, of whom 88% completed. Harris 2008a: Losing control - Gaining control Harris 2008b: Changing roles of members of health care team. – Communication - Logistics of referral for PR - Patients willingness to accept referral Harrison 2015: Construction of the self (impact of acute exacerbation on personal identity); - Relinquishing control (struggle to maintain agency following acute event); - Engagement with others Hayton 2013: Independent predictors of attendance: LTOT long term oxygen therapy – OR 0.45 (0.22, 0.96) p = 0.038 Co-habitation – OR 1.82 (1.02, 3.24) p = 0.042 Adherence: Age (youngest and oldest quartiles least likely to complete PR); current smoking status (44.9% adherence versus 79.9% ex-smoker adherence); LTOT use (59.3% adherence versus 73.0% adherence in non-LTOT users) Lewis 2014: uncertainty – related to lived experience temporally.

							Moore 2012: Difficulties with access due to geography or timing - Difficulties in prioritising the treatment - Contrary beliefs about the role and safety of exercise - Fears about criticism exposure and inadequacy Walker 2011: Significant difference in PR attendance by season (summer 74% versus winter 64%, $p < 0.05$). - Weak positive correlation between attendance and maximum temperature ($r = 0.51$), minimum temperature ($r = 0.44$), daylight hours ($r = 0.55$). - Weak negative correlation between attendance and rainfall ($r = –0.33$).
Early 2018a[8], UK	P	Interventions to improve uptake/adherence	Commencement ("referral and uptake")	Search start date not reported-end of January 2018	2007-2016	Angus 2012[96] Hopkinson 2012[97] Hull 2014[98] Roberts 2015[99] Foster 2016[27] Graves 2010[29]	Barriers for PR: Angus 2012; PR referral. Hopkinson 2012; PR referral, staff education, staff monitoring/knowledge of PR (e.g. ward staff attended PR sessions), patient information Hull 2014; PR referral, service identification/monitoring of patients (lack of patients on relevant registers - financial incentives for KPIs), completed care plans Roberts 2015 ; PR referral, patient information, completed care plans, pre referral assessment Foster 2016; PR referral, staff education, secondary care discussions about PR

							Graves 2010 PR referral, patient information, self-management, pre referral assessment Interventions: Angus: Computer-guided review, based on NICE guidance, by practice nurses during routine COPD review. Hopkinson 2012: 1)Ward-based staff education 2) Discharge care bundle with referral for PR assessment 3) Patient offered phone call 48–72 hours post discharge to check if they were improving 4) PDSA cycles to refine the process 5) Prize draw for staff completing checklist 6) ward staff attended hospital PR sessions 7) PR patient information leaflet. Hull 2014: 1) eight networks of GPs 2) Financially incentivized KPIs 3) Care package based on NICE guidance 4) IT infrastructure 5) Support from community respiratory team 6) Network boards to review practice performance against targets, 7) Quarterly community COPD multidisciplinary team meeting 8) Rapid email/phone advice from consultant. Roberts 2015: Patient-held scorecard containing six care quality indicators comparing patient's care to the standard. Sent to patient with letter advising patient to discuss scorecard at the next COPD review 2) Telephone helpline for patients.

							Foster 2016: increasing referrals; briefing note based on questionnaire feedback and literature review with suggestions for standardizing PR knowledge and increasing referral (in house education, practice protocols, "pop-ups," and memory aids to prompt discussion about PR). Graves 2010: Group Opt In Session (1.5 hours) prior to assessment for PR; run by physiotherapist and clinical psychologist; discussion of patient case study, self-management, PR information, alternatives to PR.
Milner 2018[100], Canada	P	Factors, professional views	C ("referral")	Database inception-July 28 2017	2007-2016	Harris 2008a[30] Gautam 2011[101] Jones 2012[102] Martin 2012[103] Gaduzo 2013[104] Jones 2013[105] Sewell 2013[106] Thompson 2013[107] Hull 2014[98] Jones 2014[108] Roberts 2015[99] Foster 2016[27]	Limited disaggregated data for UK studies. Data on 2 studies only (also included in other reviews). Harris 2008a: Enablers to commencement: having a streamlined referral process in place, adequate local service provision, short waiting time for patients to get into PR, protected time for info giving (time to tell patients about PR). Barriers: Difficult to access service (availability, wait times), unable to refer/difficult referral process, lack of time. Foster 2016: Enablers to commencement: PR training/experience in thoracic outpatient clinics or rehab /reading /mentoring /teaching; PR awareness events; Prompt on review template/computerized pop-ups (making it part of workflow/ reminders). Barriers: Low knowledge of/don't know what PR is; Low knowledge of/don't know what/don't believe in PR benefits; Don't know enough about patient eligibility;

							Don't know about/low knowledge of referral process; Lack of clear within-practice referral guidelines
Swift 2020[109], UK	P	Factors, professional views	Commencement ("referral")	1998-August 2019	2005-2019	Foster 2016[27] Harris 2008a[30] Summers 2017[110] Wilson 2007[111]	Foste 2016: Poor knowledge of pulmonary rehabilitation, especially from GPs impeded referral. Strategies to increase referrals: running sessions at the GP practice to increase awareness, memory aids, prompts on yearly review forms, and development of a pulmonary rehabilitation referral practice specific protocol. Harris 2008a: Perceived barriers to referral: lack of clarity (whose role it was to refer), lack of knowledge about referral process, long wait times, communication issues when introducing PR and time associated with discussion. Summer 2017: barriers: difficulty establishing realistic patient goals, difficult for patients to begin exercise, services issues (funding, less input from other disciplines, time constraints, cost effectiveness, need to justify). Wilson 2007: Barriers: patients need better understanding of COPD to reduce exercise anxiety, educates patients and their relatives about exacerbations, psychological effects as important as physical. Benefits: assists with depression, low self-esteem and smoking related remorse.
Bohplian 2021[94], USA	P C	Factors, patient views	C+A (participation and adherence)	2010-2019	2010-2018	Russell 2010[95]	Support from health care professionals improves adherence.

P – Pulmonary Rehabilitation; C – Cardiac Rehabilitation.

Included reviews

Study populations

Cardiac rehabilitation:

In terms of defining the population of interest, most reviews which considered cardiac rehabilitation did not limit their included studies to any particular stage (acute, subacute, intensive outpatient or ongoing) of, or setting for the rehabilitation. Only three reviews included studies only from one specific stage of rehabilitation which included phase one (acute) cardiac rehabilitation patients (Hall et al. 2017[42]), phase 2 (subacute) cardiac rehabilitation (Santiago de Araujo Pio 2019[77]) and rehabilitation either at the intake appointment or at 6 weeks post hospital discharge (Matata et al. 2017[53]).

Eight reviews mentioned the location of rehabilitation which specifically included outpatient clinics (Fowokan 2020[39]), patients post hospital discharge (Matata et al. 2017[53], Supervia et al. 2017[78]) in patients programmes (Hall et al. 2017[42]), homebased and centre based programmes (Jahandideh et al. 2018[46]) in hospital or outpatient (Vanzella et al. 2021c[91]) or after an acute care hospitalization (which included home or hospital based rehabilitation) (Santiago de Araujo Pio et al. 2019[77]). Vanzella 2021a[80] considered virtual education delivery of cardiac rehabilitation programmes via online platforms.

Most review authors included rehabilitation for any cardiac event or condition (Mamataz, et al. 2021[50], Matata et al. 2017[53], Supervia 2017[78], Santiago de Araujo Pio et al. 2019[77], Vanzella et al. 2021a[80], Vanzella et al. 2021b[83], Vanzella et al. 2021c[91]), but seven were more specific. Those who limited their included studies by disease population defined them as follow:

- Bohplian et al. 2021[94]: patients with AMI and CAD, post-operative cardiac surgery, and post-coronary intervention.
- Campkin et al. 2017[17]: post myocardial infarction (women and south Asian populations)
- Daw et al. 2021[37]: heart failure patients
- Fowokan et al. 2020[39]: hospitalized heart failure patients
- Hall et al. 2017[42]: hospitalised with coronary heart disease (CHD)
- Jahandideh 2018[46]: rehabilitation to stabilise, slow, or reverse cardiovascular disease and facilitate prevention of further cardiac events.
- McHale 2020[55]: Acute Coronary Syndrome CV rehabilitation
- Resurreccio´n 2017[63]: female patients with cardiovascular disease
- Rowley 2018[67]: persons with CV, MH, and MSK disorders including participants with coronary heart disease (CHD) or who were at increased CHD risk, CV disease or at increased CV disease; and participants with hypertension.

Most reviews did not limit the studies they included by PROGRESS-Plus classification [Place of residence, Race, Occupation, Gender, Religion, Education, Socioeconomic status, Social capital, personal characteristics associated with discrimination (e.g. age, disability), features of relationships (e.g. smoking parents, excluded from school), time-dependent relationships (e.g. leaving the hospital, respite care, any temporary disadvantage)] with the exception of four reviews which included studies of cardiac rehabilitation for women (Campkin 2017[17], Mamataz et al 2021[50], Resurreccio´n et al. 2017[63]) and/or ethnic minority populations (Campkin 2017[17], Vanzella 2021b[83]).

Pulmonary rehabilitation:

The four reviews which considered pulmonary rehabilitation included all populations of patients receiving pulmonary rehabilitation (Swift et al. 2020[109]) or pulmonary rehabilitation for COPD (Cox et al. 2017[24], Early et al. 2018a[8], Milner et al. 2018[100]) but did not limit their study population further in terms of location or criteria for rehabilitation, and did not use any PROGRESS-Plus classification to define their inclusion criteria.

Primary papers: Factors studies

Seventeen reviews included qualitative data from studies which considered factors affected commencement, continuation and completion of rehabilitation. In many cases the factors were reported individually (and for the identifiable UK primary studies, are discussed further below). In addition, the authors of six reviews (of which only one considered pulmonary rehabilitation (Swift et al. 2020[109]); attempted to create a typology of the types of factors which affected commencement, continuation and completion of rehabilitation. The reviews included a mixture of UK and non-UK studies, and as a result the typologies should only be used to give a sense of the type of factors being reported. Overall where typologies were reported, the factors were categorised by the review authors as follows:

- Campkin et al. (2017 Campkin 2017[17]) described factors as **external** (pragmatic and social considerations such as safety, accessibility, and social support networks); **internal** (physical, cognitive, and emotional domains, which include fear, motivation, and mood), and **cultural** factors influence exercise initiation and continued participation.
- In Resurreccio´n 2017[63]) "barriers" to rehabilitation were grouped into five categories which included: **intrapersonal barriers, interpersonal barriers, logistical barriers, CR program barriers,** and he**alth system barriers**.
- Swift et al. (2020[109]) summarised the "barriers" they identified as those which incorporated a lack of **knowledge**, a lack of **resources**, **practical barriers, patient barriers, and healthcare professional's** being unsure it is their role to refer (Swift 2020[109]).
- Vanzella et al. (2021a-c[80, 83, 91]) described the factors as **Individual, provider and system/ environmental levels.**

Interventions:

Three reviews reported on interventions, of which two reviews (of cardiac rehabilitation interventions) included a single UK-based study (Matata et al 2017[53], Santiago de Araujo Pio et al 2019[77]). The review by Early et al (2018a[8]) contained the largest number of UK studies (6 of 14 included papers). This review considered interventions to improve participation in pulmonary rehabilitation.

