



# Mobile apps to self-manage chronic low back pain: A realist synthesis exploring what works, for whom and in what circumstances

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## ABSTRACT

**Objective:** Chronic low back pain places a significant burden on healthcare services and sufferers. Clinical guidelines state that it is a condition that requires self-management. This realist synthesis explores how a mobile app could help people to self-manage chronic low back pain.

**Method:** Six databases and several non-academic sources were searched. In addition, nineteen realist interviews were conducted with stakeholders. Sources were selected and appraised for relevancy, richness, and rigour. Data was coded with analytical memos making retroductive inferences. Causal explanations were presented in context-mechanism-outcome configurations to form three programme theories.

**Results:** Data from 57 sources was synthesised to create 16 context-mechanism-outcome configurations and presented as three refined programme theories. The findings suggest people need to feel believed before they will engage with a self-management app. For those who feel abandoned by the healthcare service, a self-management app for chronic low back pain can be a valuable source of ongoing support and reduce feelings of social isolation.

**Conclusion:** A self-management app, if introduced appropriately and as adjunct to care, can be an empowering tool to self-manage chronic low back pain.

**Innovation:** Using input from key stakeholders enhances our understanding of the hidden generative mechanisms underpinning a programme's success or failure.

## 1. Introduction

Chronic low back pain (CLBP) has been described as a “wicked problem” [1]. It is multifactorial, socially complex and lacks a definitive solution. Low back pain is the leading cause of global disability [2] and costs the worldwide economy billions [3]. At a personal level, chronic back pain is associated with significant emotional distress and functional disability [4]. The prevalence of CLBP increases with age and so, with our globally ageing populations, this burden is set to increase.

International guidelines recommend supporting people to self-manage CLBP [5-7]. Within this guidance, patient empowerment has been identified as a key mechanism underpinning self-management [8]. However, there is tension in the self-management agenda between the rhetoric of patient empowerment and the reality faced by many people living with long term pain [9]. Whilst self-management does not mean ‘going it alone’ many chronic pain patients feel abandoned by the health care service when they are discharged to self-manage [10]. This was keenly felt in the early stages of the Covid-19 pandemic when NHS pain services were suspended [11]. In the aftermath, there were calls for a rethink in how

pain management services were delivered and a push towards the use of digital technology [12].

Studies have shown mobile apps can improve people's health outcomes and self-management behaviour in Diabetes [13], Heart failure [14], urinary incontinence [15], Chronic Obstructive Pulmonary Disease [16] and Asthma [17]. There is some evidence that self-management programmes delivered via mobile apps are effective in reducing pain and disability for people with CLBP [18-21]. However, little is known about who might benefit from a mobile app and why as to date, systematic reviews have focused on the effectiveness of mobile apps for CLBP [22,23]. Although useful, their conclusions do not help us get inside the black box of the programme itself to understand the mechanisms that make it work. For research results to be more meaningful to policy makers and for programme implementation, there have been calls for studies to go beyond asking whether a programme is effective or not, to explore why it works and for whom [24,25]. Pawson and Tilley's [26] scientific realism came about in response to this call and was designed to help programme evaluators make sense of complex social interventions [27]. Scientific realism is a theory-led approach that seeks to explain programme outcomes by looking for underlying causal

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mechanisms triggered in certain contexts. The aim of this study was to explore how and why a mobile app might help a person self-manage CLBP. Since people living with CLBP are experts in their own condition and are the intended users of the self-management apps, it was considered essential to include their voices within the research.

## 2. Methods

Realist syntheses are well suited to addressing the stated aim because they go beyond asking whether a programme works to explore how it works, for whom and in what context. They are also guided by stakeholder input. Underpinning this approach is a realist philosophy based on a generative understanding of causation which posits that programme outcomes are the result of unseen causal mechanisms that are triggered in certain contexts. The result of a realist synthesis are programme theories presented as a series of context-mechanism-outcome configurations (CMOCs). These programme theories are propositions as to why an intervention works, for whom and in what circumstances [28].

A realist synthesis typically relies on secondary sources however in this review — due to the lack of representation from people living with CLBP—realist interviews with stakeholders were also included. Although this is atypical, it is not without precedence [29]. The principal researcher (RH) came to the review with nascent research questions originating from their experience treating people with CLBP in the NHS. Sub questions were added after the background mapping in stage 1. The scope of the review was later refined after the first stakeholder consultation.