Included UK primary studies:

From the included reviews, a total of 76 UK primary studies were identifiable (Table 3.). Of these, 11 were included in more than one review. However, for 11 of the primary studies, no disaggregated data was presented in the review papers or supplementary material. Of the 65 primary studies with

disaggregated data presented, five were not relevant to this review as they reported on general exercise referral schemes (Anokye et al. 2012[72], Duda et al. 2014[68], Murphy et al. 2012[71], Rouse et al. 2011[75]) or did not report factors relating to attendance (Jolly et al. 2007[49]). Therefore 60 primary studies were included in the analysis.

Table 3. UK studies cited in the included reviews

[Key: Bold = study in more than one review; Grey = no disaggregated data; Strikethrough = excluded]

UK primary study	**Review**
Angus 2012[96]	Early 2018 a[8]
~~Anokye 2012[72]~~	Rowley 2018[67]
Arnold 2006[25]	Cox 2017[24]
Asbury et al 2007 [51]	Mamataz 2021[50]
Astin 2005 [84]	Vanzella 2021b[83]
Astin 2008[92]	Vanzella 2021c[91]
Bennett 1999[47]	Jahandideh 2018[46]
Bhattacharyya 2011[85]	Vanzella 2021b[83]
Bulley 2009[26]	Cox 2017[24]
Buttery 2014[40]	Fowokan 2020[39]
Chauhan 2010[66]	Resurreccio´n 2017[63], Vanzella 2021b[83]
Clark 2004[56]	McHale 2020[55]
Cole 2013[22]	Campkin 2017[17]
Cooper 2005[57]	McHale 2020[55], Resurreccio´n 2017[63]
Dalal 2012[38]	Daw 2021[37]
Darr 2008[86]	Vanzella 2021b[83]
Devi 2014[81]	Vanzella 2021a[80]
~~Duda 2014[68]~~	Rowley 2018[67]
Dunn 2014[23]	Campkin 2017[17]
Edwards 2013[69]	Rowley 2018[67]
Farooqi 2000[19]	Campkin 2017[17]
Foster 2016[27]	Early 2018a[8], Milner 2018[100], Swift 2020[109], Cox 2017[24]
Gaduzo 2013[104]	Milner 2018[100]
Galdas 2012[20]	Campkin 2017[17]
Garrod 2006[28]	Cox 2017[24]
Gautam 2011[101]	Milner 2018[100]
Graves 2010[29]	Cox 2017[24], Early 2018a[8]
Hanson 2013[73]	Rowley 2018[67]
Harris 2008a[30]	Cox 2017[24], Milner 2018[100], Swift 2020[109]
Harris 2008b[31]	Cox 2017[24]
Harrison 2015[32]	Cox 2017[24]
Hayton 2013[33]	Cox 2017[24]
Herber 2017[58]	McHale 2020[55]

Higgins 2017[82]	Vanzella 2021a[80]
Hird et al 2004[59]	McHale 2020[55]
Hopkinson 2012[97]	Early 2018a[8]
Houghton 1997[41]	Fowokan 2020[39]
Hull 2014[98]	Early 2018a[8], Milner 2018[100]
Jolly 2005[87]	Vanzella 2021b[83]
Jolly 2009[88]	Vanzella 2021b[83]
Jolly 1998[79]	Supervia 2017[78]
~~**Jolly 2007**~~[49]	Jahandideh 2018[46], Supervia 2017[78]
Jones 2007[60]	McHale 2020[55], Vanzella 2021b[83]
Jones 2012[102]	Milner 2018[100]
Jones 2013[105]	Milner 2018[100]
Jones 2014[108]	Milner 2018[100]
Kilonzo 2011[43]	Hall 2017[42]
Leong et al 2004[93]	Vanzella 2021c[91]
Lewis 2014[34]	Cox 2017[24]
Littlecott 2014[70]	Rowley 2018[67]
MacInnes 2005[64]	Resurreccio´n 2017[63]
Madison 2010[52]	Mamataz 2021[50]
Martin 2012[103]	Milner 2018[100]
McCorry 2009[62]	McHale 2020[55]
McPaul 2007[54]	Matata 2017[53], Santiago de Araujo Pio 2019[77]
Mills 2013[74]	Rowley 2018[67]
Moore 2012[35]	Cox 2017[24]
~~Murphy 2012~~[71]	Rowley 2018
Proudfoot 2007[44]	Hall 2017[42]
Roberts 2015[99]	Early 2018a[8], Milner 2018[100]
Robertson 2010[61]	McHale 2020[55]
~~Rouse 2011~~[75]	Rowley 2018[67]
Russell 2010[95]	Bohplian 2021[94]
Sewell 2013[106]	Milner 2018[100]
Shaw 2012[21]	McHale 2020[55], Campkin 2017[17]
Sherwood 2011[65]	Resurreccio´n 2017[63]
Smith 2007[45]	Hall 2017[42]
Sniehotta 2010[48]	Jahandideh 2018[46]
Sriskantharajah 2007[18]	Campkin 2017[17]
Summers 2017[110]	Swift 2020[109]
Thompson 2013[107]	Milner 2018[100]
Visram 2007 [89]	Vanzella 2021b[83]
Walker 2011[36]	Cox 2017[24]
Webb 2016[76]	Rowley 2018[67]
Webster 1997[90]	Vanzella 2021b[83]
Wilson 2007[111]	Swift 2020[109]

FACTORS PAPERS

UK primary studies

Of the 60 identifiable primary studies that considered factors which affected attendance at rehabilitation 42 considered cardiac rehabilitation, with the remaining 18 considering pulmonary rehabilitation (Table 4). The majority of papers reported on factors from the patient point of view, with fewer considering the views of professionals involved in referral or treatment. It was more common for factors to be reported as impeding attendance at rehabilitation rather than facilitating it (despite the fact that most factors could be reported as their inverse).

We grouped the reported factors as those which were from a patient perspective (including support, culture, demographics, practical, health, emotions, knowledge/beliefs, and service factors) and professional perspective (knowledge: staff and patient, staffing, adequacy of service provision, and referral from other services (including support and wait times).

Table 4. Factors identified in UK disaggregated study data

UK primary study	P/C	Family and peer support	Language	Habits / motivation	Cultural aspects/ religion	Time constraints	Knowledge / beliefs	Financial	Expected outcome of rehab	Age / gender	SES	Psychological health	Embarrassment	Patient health status	Perceived physical health	Importance of rehab	Health fears	Professional views	Format of provision	Self-confidence	Weather	Transport
		Impedes / Improves																				
Angus 2012[96]	P																					
Arnold 2016[25]	P																					
Astin 2005 [84]	C																					
Astin 2008[92]	C																					
Bennett 1999[47]	C																					
Bhattacharyya 2011[85]	C																					
Bulley 2009[26]																						
Buttery 2014[40]	C																					
Chauhan 2010[66]	C																					
Clark 2004[56]	C																					
Cole 2013[22]	C																					
Cooper 2005[57]	C																					
Dalal 2012[38]	C																					
Darr 2008[86]	C																					
Devi 2014[81]	C																					
Dunn 2014[23]	C																					
Farooqi 2000[19]	C																					

Edwards 2013[69]	C																						
Foster 2016[27]	P																						
Graves 2010[29]	P																						
Galdas 2012[20]	C																						
Garrod 200628	P																						
Hanson 2013[73]	C																						
Harris 2008a[30]	P																						
Harris 2008b[31]	P																						
Harrison 2015[32]	P																						
Herber 2017[58]	C																						
Hayton 2013[33]	P																						
Higgins 2017[82]	C																						
Hird 2004[59]	C																						
Hopkinson 2012[97]	P																						
Houghton 1997[41]	C																						
Hull 2014[98]	P																						
Jolly 2005[87]	C																						
Jolly 2009[88]	C																						
Jones 2007[60]	C																						
Kilonzo 2011[43]	C																						
Littlecott 2014[70]	C																						
Leong 2004[93]	C																						
Lewis 2014[34]	P																						
MacInnes 2005[64]	C																						
McCorry 2009[62]	C																						
McPaul 2007[54]	C																						
Mills . 2013[74]	C																						
Moore 2012[35]	P																						
Proudfoot 2007[44]	C																						
Robertson 2010[61]	C																						

Roberts 2015[99]	P																						
Russell 2010[95]	C																						
Shaw 2012[21]	C																						
Sherwood 2011[65]	C																						
Smith 2007[45]	C																						
Sniehotta 2010[48]	C																						
Sriskantharajah 2007[18]	C																						
Summers 2017[110]	P																						
Visram 2007 [89]	C																						
Walker 2011[36]	P																						
Webb 2016[76]	C																						
Webster 1997[90]	C																						
Wilson 2007[111]	P																						

P – Pulmonary Rehabilitation; C – Cardiac Rehabilitation.

Cardiac rehabilitation

Forty two UK primary studies on cardiac rehabilitation with disaggregated data presented were identified by the systematic reviews. Thirty five reported from the patient perspective, and a further five considered professional views. The remaining two studies reported factors from both viewpoints.

PATIENT PERSPECTIVE:

Family/peer support:

Feeling supported, either by friends, family or peer within a rehabilitation group setting was reported to influence attendance (enrolment, adherence and/or completion) in 10 studies of cardiac rehabilitation. Lack of family support was reported as impeding enrolment in cardiac rehabilitation in three studies (Astin et al. 2005[84], Jolly et al. 2005[87], Bhattacharyya et al. 2011[85]). Two further studies reported a lack of social support (Sriskantharajah & Kai 2007[18]) and/or family support (Cooper et al. 2005[57]) as impeding continued participation in cardiac rehabilitation. Visram et al. (2007[89]) also reported that lack of family support impeded both adherence to, and completion of cardiac rehabilitation. Conversely, a positive association between family support and adherence to cardiac rehabilitation was reported in two studies (Astin et al, 2008[92], Leong et al. 2004[93]), the latter of which focused solely on outcomes related to healthy eating habits. In addition peer support (sense of togetherness) was reported to improve adherence to cardiac rehabilitation (Dunn et al. 2014[23]), and a willing to support others in their cardiac rehabilitation was also reported to increase attendance (Clark et al. 2004[56]). However, social pressure (feeling unsupported in class), reduced adherence (Shaw et al. 2012[21]),

Cultural factors:

Cultural factors (either reported generally as “cultural factors”, or specially as language barriers) were reported to influence attendance (enrolment, adherence and/or completion) in 10 studies of cardiac rehabilitation.

Language: Having communication difficulties with the rehabilitation service due to a language barrier was reported as a factor which diminished enrolment (Astin et al. 2005[84], Bhattacharyya et al. 2011[85], Chauhan et al. 2010[66], Farooqi et al. 2000[19], Jolly et al. 2005[87], Sherwood and Povey 2011[65]) and continued adherence (Darr 2018[86]) to cardiac rehabilitation.

Culture: “Cultural factors” were listed as factors which impeded cardiac rehabilitation enrolment (Bhattacharyya et al. 2011[85], Chauhan et al, 2010[66]), and adherence/completion (Astin et al. 2005[84], Darr et al. 2008[86], Visram et al. 2007[89]). “Religions factors” were also reported as factors which impeded adherence and/or completion of cardiac rehabilitation (Darr et al. 2008[86], Webster et al. 1997[90]) although no further detail was given. In addition, Farooqi et al. (2000[19]) reported that mixed gender facilities dissuaded participation in rehabilitation due to different cultural acceptability, and Sriskantharajah & Kai (2007[18]) noted that negative cultural and religious views of exercise (with exercise being seen as selfish) also decreased participation in cardiac rehabilitation.

Demographic factors

Demographic factors (age, gender, SES, financial status) were reported to influence attendance (enrolment, adherence and/or completion) in 19 studies of cardiac rehabilitation.

Age: Bhattacharyya et al. (2011[85]), Chauhan et al. (2010[66]) and Mills et al. (2013[74]) all reported age as a barriers to enrolment in cardiac rehabilitation (but the systematic review authors (Rowley et al. 2018[67] and Vanzella et al. 2021b[83]) did not report the direction of the association). Buttery et al. (2014[40]) found that being younger improved attendance (uptake and maintenance) at cardiac rehabilitation. Conversely, Smith and Liles (2007[45]) found that those of younger age were "less interested" in cardiac rehabilitation which impeded commencement and Hanson et al (2013[73]) found that rehabilitation attendance was "more successful for over 55s". Leong et al. (2004[93]) found that older age facilitation to adherence to healthy eating aspects of a cardiac rehabilitation programme.

Devi et al. (2014[81]) considered virtual learning in cardiac rehabilitation programmes as reported older age as a barrier to participation. Higgins et al. (2017[82]) also considered technology as a facilitator to virtual learning and found that, for older individuals, the use of animation tools and websites that were easy and simple to navigate facilitated the learning process.

Gender: Houghton & Crowley (1997[41]) reported that being female impeded attendance (uptake and maintenance) in cardiac rehabilitation. Farooqi et al. (2000[19]) identified that mixed gender facilities also dissuaded participation in cardiac rehabilitation where this was a cultural concern for women. Smith and Liles (2007[45]) considered factors which impede engagement with cardiac rehabilitation and noted that participation in "alternative exercise" (not defined) having other health problems, and lack of motivation were especially problematic for females. Two other studies were conducted with women only and reported factors which impede engagement with cardiac rehabilitation including self-reported health problems (MacInnes et al. 2005[64]) and health beliefs that women could manage or solve their heart problem by themselves (Sherwood and Povey 2011[65]). Robertson et al. (2010[61]) reported that engagement with cardiac rehabilitation was "affected by male identity" – although this is not elaborated on.

SES/Finance: Socioeconomic status was reported as a barrier to cardiac rehabilitation both in terms of enrolment (Chauhan et al. 2010[66], Bhattacharyya et al. 2011[85]), and also adherence and completion (Visram et al. 2007[89]), (but the systematic review (Vanzella et al. 2021b[83]) did not report the direction of the association). Financial status (being more financially secure was also reported facilitate adherence to cardiac rehabilitation (Astin et al 2008[92]). However, Edwards et al. (2013[69]) reported that patients of "high deprivation" were more likely to complete the programme.

Practical factors

Practical factors including time constraints, travel problems, and poor weather were reported as impeding engagement in cardiac rehabilitation in seven studies.

Time constraints: Generic "time constraints" were reported to impede adherence to cardiac rehabilitation (Astin et al. 2008[92], Sherwood and Povey 2011[65]) as well as particular time constraints relating to family commitments (Hird et al 2004[59]). Time constraints related to work conflicts and employment restrictions were reported to increase non-participation and drop out (Cooper et al 2005[57]). Shaw et al. (2012[21]) reported that inconvenient class times reduced adherence due to competing demands on participants' time. With respect to virtual learning in cardiac rehabilitation programmes, Devi et al. (2014[81]) found that participants being able manage their time (learn according to their availability) was an enabler to participation.

Travel: Hird et al. (2004[59]) reported that experiencing transport problems impedes engagement with cardiac rehabilitation.

Weather: Galdas et al. (2012[20]) found that concerns regarding personal safety and environment (weather conditions) reduced participation in cardiac rehabilitation.

Health:

Health related measures including measure of physical and psychological health and perceived physical health status were considered by 13 studies in relation to cardiac rehabilitation attendance.

Physical health: Four studies reported on patients physical health. Participants with a diagnosis of CVD, or at risk from developing CVD were more likely to adhere to attend and adhere the full programme than those with mental health or pulmonary conditions (Edwards et al. 2013[69], Littlecott et al. 2014[70], Mills et al. 2013[74]). Engagement with cardiac rehabilitation was found to be less successful for obese participants (Hanson et al. 2013[73]).

Psychological health: Three studies reported that poor psychological status impeded both enrolment in (Bhattacharyya 2011[85], Chauhan et al 2010[66]), or adherence and completion (Visram 2007[89]) of cardiac rehabilitation.

Perceived physical health: Two studies found that a person having low perceptions of their own fitness impedes attendance at cardiac rehabilitation (Clark et al. 2004[56], Herber et al. 2017[58]). Conversely, three studies found that having faith in their body and fitness increased attendance (Clark et al. 2004[56], Shaw et al. 2012[21], Robertson et al. 2010[61]). Participation in alternative exercise and believing that they were "active enough already", impeded participation in cardiac rehabilitation as participants perceived it was not appropriate for them (Jones et al. 2007[60], Shaw et al. 2012[21]). However, a desire to reach previous exercise levels could increase engagement in cardiac rehabilitation (Hird et al. 2004[59]).

Emotional factors:

Ten studies reported on emotional factors which may affect engagement with cardiac rehabilitation including motivation, self-confidence and empowerment, embarrassment and health fears.

Motivation: Jones et al. (2007[60]) reported that lack of motivation for cardiac rehabilitation (especially for females) impedes engagement. Feeling positive about cardiac rehabilitation also improved participation (Shaw et al. 2012[21]).

Self-confidence/empowerment: Three studies reported positive associations between self-confidence and attending cardiac rehabilitation. Dunn et al. (2014[23]) found that self-confidence (feeling that attending rehabilitation was not intimidating) improved adherence. Robertson et al. (2010[61]) found that engagement with rehabilitation services was improved by being confidence in their physical ability to complete the programme, as well as "emotionality relating to body prior to cardiac event. Further, Devi et al. (2014[81]) in relation to virtual learning in cardiac rehabilitation programmes found that patient empowerment improves treatment adherence and reduced stress and anxiety. Additionally, Shaw et al. (2012[21]) reported that experiencing negative emotion (being unable to establish self-worth) reduced adherence to cardiac rehabilitation as it impeded self-confidence in physical ability.

Embarrassment: three studies reported that embarrassment due to the group exercise format of cardiac rehabilitation impeded attendance (Clark et al. 2004[56], Cooper et al. 2005[57], Sherwood and Povey 2011[65]).

Health fears: Fears regarding the health consequences of not attending cardiac rehabilitation improved adherence in two studies (Cole et al. 2013[22], Sriskantharajah & Kai 2007[18]).

Knowledge and beliefs relating to rehabilitation programmes:

Fourteen papers reported that having a lack of knowledge, or particular (inaccurate) beliefs about rehabilitation could limit participation, along with having negative expectations of rehabilitation, and perceiving rehabilitation as not important.

Knowledge: A lack of knowledge about cardiac rehabilitation was a barrier to enrolment in (Bhattacharyya et al. 2011[85], Chauhan et al. 2010[66]), adherence to (Astin et al. 2008[92], Cooper et al. 2005[57], Herber et al, 2017[58], Visram et al. 2007[89], Webster et al. 1997[90]), and completion of (Visram et al. 2007[89], Webster et al. 1997[90]) cardiac rehabilitation. Misunderstanding the role of exercise in rehabilitation was also said to impede attendance (Clark et al. 2004[56])

Beliefs: Cooper et al. (2005[57]) further reported that inaccurate beliefs about course content, perceptions of exercise, and the benefits of cardiac rehabilitation influenced attendance decisions; some viewed cardiac rehabilitation as important to recovery, others misunderstood the role of exercise. A further barrier to attendance were participants who perceived themselves unsuitable for cardiac rehabilitation (Herber et al. 2017[58]). Clark et al. 2004[56] reported that where a participant believed exercise important to recovery, this increased attendance at cardiac rehabilitation; conversely, misunderstood the role of exercise in rehabilitation, impeded attendance. In addition, inaccurate health beliefs (that heart attacks cannot be prevented) (MacInnes et al. 2005[64]) and health misconceptions (inaccurate perception of condition severity) (Clark et al 2004[56]) both impedes attendance at cardiac rehabilitation.

Perceived importance of rehabilitation: Believing that exercise is important to recovery increased attendance at cardiac rehabilitation (Clark et al 2004[56]). Some viewed cardiac rehabilitation as important to recovery, whilst others misunderstood the role of exercise (Cooper et al. 2005[57]). Perceiving cardiac rehabilitation as not appropriate (Shaw et al. 2012[21]) and not recognising health benefits of exercise or rehabilitation (McCorry et al 2009[62]) both impeded engagement and participation in rehabilitation. McPaul et al. 2007[54] reported that support from interventionists to improve self-determined motivation and exercise behaviours in CR was important

Expected outcomes: Having had negative expectations of cardiac rehabilitation prior to attending impeded commencement of cardiac rehabilitation. Bennett at al. (1999[47]) reported that “outcome expectancies” (not defined in the review (Jahandideh et al. 2018[46]), but relates to whether participants were expecting success) predicted intention to engage in a healthy diet and regular exercise.

Service provision factors:

Our searches identified seven studies on patient views of specific aspects of cardiac rehabilitation in terms of whether they impeded or improved service access. There were a further seven studies on professional views on aspects of cardiac rehabilitation which affected attendance.

Patient views on service provision: Clark et al. (2004[56]) found that a lack of post event communication and advice impedes attendance at cardiac rehabilitation. However, having "attentive staff" improved adherence (Galdas et al. 2012[20]). Receiving individualised information, and being given time to be understood improves commencement of cardiac rehabilitation (Kilonzo and O'Connell 2011[43]). Webb et al. (2016[76]) found that community-based exercise increased adherence (vs. continuously monitored exercise Programme), and Hanson et al. (2013[73]) reported that leisure site attendance was a significant predictor of uptake and length of engagement. In terms of virtual learning in cardiac rehabilitation, barriers to participation can include the format of the delivered materials (Devi et al. 2014[81], Higgin et al. 2017). For older individuals the use of animation tools and websites that were easy and simple to navigate facilitated the learning process (Higgin et al. 2017).

PROFESSIONAL PERSPECTIVE

Professional views on service provision:

In seven studies, professional involved in cardiac rehabilitation identified a number of factors which impacted on the likelihood of participants attending cardiac rehabilitation.

Service factors: A lack of service funding was said to impede commencement in cardiac rehabilitation (Proudfoot et al. 2007[44]), along with a lack of resources and a lack of service commissioning (Dalal et al. 2012[38]). A lack of staff also impedes commencement of rehabilitation (Proudfoot et al. 2007[44]). Dalal at al. (2012[38]) further reported that "delivery of services" were improved by tailored guidelines, offering different modes of delivery; and impeded by a poor evidence base, on tailored guidelines and a lack of clear patient pathways.