This synthesis had 8 iterative stages which are outlined in the following sections. A schematic overview of the process has been published elsewhere [27]. This review has been reported with reference to the RAMESES publication standards for realist synthesis [30] [see Appendix A].

### 2.1. Stage 1: Background mapping

Published studies involving self-management apps for long-term health conditions were reviewed to sensitise the research team to the area. Key policies around self-management and digital health technology from UK Government websites and national pain charities were also consulted. In addition, newspapers, blogs, artwork, social media, and book chapters were included to gain insights from multiple perspectives. Key terms such as ‘self-management’ and ‘empowerment’ were explored in a process called concept mining [31]. The aim of stage 1 was to identify how self-management apps were thought to work so initial rough programme theories (IRPTs) could be developed and then tested.

### 2.2. Stage 2: Formulate initial rough programme theories

Substantive theories were purposively selected to help formulate IRPTs. Substantive theories can help researchers consider what part of an intervention might be important [32]. Guided by Booth and Carroll [33] a purposeful search was conducted to find substantive theories relating to self-management and back pain. As a result of this search, Lee and Koh's conceptual definition of empowerment [34] and May et al.'s burden of treatment theory [35] were used to inform programme theory development. At the end of stage 1, sixteen IRPTs were taken to stakeholders for comment.

### 2.3. Stage 3: First consultation with stakeholders

#### 2.3.1. Stakeholder characteristics

Twelve stakeholders were purposively selected for their experience in dealing with long-term pain (See Table 1). They were divided into experiential and professional stakeholders. Experiential stakeholders were adults who had been diagnosed with CLBP (or a condition that resulted in CLBP). Professional stakeholders were either healthcare workers treating people with CLBP; members of charity groups supporting people living in pain; or people working in the field of health technology.

**Table 1**

Stakeholder characteristics in first consultation.

Role	Number
Persons living with long term pain/CLBP	4
Pain specialist Health Care Professionals	3
NHS Senior management and Board members	2
Third sector Pain Charity Directors	2
NHS Service redesign (consultant)	1
Total	12

#### 2.3.2. Stakeholder recruitment

Experiential stakeholders were recruited through an advertisement placed on a twitter account that had been created for the study. Professional stakeholders were recruited by email via healthcare connections and networking events. NHS ethical approval for the study was obtained from the West of Scotland Research Ethics Committee (Reference number: 20/WS/0041).

#### 2.3.3. Stakeholder interviews

Each stakeholder participated in a sixty-minute recorded telephone interview. During the interview 8–10 IRPTs were selected for comment depending on the relevance that potential programme theory had to the stakeholder's experience. Realist interviews are based on a teacher-learner cycle which is a distinct characteristic of realist research [36]. In the teacher-learner relationship the interviewer presents a theory about the programme under review for the interviewee to consider. The interviewee in turn confirms, refutes, falsifies, or affirms the theory based on their experience [36]. In this way, a cyclical relationship is established between the interviewer and interviewee, the former starting in the teacher role then becoming the learner. As a result, the interviewee is more than a simple source of information but becomes an integral part of the meaning-making process and can add to the trustworthiness of the realist research process [37].

#### 2.3.4. Data coding and analysis

Interviews were transcribed and coded by RH. The coding strategy followed the principles outlined in the Centre for Advancement in Realist Evaluation and Synthesis training programme [38]. Extracts of the transcripts were highlighted and inferences from the data were made using abductive and retroductive logic. These inferences were extracted and recorded in a series of analytical memos in a coding journal. These memos were subsequently mind-mapped into a series of causal loops using a whiteboard and then Xmind software (Version 22.10) to create six refined programme theories (Appendix B). This use of analytical memo's was informed by Gilmore et al.'s [39] review and the mind-mapping drew on the causal loop diagrams from Mukumbang et al.'s work [40]. At the end of this process the sixteen IRPTs had been reduced to six. These six were deemed to be the most meaningful and relevant to the stakeholders and helped to narrow the scope of the research (See Appendix B).