Staff factors: Low referrer level knowledge of cardiac rehabilitation was a barrier to enrolment (Bhattacharyya et al. 2011[85], Chauhan et al. 2010[66]) along with where professionals viewed medication as more important than rehabilitation (McCorry et al 2009[62]). A good skill mix improved "delivery of services", but blurred professional roles impede delivery of services (Dalal. at al 2012[38]). Kilonzo and O'Connell (2011[43]) also considered the views of cardiac nurses on service provision, but the systematic review (Hall et al. 2017[42]) reported only that they "differed in their perception of what was most important but also in their perception of the value of their instruction with patients".

Pulmonary rehabilitation:

Eighteen UK primary studies on pulmonary rehabilitation with disaggregated data presented were identified by the four systematic reviews. Seven studies reported from the patient perspective, and a further nine considered professional views on service provision. The remaining two studies reported factors from both viewpoints.

PATIENT PERSEPCTIVE

Family / peer support: Arnold et al. 2006[25] reported that non-completers of pulmonary rehabilitation identified lack of social as a barrier.

Demographic factors:

Foster et al. 2016[27] found that current smokers were more evident among those who declined referral for pulmonary rehabilitation. Garrod et al. (2006[28]) also found that more years of smoking

reduced the likelihood of participation in pulmonary rehabilitation (p = 0.04). Hayton et al. (2013[33]) also found that a predictor of pulmonary rehabilitation non-attendance was current smoking status (44.9% current smoker adherence versus 79.9% ex-smoker adherence).

Living arrangements also predicted attendance with Foster et al. (2016[27]) reporting that of those who declined to participate in pulmonary rehabilitation, a greater proportion lived alone, were divorced or separated. Hayton et al (2013[33]) found that co-habitation was a predictor of attendance compared to other living arrangements (OR 1.82 (1.02, 3.24) p = 0.042).

Hayton et al. (2013[33]) also reported that age predicted adherence to pulmonary rehabilitation (with the youngest and oldest quartiles least likely to complete their rehabilitation).

Practical factors:

Time constraints / Travel: Moore et al. (2012[35]) reported difficulties with accessing pulmonary rehabilitation due to geography (location) or timing, as well as difficulties in prioritising the treatment.

Weather: Walker et al. (2011[36]) reported a significant difference in pulmonary rehabilitation attendance by season (summer 74% versus winter 64%, p < 0.05) plus weak correlations with temperature and rainfall.

Health:

Three studies reported different rates of attendance at pulmonary rehabilitation by health condition. Two studies found that those who accepted a referral to pulmonary rehabilitation included a higher percentage of individuals on oxygen therapy (Foster et al. 2016[27]) and that an independent predictor of reduced attendance was long term oxygen therapy (OR 0.45 (0.22, 0.96) p = 0.038: 59.3% adherence versus 73.0% adherence in non-LTOT users) (Hayton et al 2013[33]). Garrod et al. (2006[28]) reported that quads strength (p = 0.03), SGRQ (health status) (p = 0.02) and depression (p < 0.001) independently discriminated between completers and dropouts, with depression being a risk factor for dropout from rehabilitation.

Emotional factors:

Fears about criticism exposure and inadequacy limited engagement with pulmonary rehabilitation (Moore et al. 2012[35]). On evaluating the "threat of exercise", (Bulley et al. 2009[26]) found that fear of exercise deterred some from participating while determination conveyed a more positive attitude. Arnold et al. (2006[25]) identified lack of motivation as a barrier to completion of pulmonary rehabilitation. Harris et al. (2008a[30]) considered the ratio of losing control and gaining control on pulmonary rehabilitation attendance (with more control improving attendance) and Harrison et al. (2015[32]) reported that relinquishing control (struggle to maintain agency following acute event), limited attendance due to an "impact of acute exacerbation on personal identity". Similarly Lewis et al. (2014[34]) noted that uncertainty (related to the "lived experience temporally") impeded engagement in rehabilitation.

Knowledge and beliefs relating to rehabilitation programmes:

Moore et al. (2012[35]) found that having "contrary beliefs about the role and safety of exercise" impeded participation in pulmonary rehabilitation.

Perceived importance of rehabilitation:

Arnold et al. (2006[25]) found that "self-help" defined as enjoying the program and seeing improvement due to the effect of the group have a positive impact on participation in pulmonary rehabilitation. Further, Bulley et al. (2009[26]) found that attributing positive value to pulmonary rehabilitation through information provided at referral had an important influence on increasing attendance.

Expected outcomes:

Bulley et al. (2009[26]) also described "desired benefit of attending pulmonary rehabilitation": where most participants had positive and realistic expectations engagement with pulmonary rehabilitation increased as a result.

Service provision factors:

Two studies reported the impact of service provision factors on pulmonary rehabilitation attendance. Arnold et al. (2006[25]) found that participants who reported a positive influence of referring practitioner were more likely to complete their pulmonary rehabilitation. Harris et al. (2008b[31]) reported on changing roles of members of health care team which could impact on communication and the logistics of referral for pulmonary rehabilitation – including patients willingness to accept referral which was improved by good communication.

STAFF PERSPECTIVE:

Staff knowledge: Barriers to patients accessing pulmonary rehabilitation included where referring professionals (especially general practitioners) had low knowledge of, or didn't know what pulmonary rehabilitation is, or don't believe in the benefits of pulmonary rehabilitation (Foster et al. 2016[27]). In addition, where professionals don't know enough about patient eligibility, or don't know about/ have low knowledge of referral process referral is impeded (Foster et al. 2016[27]). An overall lack of staff education was also reported as a barrier to access in Hopkinson et al. (2012[97]) with staff monitoring and knowledge of pulmonary rehabilitation (e.g. ward staff attended rehabilitation sessions) improving engagement with rehabilitation services.

Patient knowledge: In addition there was a recognised need to provide patients with a better knowledge and understanding of COPD to reduce exercise anxiety, educates patients and their relatives about exacerbations, and to understand that psychological effects as important as physical (Wilson et al. 2007[111]). Patient knowledge could also act as a barrier to accessing rehabilitation with a lack of patient information reported in three studies (Hopkinson et al. 2012[97], Roberts et al. 2015[99], Graves et al. 2010[29]).

Referral process: Lack of clear within-practice referral guidelines impeded referral to (and therefore commencement of pulmonary rehabilitation (Foster et al. 2016[27]). Further perceived barriers to referral were lack of clarity (whose role it was to refer) and a lack of knowledge about referral process (Harris et al. 2008a[30]). Having a streamlined referral process in place encouraged referral (Harris et al. 2008a[30]). Referral to pulmonary rehabilitation was also listed as a barrier to attending rehabilitation in 5 further studies in the review by Early et al. (2018a[8]); but unfortunately no further clarity was provided by the authors in reference to this statement (Angus et al. 2012[96], Graves et al.

2010[29], Hopkinson et al. 2012[97], Hull et al. 2014[98], Roberts et al. 2015[99]). In addition Early et al. (2018a[8]) also listed the lack of a pre-referral assessment as a barrier to rehabilitation in two studies (Graves et al. 2010[29], Roberts et al. 2015[99]).

Adequate service provision: Enablers to commencement of pulmonary rehabilitation included adequate local service provision, protected time for information giving (time to tell patients about pulmonary rehabilitation) (Harris et al. 2008a[30]).

Barriers to commencement included lack of time, communication issues when introducing pulmonary rehabilitation, and subsequent time associated with discussion ((Harris et al. 2008a[30]), an overall lack of funding, and time constraints (Summers et al 2017[110]). A lack of service identification (due to a lack of patients on relevant registers) and poor monitoring of patients was also said to reduce engagement with rehabilitation (Hull et al. 2014[98]). Patients with completed care plans (Hull et al. 2014[98], Roberts et al. 2015[99]) and those with high self-management (Graves et al. 2010[29]) were less likely to commence rehabilitation. There was also a view that less input from other disciplines limited access to rehabilitation along with cost effectiveness and a need to justify the service (Summers et al. 2017[110]). Secondary care discussions about pulmonary rehabilitation was said to improve engagement with services (Foster et al. 2016[27]).

Waiting time: A short waiting time for patients to get into pulmonary rehabilitation facilitated commencement, whereas when there was difficultly accessing services (due to availability and long wait times) commencement was impeded (Harris et al. 2008a[30])

Support: Support from health care professionals improved adherence to pulmonary rehabilitation (Russell and Bray 2010[95]). Barriers to referral were created by a lack of support resulting from difficulties establishing realistic patient goals, and difficulties preventing patients beginning exercise (Summers et al. 2017[110]).

PRIMARY PAPERS: INTERVENTIONS

Interventions identified in the UK disaggregated study data

The following section outlines the features of interventions to increase uptake and adherence which are described in the included reviews. In total, three reviews (Table 5) identified interventions, two which considered cardiac rehabilitation and one of pulmonary rehabilitation**.**

Cardiac rehabilitation:

Two reviews (Matata 2017[53], Santiago de Araujo Pio 2019[77]) included the same UK RCT study (McPaul et al. 2007[54]). However there were no details for the UK study by Matata et al. (2017[53]). Whereas in Santiago de Araujo Pio (2019[77]), the intervention was reported to study the effects of home visits versus telephone follow-up by an occupational therapist on CR attendance.

Pulmonary rehabilitation:

The review by Early et al. (2018a[8]) was the only review to address pulmonary rehabilitation (PR). They included six UK-based studies (described by the authors as before and after study[96], observational study (n=2)[97,29], longitudinal audit (n=2)[27,98], non-RCT[99]) as a part of a narratively synthesised systematic review (Angus et al. 2012[96]; Hopkinson et al. 2012[97], Hull et al 2014[98], Roberts et al. 2015[99], Foster et al. 2016[27] and Graves et al. 2010[29]). The review aimed to establish the

effectiveness of interventions to improve referral to and uptake of PR in patients with COPD when compared to standard care, alternative interventions, or no intervention.

The UK interventions to increase referral or uptake included in the review were:

- Computer-guided COPD review (Angus et al. 2012[96])
- An action research study which generated a range of interventions including education and memory aids (Foster et al. 2016[27])
- General practice networks with specialist support and financial incentives (Hull et al. 2104[98])
- A patient-held scorecard comparing the patient's own care against care quality indicators (Roberts et al. 2015[99])
- Education for HCPs plus a discharge bundle (Hopkinson et al. 2012[97])
- Group opt-in session for patients prior to PR assessment (Graves et al. 2010[29])

Angus et al. (2012[96]) conducted a descriptive observational study aimed at improving management of COPD using a computer-guided review, based on NICE guidance, by practice nurses during routine COPD review. Hopkinson et al. (2012[97]) conducted a before and after study of process indicators for a multicomponent intervention for a discharge bundle including 1)ward-based staff education 2) Discharge care bundle with referral for PR assessment 3) Patient offered phone call 48–72 hours post discharge to check if they were improving, if not then community input expedited 4) PDSA (Plan-Do-Study-Act) cycles to refine the process 5) Prize draw for staff completing checklist 6) ward staff attended hospital PR sessions 7) PR patient information leaflet.