### 2.4. Stage 4: Search for empirical evidence

#### 2.4.1. Database search

The research strategy was prepared by RH in consultation with a subject librarian (CO) and other members of the research team (TG & MB). Search terms were used from relevant papers identified in stage 1. The informal literature search undertaken as part of the mapping exercise in stage 1 revealed a paucity of empirical literature on mHealth apps for CLBP. This was not surprising given mHealth is a relatively new field. In the absence of research directly related to the programme under review, realist researchers are encouraged to learn from studies of similar programmes [41]. For this reason, research on mobile apps for chronic pain, fibromyalgia, irritable bowel disease and chronic fatigue syndrome were included in the search strategy. These conditions were purposely chosen because they come under an umbrella of long term conditions with medically unexplained symptoms [42]. Medically unexplained symptoms are those for which no pathological cause can be identified or the origin remains unclear

[43]. It was reasoned that people suffering with these conditions may share similar feelings of not being believed or feeling like they have been told their symptoms are 'all in their head'. They may also share a desire to obtain a specific diagnosis for their symptoms.

For the database search, the research question was broken down into key conceptual components: back pain; irritable bowel syndrome, chronic pain, chronic fatigue syndrome, fibromyalgia / self-management / mobile apps/ chronic. Search terms were piloted in MEDLINE and key papers from stage 1 were used to test the sensitivity of the search. The literature search was run on 4th May 2021 and included the following databases: CINAHL; MEDLINE; EMBASE; PsycINFO, Scopus, ACM Digital (See Appendix C for an example of the search strategy and key words). Search results were limited to English language studies and no start or end dates were specified.

#### 2.4.2. Selection and appraisal

The database search resulted in 662 articles. Duplicates were removed via the reference management software (Zotero version 6.0.10) leaving 432 articles for screening. See Fig. 1 for a flow diagram of article selection and inclusion. Results were imported into Rayyan — a web and mobile app for systematic reviews [44]. Decisions to include or exclude a study was based on relevancy. Relevancy was determined by how the study contributed to programme theory development.

There were two relevancy screens. The first was a title and abstract screen piloted and applied to all papers by RH. Papers were scored on a five-point scale from highly relevant (1) to likely irrelevant (5) (See Appendix D). Reasons for exclusion were recorded and 20% of the results were checked by the research team (TG & MB) for consistency. Articles categorised as 'less relevant' (4) or 'likely irrelevant' (5) were kept to one side, leaving 35 articles to be taken through for a second screen. Two articles could not be obtained leaving the full texts of 33 articles to be screened for relevancy, rigour, and richness (See Appendix E). Rigour was assessed in terms of the trustworthiness of the data and richness in terms of how much explanatory detail it offered. Articles were scored using a 4-point scale from high to none. The conceptualisation and application of rigour, relevance and richness followed the research brief published by Dada et al. [45]. Judgements were made based on how the article could contribute to programme theory development and were ranked by RH in discussion with the research team. A total of thirteen articles rated high ( $n.7$ ) or moderate ( $n.6$ ) were included in the synthesis (see Table 2).

#### 2.5. Stage 5: Extract and organise data

A bespoke data extraction form was created and study characteristics, methodological rigour, and articles of interest in the reference list were recorded. Analytical memos and inferences were created and extracted into a coding journal.

At the end of this process, it was felt that the academic literature did not provide sufficient data to gain the ontological depth necessary to identify why mobile apps may or may not work for people self-managing CLBP. Instead of choosing to do a supplementary literature search in the databases, evidence was brought in from sources identified in stage 1 (See Table 3). This aligns with Booth et al.'s [58] pick and place search strategy. The context-mechanism-outcome framework was used to pick data from the background search undertaken in stage 1 and place it within the realist synthesis to help with theory development. Data was extracted and coded in a similar way to the stakeholder transcripts and added to the coding journal.

#### 2.6. Stage 6: Refine programme theories

During stage 6 the sixteen IRPTs were refined to create seven rough programme theory areas. Each area was a pattern code [59] that identified a 'big picture' with constituent codes attached (See Appendix F). These constituent codes guided the realist interviews in the second consultation with stakeholders.

#### 2.7. Stage 7: Second consultation with stakeholders

These seven refined programme theory areas with their constituent codes were taken forward for testing with a second round of realist interviews. The second consultation replicated the first (Stage 3) and involved seven new stakeholders all of whom were living with CLBP. They were recruited via an additional advertisement placed on the study's Twitter page. In a similar process to the first consultation, the stakeholder transcripts were coded using analytical memos but, in this instance, both deductive and inductive-retroduction was applied [60]. Causal insights from the stakeholders were used to test and refine the seven theory areas (deductive) whilst at the same time data from the transcripts was used to create new causal insights (inductive). These memos were added into the coding journal.

#### 2.8. Stage 8: Synthesise findings and draw conclusions

The evidence was synthesised via a process of free-writing and visual displays (See Appendix G). Although it is listed as 'stage 8', data synthesis was an ongoing and iterative process that took place throughout the review. It involved going over the coding journal, transcripts, and articles repeatedly and applying retroductive and abductive logic to create chains of inferences and eventually CMO configurations. The analysis and synthesis steps have been illustrated in Fig. 2. Although it is depicted as a linear process, in practise, there were regular back and forth exchanges between the steps.

Lee and Koh's conceptual definition of empowerment [34] and May et al.'s burden of treatment theory [35] were brought back into the synthesis as substantive theories to help with theory development. The analysis process was facilitated throughout by discussions with the research team and by presenting preliminary findings and nascent theories at realist training events and conferences. The final CMO configurations were presented and discussed with one of the experiential stakeholders in a sense checking and validation exercise.

### 3. Results

A total of fifty-seven sources of data from academic (Table 2) and non-academic sources (Table 3) as well as stakeholder interviews contributed to the realist review. From this data, 16 context-mechanism-outcome configurations (CMOCs) were created to produce three related programme theories on how self-management apps may work for people with CLBP (See Table 4). These theories are presented at an abstracted, or middle range level so they may be applied across different settings [60].

#### 3.1. Programme theory one: Empowerment

Given the importance of empowerment in healthcare policies relating to self-management, the research team purposively drew on Lee and Koh's conceptual definition of empowerment [34] to develop this programme theory (Fig. 3).

##### 3.1.1. Convenience; accessibility and choice

Traditional self-management programmes for CLBP are restricted by the National Health Service's (NHS) infrastructure which makes them inflexible and inconvenient to many programme participants. The literature and both stakeholder groups repeatedly emphasised that the lack of choice in how self-management programmes were delivered disincited people from attending.

*"...we found that logistically the patients may not be able to commit themselves to a set day a week for six consecutive weeks as it's going to be."*  
[PS07, 339–340]

Policy papers and third sector charity reports repeatedly stressed that digital health technology (such as mobile apps) could empower patient's