Hull et al. (2014[98]) conducted a longitudinal audit slightly broader in scope to improve outcomes for people with COPD through a quality improvement project in networks of 36 general practices. Features of the intervention were: 1) eight networks of GPs 2) Financially incentivized KPIs 3) Care package based on NICE guidance 4) IT infrastructure 5) Support from community respiratory team 6) Network boards to review practice performance against targets, 7) Quarterly community COPD multidisciplinary team meeting 8) Rapid email/phone advice from consultant.

Roberts et al. (2015[99]) undertook a quasi-experimental, pragmatic non-randomized controlled study) of 1) patient-held scorecard containing six care quality indicators comparing patient's care to the standard (sent to patient with letter advising patient to discuss scorecard at the next COPD review) 2) Telephone helpline for patients. The study consisted of 1,235 patients (640 intervention, 595 control).

Foster et al. (2016[27]) employed an audit as a first component. Outcomes were based on COPD register, number of patients eligible for PR who were coded as conversation about PR in primary care, outcome of conversation about PR (including referral). As a second component, they used a participatory action research approach for a cross-sectional to assess clinician knowledge and attitudes about PR and ideas for increasing referrals; briefing note based on questionnaire feedback and literature review with suggestions for standardizing PR knowledge and increasing referral (in house education, practice protocols, "pop-ups," and memory aids to prompt discussion about PR). Intervention was a briefing note based on responses.

Graves et al. (2010[29]) focused on uptake of PR through a multicentre UK observational study of 600 patients. Intervention components included a Group Opt-In Session (1.5 hours) prior to assessment for PR; run by physiotherapist and clinical psychologist; discussion of patient case study, self-management, PR information, alternatives to PR.

Effectiveness of interventions

In terms of the effectiveness of the identified interventions, three of the studies did not provide any comparative data in order to determine effectiveness (Foster et al 2016[27], Hull et al 2014[98], Angus et al 2012[96]. One small study on an intervention to improve attendance at cardiac rehabilitation suggested a positive effect (McPaul 2007[54]), although the change was not statistically significant. For pulmonary rehabilitation, two interventions reported an increase in referral rates (Roberts et al 2015[99], Hopkinson et al 201297) but a third was not effective (Graves et al 2010[29]).

Pulmonary rehabilitation:

The review by Early et al (2018a[8]) aimed to establish the effectiveness of interventions to improve referral to and uptake of PR in patients with COPD.

Amongst the UK-based studies in Early et al (2018[8]), four studies reported statistically significant improvements in referral (range 3.5%–36%), and two studies reported statistically significant increases in uptake (range 18%–21.5%). In Hopkinson et al 2012[97], 47 of 191 patients with confirmed COPD diagnosis were referred to PR (Angus et al (2012[96]). In Roberts et al 2015[99] a 54% increase in PR referral (13.6-69%) was. One further study showed an increase in referral over time (45%–70%, between 2010 and 2013). although there was no comparator data reported (Hull et al 2104[98]). Other non-comparator studies provided referral rates only. Graves et al (2010[29]) measured attendance (including at assessment) and retention on PR and results indicated that 6.3% fewer patients in the intervention group attended pre-course assessment compared to usual care (58.7% vs 75%) (p=0.001).

Cardiac rehabilitation:

In McPaul et al. (2007[54]) the results favoured the control (but were not significant).

Table 5. UK primary studies of attendance or adherence interventions

UK Study	Review	P/C	Attendance/ Adherence	Intervention type/facilitating action	Effective/considered successful or ineffective/ unsuccessful/ no significant effect	RCT design?
Angus 2012[96]	Early 2018a[8]	P	Attendance (referral)	Computer-guided review, based on NICE guidance, by practice nurses during routine COPD review	N/A no comparative data	No

Hopkinson 2012[97]	Early 2018a[8]	P	Attendance (referral)	1)Ward-based staff education 2) Discharge care bundle with referral for PR assessment 3) Patient offered phone call 48–72 hours post discharge 4) PDSA cycles to refine the process 5) Prize draw for staff completing checklist 6) ward staff attended hospital PR sessions 7) PR patient information leaflet	Effective (reported increases in referral)	No
Hull 2014[98]	Early 2018a[8]	P	Attendance (referral)	1) eight networks of GPs 2) Financially incentivized KPIs 3) Care package based on NICE guidance 4) IT infrastructure 5) Support from community respiratory team 6) Network boards to review practice performance against targets, 7) Quarterly community COPD multidisciplinary team meeting 8) Rapid email/phone advice from respiratory consultant.	Cannot establish effectiveness- increase in referral over time No comparative data reported	No
Roberts 2015[99]	Early 2018a[8]	P	Attendance (referral)	Patient-held scorecard containing six care quality indicators comparing patient's care to the standard. Sent to patient with letter advising patient to discuss scorecard at the next COPD review 2) Telephone helpline for patients	Effective (reported increases in referral)	No
Foster 2016[27]	Early 2018a[8]	P	Attendance (referral)	Clinician questionnaire to assess knowledge and attitudes about PR and ideas for increasing referrals; briefing note based on questionnaire feedback and literature review with suggestions for standardizing PR knowledge and increasing referral (in house education, practice protocols, "pop-ups," and memory aids to prompt discussion about PR)	N/A no comparative data	No
Graves 2010[29]	Early 2018a[8]	P	Attendance (referral)	Group Opt In Session (1.5 hours) prior to assessment for PR; run by physiotherapist and clinical psychologist; discussion of patient case study, self-	Not effective	No

				management, PR information, alternatives to PR.		
McPaul 2007[54]	Matata 2017[53] Santiago de Araujo Pio 2019[77]	C	Attendance (enrolment)	Home visit interview with an occupational therapist instead of a phone call.	(NR in Matata et al 2017[53]) Intervention favours control (not significant)	Yes

P – Pulmonary Rehabilitation; C – Cardiac Rehabilitation.

*(NR in Matata et al 2017[53]) Intervention favours control intervention (not significant, CI crosses line of no effect) to increase enrolment and sub-group analyses of interventions targeting healthcare providers and delivered with at least some face-to-face format

Summary of recent unpublished initiatives

In addition to published interventions, our web based searches also identified recent UK initiatives to improve uptake and /or adherence to rehabilitation which have not yet been published in the peer reviewed literature. The majority of initiatives we identified in this way focused on promoting digital and online delivery of rehabilitation directly in response to the COVID-19 pandemic; or service delivery options that were further developed to address the pandemic. The immediacy of the pandemic meant that initiatives were often developed quickly to ensure continued delivery of rehabilitation and there has been different levels of evaluation of the initiatives. Table 6. provides brief details of the initiatives with more details in the summary below.

Table 6. Brief details of unpublished recent initiatives

Study team	**Pulmonary or cardiac**	**Approach**	**Findings**
Aspetika in partnership with Addenbroke's Hospital	Cardiac	Trialled Active+me REMOTE Cardiac Rehabilitation programme which is delivered remotely by Aspetika's technology platform and enabled quick adaption to continue remote delivery during COVID-19 pandemic	Programme had positive outcomes and was highly commended in the Coronavirus Innovation Award 2020
Cambridge University Hospital NHS Foundation Trust	Pulmonary	Developing a toolkit for clinicians referring patients to pulmonary rehabilitation that will enhance inclusivity	Study identified barriers and enablers across 6 domains: patient, interface: patient/primary care, interface

			patient/PR, primary care, interface primary care/PR and PR service.
Care City test bed implementation within East London	Cardiac	To improve the uptake of cardiac rehabilitation using the innovation TickerFit introduced prior to COVID-19 pandemic in November 2019 and continued until end of November 2020 to provide services during the pandemic	Thorough evaluation of Care City Wave 2 test bed by Nuffield Trust. TickerFit offered to 157 patients with 39 (25%) downloading the app, rates of downloading increased when face-to-face clinics were suspended in March 2020 from approximately 9% to 43%. 17/39 patients downloading TickerFit had completed course by 30 November 2020. Despite increase during pandemic uptake was a problem.
Liverpool Heart and Chest Hospital NHS Foundation Trust	Cardiac	Training staff in new communication skills to encourage more patients to take part in physical activity during and after rehabilitation	Ongoing
Northern Devon Healthcare NHS Trust	Cardiac	REACH-HF Home delivery of cardiac rehabilitation to increase access and useful to continue service delivery during COVID-19 pandemic	Currently being evaluated as routine clinical practice
Nottinghamshire Healthcare NHS Foundation Trust	Cardiac	Virtual pulmonary rehabilitation programme for patients to ensure continued delivery of service during pandemic using www.SpaceforCOPD.co.uk and the phone app MyCOPD as virtual platforms	Great engagement in programme
Portsmouth Hospital NHS Trust	Cardiac	Personalised cardiac using Exi, app to enable continued service delivery during COVID-19 pandemic	Adherence and completion rates were high – 60% of patients met their personalised weekly

			exercise goals and 75% completed the 12 week programme.
Southend University Hospital	Pulmonary	Menu-based PR delivery model to provide patients who couldn't attend traditional centre-based classes and aimed to address the challenges the service faced with capacity and PR completion rates. Three delivery modes for PR are offered: 1. Centre-based, 2. Hybrid option – mixture of face-to-face and session at home using myCOPD or paper manuals. or 3. Home-based – sessions conducted at home using myCOPD app or paper manuals	Evaluation following first year of implementation found the model increased service capacity and completion rates.
South Tyneside Cardiac Rehabilitation Team	Cardiac	Digitally enhanced model of cardiac rehabilitation using myHeart app to enable continued service delivery during COVID-19 pandemic	164 patients registered to myHeart and patients and clinical team have provided positive feedback.
University of Gloucestershire	Pulmonary	Rapid remodelling of PR service using eLearn Moodle platform to enable continued delivery of PR during the COVID-19 pandemic	Service evaluation showed that online PR is feasible and acceptable for patients referred to PR when there is a need for social distancing and that rapid adaptation of face-to-face programmes is possible.
Wirral	Cardiac	REACH-HF home-based increase access to service for patients with transport issues and useful during COVID-19 pandemic	113 patients have been referred to REACH-HF and 59 have completed, 15 dropped out, 5 patients died and there are 34 currently progressing through the programme. Currently being evaluated as Beacon Site

Cardiac Rehabilitation

Within cardiac rehabilitation eight initiatives were retrieved, the majority (7) were around online delivery during the COVID-19 pandemic and the other one investigated training staff in communication skills to encourage more patients to exercise.

Digital/online COVID

Two of the initiatives build on the successful REACH-HF service (Rehabilitation EnAblement in Chronic Heart Failure) (REACH-HF 2021) which was initially development as part an RCT (Dalal et al. 2021[112]) and then trialled at 'Beacon Sites' and aims to help more people access cardiac rehabilitation. REACH-HF was shown to be clinically and cost effective and is now being evaluated as part of routine clinical practice in eight NHS cardiac rehabilitation centres. In February 2020 Northern Devon Healthcare NHS Trust launched a cardiac rehabilitation programme delivered in patient's homes that is designed by the individual patient and the cardiac rehabilitation team to meet each patient's specific needs. The team's adaptation of the programme to ensure its continued delivery during COVID-19 pandemic helped them to win the BMJ Stroke and Cardiovascular team of the year award for 2020 (University of Exeter 2021[113])

To improve accessibility for patients with transport issues Wirral provided a home-based CPRP through REACH-HF which was particularly valuable during the COVID-19 pandemic. REACH-HF enabled patients to engage in a service that they were previously unable to access and they felt well supported. 113 patients have been referred to REACH-HF and 59 have completed, 15 dropped out, 5 patients died and there are 34 patients currently progressing through the programme. Patients were able to increase their exercise capacity although it is difficult to quantify the impact on admission avoidance and additionally the long-term funding of the service once Beacon site funding is finished needs determining (NICE 2021[114]).