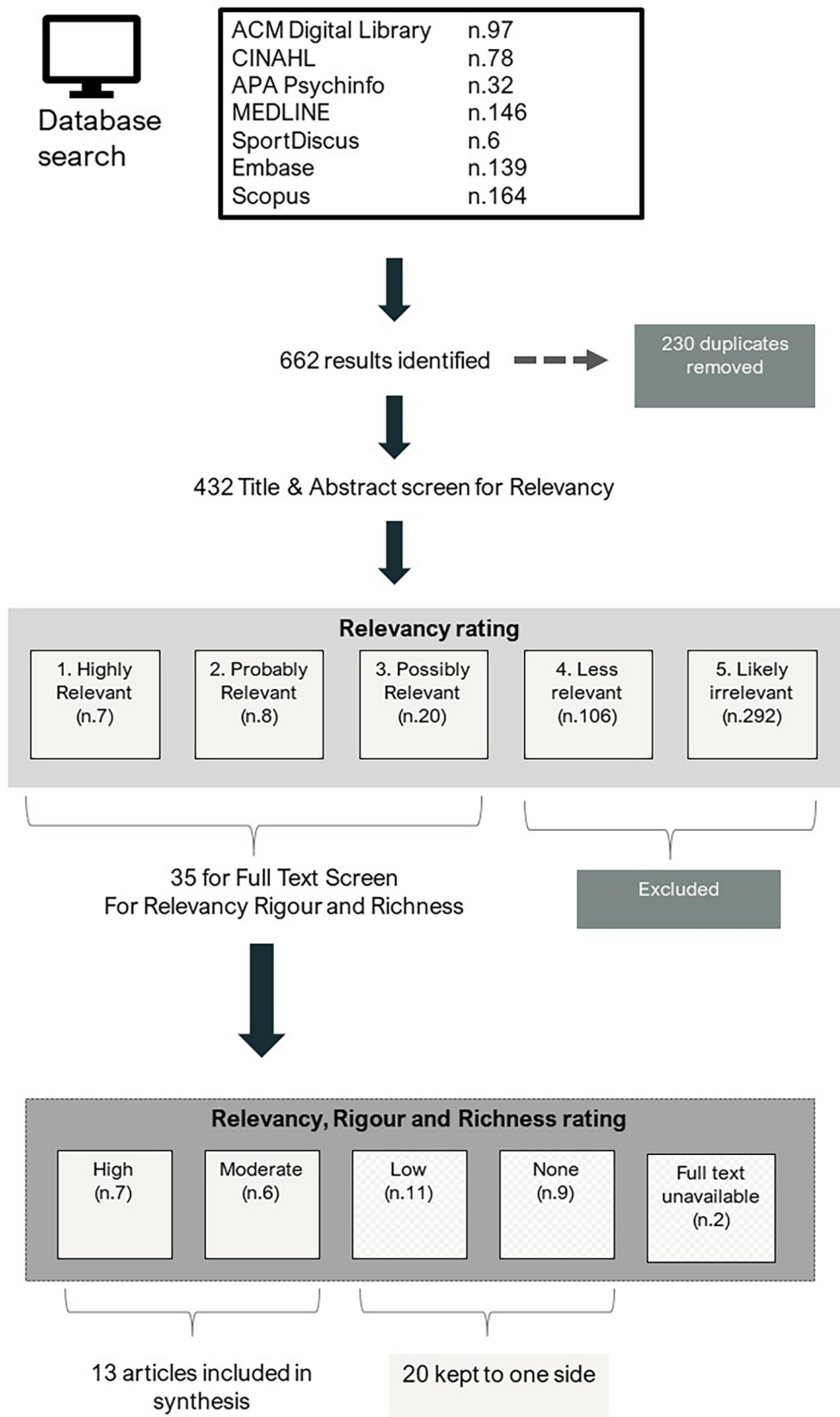


Fig. 1. Flow diagram of article selection and inclusion.

**Table 2**

Document characteristics of included papers included. Key: CLBP: Chronic low back pain; LBP: Low back pain; CP: Chronic pain; IBS: Irritable Bowel Syndrome.