Portsmouth Hospital NHS Trust developed a personalised cardiac rehabilitation programme to enable them to continue delivering their service during the pandemic and monitor their patients (NHSX 2021[115]). A remotely monitored service was delivered using the EXi, a patient-facing app that can analyse patient health and develop a personalised exercise plan. Adherence and completion rates were high with 60% of patients meeting their personalised weekly exercise goals and 75% completing the 12 week programme.

South Tyneside Cardiac Rehabilitation team also started to use a digital enhanced model in March 2002 to continue to provide services during the pandemic (NHSX 2020[116]). The team used the myHeart app, which was designed to support patients with cardiac conditions and includes a full cardiac rehabilitation programme which can be tailored to a patient's individual diagnosis and functional ability. The South Tyneside team have registered 164 patients myHeart and patients and clinical team have provided positive feedback.

The Coronavirus Innovation 2020 Selfcare Forum highly commended Aseptika Ltd for developing Active+me REMOTE Cardiac Recovery, a remotely delivered programme for cardiac rehabilitation patients (Sheffield Hallam University 2020[117]). The remote programme was piloted at Addenbroke's Hospital during the pandemic and had positive outcomes.

Nottinghamshire Healthcare NHS Foundation Trust developed a virtual pulmonary rehabilitation programme for patients to ensure continued delivery of service during pandemic (Nottinghamshire

Health Care 2020[118]). The team used www.SpaceforCOPD.co.uk and the phone app MyCOPD as virtual platforms. They reported "great engagement" in the pulmonary rehabilitation programme.

Care City test bed implementation within East London included cardiac rehabilitation using the innovation TickerFit. The innovation was offered to all patients eligible for cardiac rehabilitation from November 2019 and was extended until end of November 2020 to enable provision of services during the COVID-19 pandemic. During the project TickerFit was offered to 157 patients with 39 (25%) downloading the app, rates of downloading increased when face-to-face clinics were suspended in March 2020 from approximately 9% to 43%. 17 pf the 39 patients downloading TickerFit had completed the course by 30 November 2020. Despite increases during the pandemic uptake was a problem. Further detail is included in the evaluation report published by the Nuffield Trust (Sherlaw-Johnson et al. 2021[110]).

Communication skills

Liverpool Heart and Chest Hospital NHS Foundation Trust is investigating whether training staff in new communication skills will enable them to encourage more patients to take part in physical activity during and after rehabilitation (NHS Health Research Authority 2022[120]). The evaluation is ongoing.

Pulmonary Rehabilitation

Three initiatives were retrieved for pulmonary rehabilitation, two were the development of online/digital PR one prior to the COVID-19 pandemic and one during and one study was developing a toolkit to increase inclusivity.

Digital/online COVID

Southend University Hospital in 2018 introduced a new menu-based PR delivery model to provide patients who couldn't attend traditional centre-based classes and aimed to address the challenges the service faced with capacity and PR completion rates (North et al. 2020[121]). The Southend DEPR model offers three delivery modes for PR: 1. Centre-based, 2. Hybrid option – mixture of face-to-face and session at home using myCOPD or paper manuals. or 3. Home-based – sessions conducted at home using myCOPD app or paper manuals. A review after the first year of the DEPR model found that it increased service capacity and increased completion rates.

University of Gloucestershire investigated the feasibility of online deliver of PR (Lewis et al. 2021[122]). At the start of the COVID-19 pandemic there was a rapid remodelling of the PR service using eLearn Moodle platform to enable continued delivery of PR during the COVID-19 pandemic. Service evaluation showed that online PR is feasible and acceptable for patients referred to PR when there is a need for social distancing and that rapid adaptation of face-to-face programmes is possible. They suggest that further trials comparing online-PR and face-face PR would be useful to investigate the promising initiative further.

Inclusivity

Cambridge University Hospital NHS Foundation Trust are undertaking a research study to develop a toolkit for clinicians referring patients to pulmonary rehabilitation that will enhance inclusivity (Early et al 2018b[123]). The development and use of the toolkit aims to increase referral take-up and

improve the experience of the COPD pathway for patients. The design process will consider how patients' capabilities (vision, hearing, mobility, reach and stretch, dexterity, thinking and communication and their ability to access PR and their and health care professionals experience of the PR pathway. The toolkit will be tested in primary care to determine if it is user-friendly, practical for the NHS and if it has the potential to increase referral and uptake of PR. The study identified barriers and enablers across 6 domains: patient, interface: patient/primary care, interface patient/PR, primary care, interface primary care/PR and PR service (Early 2020[124]).

Summary

Therefore, the majority of the initiatives to increase uptake focused on digital or online programme delivery which become more important during the COVID-19 pandemic. Full evaluation of these potentially promising initiatives will be required to determine their impact on uptake.

What factors do the interventions aim to address?

In considering our typology of factors which improve or impede attendance at cardiac and/or pulmonary rehabilitation, it is interesting to note that most of the identified interventions were implemented in order to address barriers to access in terms of provider perspective (Table 7.). This was particularly true of the studies identified by Early et al. (2018a[8]) which considered access to pulmonary rehabilitation. A better understanding of the access challenges from the patient perspective may facilitate interventions to address the service provision challenges they experience more effectively. Only two interventions to improve attendance at cardiac rehabilitation were identified. However these did better address patient barriers to access including improving support and motivation to exercise, and overcoming issues with travel to cardiac rehabilitation. Overall however, the majority of access challenges identified by patients would not be addressed by the identified interventions. This reflects the very small number of patient access interventions identified.

In addition, through supplementary searching of key websites we identified 11 recent, unpublished interventions which were included in this review. Nine, were of online delivery of cardiac rehabilitation (n=7) or pulmonary rehabilitation (n=2) during the COVID-19 pandemic. These interventions may have the potential to act on patient barriers around access to services, including travel and inconvenient timing of services. However, this will depend on whether services remain online as the impacts of the pandemic diminish. One further intervention for cardiac rehabilitation trained staff in communication skills to encourage more patients to exercise, which may impact on patient knowledge and beliefs about rehabilitation. The final pulmonary rehabilitation intervention (developing a toolkit to increase inclusivity) may have the potential to impact on some of the demographic and cultural patients barriers identified in the factors literature.

Table 7. Factors addressed by published interventions

Study (UK primary)	Intervention	Perspective	Factors addressed
McPaul 2007[54] [C]	Home visiting vs. telephone follow up	CR outpatients	Patient travel

	by occupational therapist (CR attendance)		Adequacy of service provision Referral from other services
Angus 2012[96] [P]	Computer-guided COPD review by practice nurse	Practitioners	Staff knowledge
Foster 2016[27] [P]	An action research study which generated a range of interventions including education and memory aids (practice protocols, "pop-ups," and memory aids to prompt discussion)	Practitioners	Staff knowledge
Hull 2104[98] [P]	General practice networks with specialist support and financial incentives (Financially incentivized KPIs, care package based on NICE guidance, IT infrastructure, support from community respiratory team, Network boards to review practice performance, Quarterly community COPD multidisciplinary team meeting, rapid email/phone advice from respiratory consultant.	Practitioners	Referral from other services Adequacy of service provision
Roberts 2015[99] [P]	Patient-held scorecard comparing patient's own care against care quality indicators (advising patient to discuss scorecard at next COPD review)	Practitioners	Adequacy of service provision Knowledge: staff and patient
Hopkinson 2012[97] [P]	Education for HCPs plus a discharge	Practitioners	Referral from other services

	bundle (referral for PR assessment, phone call post discharge, PDSA cycles to refine the process, prize draw for staff completing checklist, ward staff attended hospital PR sessions, PR patient information leaflet).		Knowledge: staff and patient, Adequacy of service provision
Graves 2010[29] [P]	Group opt-in session for patients prior to PR assessment (run by physiotherapist and clinical psychologist; discussion of patient case study, self-management, PR information, alternatives to PR)	Practitioners	Referral from other services Adequacy of service provision

C = Cardiac Rehabilitation; P = Pulmonary Rehabilitation

Discussion

Summary of findings:

Summary of identified reviews:

In total we identified twenty review papers which met our inclusion criteria and could contribute to answering one of the research questions. Although individual quality appraisal was not undertaken the reviews all met minimum standards for conducting and reporting systematic reviews. It is important to note that we also identified a wider body of review level evidence of non-UK studies considering the effectiveness of interventions to increase commencement, continuation or completion of rehabilitation which were outside the scope of this review.

From the included reviews, a total of 60 UK primary studies were identifiable. There was a bias towards reviews considering cardiac rehabilitation, with these numbering sixteen; only four reviews considered pulmonary rehabilitation. Most reviews did not limit the studies they included by PROGRESS-Plus classification, with the exception of four reviews which included studies of cardiac rehabilitation for women (Campkin et al.2017[17], Mamataz et al 2021[50] Resurreccio´n et al. 2017[63]) and/or ethnic minority populations (Campkin et al.2017[17], Vanzella 2021b[83]).

Factors which impede and/or facilitate participation in rehabilitation:

What are the factors that impede or facilitate engagement (commencement, continuation or completion) in rehabilitation by patients with heart disease or chronic lung disease?

Seventeen reviews included qualitative data from studies which considered factors which impede and/or facilitate participation in rehabilitation including referral, commencement, continuation and completion. We grouped the reported factors into those which were from a patient perspective (including support, culture, demographics, practical, health, emotions, knowledge/beliefs, and service factors) and professional perspective (knowledge: staff and patient, staffing, adequacy of service provision, and referral from other services (including support and wait times).

There was a bias in the volume of evidence towards studies which considered these factors in relation to the patient perspective, with only 12 studies considering aspects of staffing, service provision and knowledge from the perspective of professionals.

Some factors could be said to act in a particular direction which facilitated or impeded participation in rehabilitation. From the patient perspective these included feeling supported to attend rehabilitation consistently facilitated attendance (either commencement or continued engagement with a rehabilitation programme). However, other factors were reported in a more equivocal way with variation in terms of practical, health, knowledge/beliefs, service factors and some demographic factors in terms of whether these were facilitating or inhibiting factors. Cultural factors, and the demographic factors associated with these, in contrast, were mostly shown to reduce attendance.

Despite only four studies (all of cardiac rehabilitation) considering specific subpopulations (namely women; Campkin et al.2017[17], Mamataz et al 2021[50] Resurreccio´n et al. 2017[63], and/or ethnic minority populations: Campkin et al.2017[17], Vanzella 2021b[83]), a number of additional studies did mention the differential impact on service access as a result of Progress Plus characteristics.

In terms of ethnicity, challenges `included having communication difficulties with the rehabilitation service due to a language barrier (Astin et al. 2005[84], Bhattacharyya et al. 2011[85], Chauhan et al. 2010[66], Farooqi et al. 2000[19], Jolly et al. 2005[87], Sherwood and Povey 2011[65], Darr 2018[86]), and cultural and religious beliefs and expectations which made attendance at rehabilitation problematic (Bhattacharyya et al. 2011[85], Chauhan et al, 2010[66], Astin et al. 2005[84], Darr et al. 2008[86], Visram et al. 2007[89], Darr et al. 2008[86], Webster et al. 1997[90]). Notably these factors included mixed gender rehabilitation which was considered culturally inappropriate (Farooqi et al. 2000[19]), and negative cultural views of exercise (with exercise participation being seen as selfish) (Sriskantharajah & Kai (2007[18]).

Demographic factors (age, gender, SES, financial status) were reported to influence attendance at cardiac rehabilitation. The reporting of the impact of age only likely attendance varied with four reviews not reporting an overall direction of the association (Battacharyya et al. 2011, Chauhan et al. 2010[66], Mills et al. 2013[74], Hayton et al. 2013[33]). Others reported younger (Smith and Liles 2007[45], Hanson et al. 2013[73], Leong et al. 2004[93]) or older age (Buttery et al. 2014[40], Devi et al. 2014[81]) as a barrier to attending rehabilitation. Lower socioeconomic status was mostly reported as a barrier to cardiac rehabilitation (Chauhan et al. 2010[66], Bhattacharyya et al. 2011[85], (Visram et al. 2007[89]), Vanzella et al. 2021b[83], Astin et al 2008[92]). However, Edwards et al. (2013[69]) reported that patients of "high deprivation" were more likely to complete the rehabilitation programme.

Gender differences in attendance were also reported, with females having lower attendance (Houghton & Crowley 1997[41], Farooqi et al. 2000[19]). In studies of women only Smith and Liles

(2007[45]) found that participation in alternative exercise, having other health problems, and lack of motivation were especially problematic for females. Two other studies were conducted with women only and reported factors which impede engagement with cardiac rehabilitation including self-reported health problems (MacInnes et al. 2005[64]) and health beliefs that women could manage or solve their heart problem by themselves (Sherwood and Povey 2011[65]). Robertson et al. (2010[61]) reported that engagement with cardiac rehabilitation was "affected by male identity".

Intervention to facilitate participation in rehabilitation:

Which intervention components, evaluated or innovative, have been proposed to increase engagement in rehabilitation and which factors do they propose to address?

We found considerably fewer reviews looking at interventions to facilitate participation in rehabilitation. Three reviews reported on interventions, of which two (of cardiac rehabilitation) included a total of one UK-based study (Matata et al. 2017[53], Santiago de Araujo Pio et al. 2019[77]). The review by Early et al. (2018a[8]) contained the six UK studies and considered interventions to improve participation in pulmonary rehabilitation.

For cardiac rehabilitation, the effects of home visits versus telephone follow-up by an occupational therapist on CR attendance (McPaul et al. 2007[54]) was reported. For pulmonary rehabilitation interventions included a computer-guided COPD review (Angus et al. 2012[96]), education and memory aids (Foster et al. 2016[27]), specialist support and financial incentives (Hull et al. 2104[98]) , a patient-held scorecard (Roberts et al. 2015[99]), education for HCPs plus a discharge bundle (Hopkinson et al. 2012[97]) and group opt-in session for patients prior to PR assessment (Graves et al. 2010[29]).

In addition, 11 recent, unpublished interventions (identified through additional internet based searching of key websites) were included in this review. The majority of initiatives we identified in this way focused on promoting digital and online delivery of rehabilitation directly in response to the COVID-19 pandemic; or service delivery options that were further developed to address the pandemic. Within Cardiac Rehabilitation eight initiative were retrieved, the majority (7) were around online delivery during the COVID-19 pandemic and the other one investigated training staff in communication skills to encourage more patients to exercise. Three initiatives were retrieved for pulmonary rehabilitation, two were the development of online/digital PR one prior to the COVID-19 pandemic and one during and one study was developing a toolkit to increase inclusivity.

In terms of addressing factors, it is interesting to note that most of the identified interventions were implemented in order to address barriers to access in terms of provider perspective. This was particularly true of the studies identified by Early et al. (2018a[8]) which considered access to pulmonary rehabilitation. The two interventions to improve attendance at cardiac rehabilitation did better address some of the patient barriers to access including improving support and motivation to exercise, and overcoming issues with travel to cardiac rehabilitation. Overall however, the majority of access challenges identified by patients would not be addressed by the identified interventions. This reflects the very small number of patient access interventions identified.

Through additional searching we found a further eleven unpublished interventions, nine of which consisted of online delivery of cardiac rehabilitation (n=7) or pulmonary rehabilitation (n=2) during the COVID-19 pandemic. These interventions may have the potential to act on patient barriers

around access to services, including travel and inconvenient timing of services. However, this will depend on whether services remain online as the impacts of the pandemic diminish. One further intervention for cardiac rehabilitation trained staff in communication skills to encourage more patients to exercise, which may impact on patients knowledge and beliefs about rehabilitation. The final pulmonary rehabilitation intervention (developing a toolkit to increase inclusivity) may have the potential to impact on some of the demographic and cultural patients barriers identified in the factors literature. It is important to acknowledge the wider context in which these interventions will be delivered and evaluation with these patient populations experience huge issues accessing digital interventions/technology.

What evidence is there for the effectiveness of such interventions as documented at a review level?

In terms of the effectiveness of the identified interventions, very little UK evidence was identified. One RCT study on an intervention to improve referral to or attendance at cardiac rehabilitation included home visits versus telephone follow-up by an occupational therapist (McPaul 2007[54]), although the result was not significant. For pulmonary rehabilitation, two interventions increase in referral rates; a patient-held scorecard (non-RCT) (Roberts et al 2015[99]), and education for HCPs (Hopkinson et al 2012[97]) but a third which consisted of group opt-in session for patients prior to PR assessment was not effective (Graves et al 2010[29]). Three of the studies did not provide any comparative data in order to determine effectiveness (Foster et al 2016[27], Hull et al 2014[98], Angus et al 2012[96]).

Our additional web based searches identified a further 11 recent, unpublished initiatives which aimed to increase uptake of rehabilitation, which mostly focused on digital or online programme delivery during the COVID-19 pandemic. Full evaluation of these potentially promising initiatives is required to determine their impact.

Ecological model of health promotion

Although developed independently, it is notable that our typology of factors bears significant resemblance to the ecological model of health promotion described by McLeroy et al. (1988)[125]. In this model, behaviour (e.g. attending rehabilitation) is determined by the following:

(1) intrapersonal factors-characteristics of the individual

(2) interpersonal processes and primary groups-formal and informal social network and social support systems

(3) institutional factors-social institutions with organizational characteristics

(4) community factors

(5) public policy-local, state, and national laws and policies.

The underlying assumption of this model is that that these five levels reflect the range of strategies potentially available for health promotion interventions which should be based on beliefs, understandings, and theories of these determinants of behaviour. The purpose of an ecological model is to focus attention on the environmental causes of behaviour and to identify environmental interventions. Therefore it may be beneficial to ensure all aspects of the model are considered when developing new interventions to improve attendance at rehabilitation. Given the limited effectiveness data in identified reviews it may be beneficial to look to established models such as this to propose interventions.

Strengths and limitations:

This systematic review was undertaken by an experienced team, including methodological experts. We followed a protocol developed in collaboration the Department of Health and Social Care, specifically relating to the NHS England and NHS Improvement (NHSEI) NHS @home initiative, in order to provide timely information to stakeholders, and to help clarify research priorities. The protocol was registered prospectively with the PROSPERO database of systematic review protocols.

One strength of our approach to this review is that we included both quantitative and qualitative data, with the evidence regarding views and perceptions of both patients and staff providing key insights; this is of particular importance given the dearth of robust quantitative evaluations of interventions to improve engagement with rehabilitation services.

However, time limitations restricted our search dates (2017 onwards) constrained the consideration of study quality and precluded the inclusion of additional searching methods such as citation searching and contacting key authors. Also we did not search (due to time restrictions) for primary studies published after the search dates of the included systematic reviews. This may have implications for the completeness of the evidence base identified but should not significantly impact the main findings of the review. In addition we did not consider studies comparing home with clinic based rehabilitation and we acknowledge that the factors which facilitate or impede engagement will be likely to differ between these two settings.

Research on inequalities of access and adherence to rehabilitation programmes

Only four studies (all of cardiac rehabilitation) set out to consider specific subpopulations (namely ethnic minority populations and women) a number of additional studies did mention the differential impact on service access as a result of Progress Plus characteristics, with ethnicity, age, gender, SES, financial status, all impacting on access and adherence to rehabilitation programmes. Therefore greater emphasis on understanding access needs to reduce inequalities in access and adherence is needed.

Implications for service delivery

Services should in particular, consider the barriers imposed for some patients by cultural and demographic factors which may require additional effort to:

- make service alterations to improve engagement with specific patient groups (e.g. females, ethnic minorities)
- consider the implications of group exercise on creating reluctance to attend for some individuals
- provide patient educational interventions to alter perceptions of rehabilitation and ensure that patients have a good understanding of what it involves and how it is appropriate for their needs
- provide staff training around engagement with specific patient groups, communication to encourage exercise and to better explain both the content and benefits of rehabilitation
- consider the impact of location and timing of service provision on attendance, including whether the continued provision of online services may be appropriate in some instances.

As variations between the factors reported as impacting on cardiac or pulmonary rehabilitation are not due to fundamental differences (except those related to the specific condition e.g. smokers reluctance for COPD rehab), specialities can learn from each other in terms of potential generic interventions to improve attendance

Implications for research

The review level literature on the factors which impact on attendance for rehabilitation of both pulmonary and cardiac conditions would benefit from a greater focus on what could be done to facilitate attendance as at the moment, the evidence has a negative focus. Research into interventions to improve attendance at rehabilitation, both overall, and for key patient groups, should be the focus moving forward and should consist of high quality effectiveness studies of promising interventions. In developing interventions to improve access to an engagement with rehabilitation services the perspectives of both the patients and the services providers should be considered. Given the limited effectiveness data in identified reviews it may be beneficial to look to established models, such as the Ecological Model of Health Promotion[126] to propose interventions and facilitate the engagement of minority communities with rehabilitation services.

Conclusions

The factors affecting commencement, continuation or completion of cardiac or pulmonary rehabilitation consist of a web of complex and interlinked factors taking into consideration the perspectives of patients and service providers. The factors are understandably complex and it is challenging to discern any patterns within them, or to make statements regarding the importance of one factor versus another. Although most of the factors affecting participation were reported from a patient perspective, most of the identified interventions were implemented to address barriers to access in terms of the provider perspective. The small number of published interventions we identified which aim to improve access are unlikely to address the majority of these factors;

especially those identified by patients as limiting their access. Better understanding of these factors will allow future interventions to be more evidence based with clear objectives as to how to address the known barriers in order to improve access. As variations between the factors reported as impacting on cardiac or pulmonary rehabilitation are not due to fundamental differences in the patient reported factors (except those related to the specific condition e.g. smokers reluctance for COPD rehab), specialities can learn from each other in terms of potential interventions to improve attendance.

Equality, Diversity and Inclusion

As a secondary data study our review did not include any research participants. We were however, inclusive in the studies we selected and reported where demographic and socio-economic factors were considered by the studies we included.

Disclaimer

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Andrew Booth (Professor in Evidence Synthesis): Methodological adviser, lead protocol developer, guarantor of the review.

All authors commented on drafts of the protocol and report.

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Ethical approval: This review did not involve the collection or analysis of any data that was not included in previously published research in the public domain. Therefore it was exempt from formal ethical review by the University of Sheffield Ethics Committee.

Data sharing

Any additional data not included in this report and its appendices are available on request. All queries should be submitted to the corresponding author.

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Appendices

Appendix 1: Medline Search Strategy

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations and Daily <1946 to January 25, 2022>

Search Strategy:

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1 Cardiac Rehabilitation/ (3199)

2 exp Pulmonary Disease, Chronic Obstructive/rh [Rehabilitation] (2586)

3 exp Lung Diseases/rh [Rehabilitation] (6270)

4 "cardiac rehab*".ab,ti. (7275)

5 "pulmonary rehab*".ab,ti. (4104)

6 or/1-5 (16470)

7 (engag* or participat* or involv* or attend* or contin* or commit* or maint* or adhere*).ab,ti. (5334012)

8 (uptake* or initiat* or referral* or self-referral* or recruit* or commenc* or inten*).ab,ti. (2619801)

9 (complet* or finish* or retention or "drop out*" or withdraw* or discontin*).ab,ti. (2110028)

10 (barrier* or facilitat* or imped*).ab,ti. (1011927)

11 or/7-10 (9073367)

12 6 and 11 (9016)

13 (MEDLINE or systematic review).tw. or meta analysis.pt. (352967)

14 ("Qualitative systematic review" or "qualitative systematic reviews" or "qualitative evidence synthesis" or "qualitative evidence syntheses" or "qualitative research synthesis" or "qualitative research syntheses" or "Qualitative synthesis" or "qualitative syntheses").ab,ti. (3606)

15 13 or 14 (353509)

16 12 and 15 (478)

17 limit 16 to english language (464)

18 limit 17 to yr="2017 - 2022" (269)

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Search strings 1-3 are MeSH terms for cardiac and pulmonary rehabilitation

Search strings 4 and 5 are terms for cardiac and pulmonary rehabilitation searched for in the title and abstract

Search string 6 combines the terms for cardiac and pulmonary rehabilitation using OR

Search strings 7-10 are terms, searched for in the title and abstract, for factors affecting commencement, continuation or completion of rehabilitation

Search string 11 combines the above terms using OR

Search string 12 combines search strings 6 and 11 using AND to retrieve research on factors affecting commencement, continuation or completion of cardiac or pulmonary rehabilitation

Search string 13 is the reviews filter from McMaster University Health Information Research Unit that maximises sensitivity (https://hiru.mcmaster.ca/hiru/HIRU_Hedges_MEDLINE_Strategies.aspx)

Search string 14 are terms for qualitative systematic reviews using in other review and evidence syntheses by Information Specialists at ScHARR

Search string 15 combines the reviews and qualitative systematic reviews filters using OR

Search string 16 combines search string 12 and 15 using AND to retrieve reviews (including qualitative reviews) on factors affecting commencement, continuation or completion of rehabilitation

Search string 17 limits the search to English Language

Search string 18 limits the search to reviews from 2017-2022

Appendix 2.

Table 8. Full paper excludes with reasons

Study	Exclude with reason
Astley CM, Neubeck L, Gallagher R, Berry N, Huiyun D, Hill MN, et al. Cardiac Rehabilitation. J Cardiovasc Nurs. 2017;32(3):236-43.	Exclude - Australia
Attwell L, Vassallo M. Response to Pulmonary Rehabilitation in Older People with Physical Frailty, Sarcopenia and Chronic Lung Disease. Geriatr. 2017;2(1):22.	Exclude – not about engaging with rehab
Augustine A, Bhat A, Vaishali K, Magazine R. Barriers to pulmonary rehabilitation - A narrative review and perspectives from a few stakeholders. Lung India. 2021;38(1):59-63.	Excluded. Not a systematic review. Basic Medline search with narrative discursive paper. Location of studies n/s Reference to India
Barker RE, Brighton LJ, Maddocks M, Nolan CM, Patel S, Walsh JA, et al. Integrating Home-Based Exercise Training with a Hospital at Home Service for Patients Hospitalised with Acute Exacerbations of COPD: Developing the Model Using Accelerated Experience-Based Co-Design. Int J Chron Obstruct Pulmon Dis. 2021;16:1035-49.	Exclude – not a review.
Bayly J, Wakefield D, Hepgul N, Wilcock A, Higginson IJ, Maddocks M. Changing health behaviour with rehabilitation in thoracic cancer: A systematic review and synthesis. Psycho-Oncology. 2018;27(7):1675-94.	Exclude Exclude condition
Buckley JP. The changing landscape of cardiac rehabilitation; from early mobilisation and reduced mortality to chronic multi-morbidity management. Disabil Rehabil. 2021;43(24):3515-22.	Exclude – opinion piece not SR.
Butland M, Corones-Watkins K, Evanson AD, Cooke M. Health behaviours of rural Australians following percutaneous coronary intervention: a systematic scoping review. Rural & Remote Health. 2019;19(2):1-10.	Exclude - Australia
Castellanos LR, Viramontes O, Bains NK, Zepeda IA. Disparities in Cardiac Rehabilitation Among Individuals from Racial and Ethnic Groups and Rural Communities-A Systematic Review. J Racial Ethn Health Disparities. 2019;6(1):1-11.	Excluded No UK studies Studies from USA and Canada
de Araujo Pio CS, Chaves G, Davies P, Taylor R, Grace S. Interventions to promote patient utilization of cardiac rehabilitation: Cochrane systematic review and meta-analysis. Journal of Clinical Medicine. 2019;8(2) (no pagination).	Exclude DUPLICATE Author incorrect
Draper O, Goh I, Huang C, Kibblewhite T, Le Quesne P, Smith K, et al. Psychosocial interventions to optimize recovery of physical function and facilitate engagement in physical activity during the first three months following CABG surgery: a systematic review. Physical Therapy Reviews. 2020;25(5/6):381-98.	Excluded No UK studies Studies from USA, Iran, Denmark, Finland, Taiwan, Canada, Thailand. Authors from NZ
Field PE, Franklin RC, Barker RN, Ring I, Leggat PA. Cardiac rehabilitation services for people in rural and remote areas: an integrative literature review. Rural & Remote Health. 2018;18(4):1-13.	Exclude - Australia
Graham H, Prue-Owens K, Kirby J, Ramesh M. Systematic Review of Interventions Designed to Maintain or Increase Physical Activity Post-Cardiac Rehabilitation Phase II. Rehabil. 2020;9:1179572720941833.	Exclude – review of exercise post rehabilitation.

Herber OR, Smith K, White M, Jones MC. 'Just not for me' - contributing factors to nonattendance/noncompletion at phase III cardiac rehabilitation in acute coronary syndrome patients: a qualitative enquiry. Journal of Clinical Nursing (John Wiley & Sons, Inc). 2017;26(21-22):3529-42.	Exclude Not a review paper (qualitative interview study)
Jones AW, Taylor A, Gowler H, O'Kelly N, Ghosh S, Bridle C. Systematic review of interventions to improve patient uptake and completion of pulmonary rehabilitation in COPD. ERJ open res. 2017;3(1).	Exclude Not UK (only 1 study)
Kebapci A, Ozkaynak M, Lareau SC. Effects of eHealth-Based Interventions on Adherence to Components of Cardiac Rehabilitation: A Systematic Review. J Cardiovasc Nurs. 2020;35(1):74-85.	Exclude Adherence to medication mostly. Also no UK studies.
Kozik M, Isakadze N, Martin SS. Mobile health in preventive cardiology: current status and future perspective. Current Opinion in Cardiology. 2021;36(5):580-8.	Exclude CVD prevention not rehabilitation
Lavie CJ, Bennett A, Arena R. Enhancing Cardiac Rehabilitation in Women. Journal of Women's Health (15409996). 2017;26(8):817-9.	Exclude Editorial
Pio CSA, Chaves G, Davies P, Taylor R, Grace S. Interventions to Promote Patient Utilization of Cardiac Rehabilitation: Cochrane Systematic Review and Meta-Analysis. Journal of Clinical Medicine. 2019;8(2):05.	Exclude DUPLICATE Author incorrect
Ragupathi L, Stribling J, Yakunina Y, Fuster V, McLaughlin MA, Vedanthan R. Availability, Use, and Barriers to Cardiac Rehabilitation in LMIC. Glob Heart. 2017;12(4):323-34.e10.	Exclude – low and middle income countries
Rao A, Newton PJ, DiGiacomo M, Hickman LD, Hwang C, Davidson PM. Optimal Gender-Specific Strategies for the Secondary Prevention of Heart Disease in Women: A SYSTEMATIC REVIEW. J Mol Signal. 2018;38(5):279-85.	Exclude No UK studies Studies from USA/Canada
Resurreccion DM, Moreno-Peral P, Gomez-Herranz M, Rubio-Valera M, Pastor L, Caldas de Almeida JM, et al. Factors associated with non-participation in and dropout from cardiac rehabilitation programmes: a systematic review of prospective cohort studies. Eur J Cardiovasc Nurs. 2019;18(1):38-47.	Exclude No UK studies identifiable Only mentions “Europe”
Riley H, Stabile L, Wu WC. Transition to Home-Based Treatment Plans for Center-Based Cardiac, Pulmonary, and Vascular Rehabilitation during COVID-19. Rhode Island medical journal (2013). 2020;103(9):30-3.	Exclude Not review
Robinson H, Williams V, Curtis F, Bridle C, Jones AW. Facilitators and barriers to physical activity following pulmonary rehabilitation in COPD: a systematic review of qualitative studies. NPJ Prim Care Respir Med. 2018;28(1):19.	Exclude – post rehab.
Shephard RJ. A Half-Century of Evidence-Based Cardiac Rehabilitation: A Historical Review. Clinical Journal of Sport Medicine. 2022;32(1):e96-e103.	Exclude Not review
Subedi N, Rawstorn JC, Gao L, Koorts H, Maddison R. Implementation of Telerehabilitation Interventions for the Self-Management of Cardiovascular Disease: Systematic Review. JMIR Mhealth Uhealth. 2020;8(11):e17957.	Exclude No UK studies (only one multi centre including UK – cannot disaggregate).
Sun EY, Jadotte YT, Halperin W. Disparities in Cardiac Rehabilitation Participation in the United States: A SYSTEMATIC REVIEW AND META-ANALYSIS. Journal of Cardiopulmonary Rehabilitation and Prevention. 2017;37(1):2-10.	Exclude No UK studies USA only
Tadas S, Coyle D. Barriers to and Facilitators of Technology in Cardiac Rehabilitation and Self-Management: Systematic Qualitative Grounded Theory Review. J Med Internet Res. 2020;22(11):N.PAG-N.PAG.	Excluded Countries of studies not stated.

Xu L, Li F, Zhou C, Li J, Hong C, Tong Q. The effect of mobile applications for improving adherence in cardiac rehabilitation: a systematic review and meta-analysis. BMC Cardiovasc Disord. 2019;19(1):166.	Exclude No UK studies 8 included studies – 4 in USA, 2 in Australia, 1 in Denmark and 1 in German