Doc ID	Title	Authors	Year	Country	Type of Study	Subject area	Relevancy screening Title/Abstract screen	Relevancy Rigour and Richness Full Text screen	CMOC contribution
LIT08 [23]	The efficacy of e-health in the self-management of chronic low back pain: A meta analysis.	Du, Shizheng and Liu, Wen and Cai, Shining and Hu, Yan and Dong, Jianshu	2020	China	Meta analysis	CLBP	2	Moderate	CMOC1 CMOC7 CMOC8
LIT09 [46]	Barriers and facilitators to patient uptake and utilisation of digital interventions for the self-management of low back pain: a systematic review of qualitative studies	Svensden, Malene Jagd, Karen Wood Wood, John Kyle, Kay Cooper, Charlotte Diana Nørregaard Rasmussen, Louise Fleng Sandal, Mette Jensen Stochkendahl, Frances S. Mair, and Barbara I. Nicholl	2020	Denmark	Systematic review	LBP	2	High	CMOC1 CMOC2 CMOC7
LIT11 [47]	Exploring Patients' Experiences of Internet-Based Self-Management Support for Low Back Pain in Primary Care.	Geraghty, Adam W A and Roberts, Lisa C and Stanford, Rosie and Hill, Jonathan C and Yoganantham, Dinesh and Little, Paul and Foster, Nadine E and Hay, Elaine M and Yardley, Lucy	2019	UK	Qualitative study	LBP	2	High	CMOC3 CMOC9
LIT14 [48]	Self-management of chronic low back pain: An exploration of the impact of a patient-centered website.	Zufferey MC, Schulz PJ.	2009	Switzerland	Qualitative study	CLBP	2	High	CMOC3 CMOC9
LIT15 [49]	Evaluation of Self-Management Support Functions in Apps for People With Persistent Pain: Systematic Review.	Devan, Hemakumar and Farmery, Devin and Peebles, Lucy and Grainger, Rebecca	2019	New Zealand	Systematic review	CP	3	Moderate	CMOC1 CMOC3
LIT18 [50]	Pain Self-Management for Veterans: Development and Pilot Test of a Stage-Based Mobile-Optimized Intervention	Johnson, Sara S. and Levesque, Deborah A. and Broderick, Lynne E. and Bailey, Dustin G. and Kerns, Robert D.	2017	USA	Pilot study	CP	3	Moderate	CMOC1
LIT21 [51]	A Smartphone-Based Health Care Chatbot to Promote Self-Management of Chronic Pain (SELMA): Pilot Randomized Controlled Trial.	Hauser-Ulrich, Sandra and Kunzli, Hansjorg and Meier-Peterhans, Danielle and Kowatsch, Tobias	2020	Switzerland	RCT	CP	3	High	CMOC2
LIT23 [52]	Smartphone Applications Designed to Improve Older People's Chronic Pain Management: An Integrated Systematic Review.	Dunham, Margaret and Bonacaro, Antonio and Schofield, Patricia and Bacon, Liz and Spyridonis, Fotios and Mehrpouya, Hadi	2021	UK	Systematic review	CP	3	High	CMOC1 CMOC5 CMOC9
LIT24 [53]	The Efficacy of Zemedy, a Mobile Digital Therapeutic for the Self-Management of Irritable Bowel Syndrome: a Cross-Over, Randomized Controlled Trial.	Hunt, Melissa and Miguez, Sofia and Dukas, Benji and Onwude, Obinna and White, Sarah	2021	USA	RCT	IBS	3	High	CMOC6 CMOC11
LIT25 [54]	User Engagement and Clinical Impact of the Manage My Pain App in Patients With Chronic Pain: A Real-World, Multi-site Trial.	Bhatia, Anuj and Kara, Jamal and Janmohamed, Tahir and Prabhu, Atul and Lebovic, Gerald and Katz, Joel and Clarke, Hance	2021	Canada	Clinical trial	CP	3	Moderate	CMOC7
LIT30 [55]	Designing a mobile-based solution for self-management of chronic pain	Meawad, F. and Yang, S.-Y. and Loy, F.L. and Chang, E.J. and Isryad, M.H.	2018	Singapore	Evaluation study	CP	3	Moderate	CMOC1 CMOC7
LIT33 [56]	Digital Health Apps in the Clinical Care of Inflammatory Bowel Disease: Scoping Review	Yin, Lukas Andrew and Hachuel, David and Pollak, P. John and Scherl, J. Ellen and Estrin, Deborah	2019	USA	Scoping review	IBS	3	High	CMOC2 CMOC8 CMOC9 CMOC10
LIT34 [57]	Integration of Mobile Health Technology in the Treatment of Chronic Pain: A Critical Review	Sundaraman, L.V. and Edwards, R.R. and Ross, E.L. and Jamison, R.N.	2017	USA	Critical review	CP	3	Moderate	CMOC1

by providing equitable access to healthcare. The findings from the review suggest a mobile app could restore a person's sense of autonomy and control because they could choose when and where they accessed support for their CLBP. [CMOC-1].

### 3.1.2. Knowledge

A lack of knowledge about the human body and back pain specifically creates a power differential between the HCP who knows more about the condition and how to manage it than the person with CLBP.

*"But I don't know anything about my back, so I am actually naturally disadvantaged so I'm almost already compromised because you [HCP] have knowledge I don't have .... If I was better informed, there wouldn't need to be so much of a shift in power...." [PS01, 164–167].*

Providing education and self-management strategies was linked to patient empowerment. The more a person with CLBP knew about their back and how to help themselves, the less beholden they would be on HCPs for support [CMOC-2].

*"...when you start to learn about your condition and learn about methods of coping with it you are reclaiming that power..." [ES12, 425–431].*

### 3.1.3. Personalisation

Knowledge can only be considered empowering if a person feels the information, they are given relates to them. Experiential stakeholders expressed reservations about using a self-management app for their CLBP if the information was too generic.



**Table 3**  
Supplementary evidence brought in from Stage 1.

Supplementary evidence	Number
UK Government reports	7
UK pain charity papers	3
Book chapters	2
Blog post	1
Art	2
Twitter thread	3
Newspaper articles	7
Total	25

“... Does the Bot know me? ...Is this the standard generic responses that everyone is getting?” [ES05, 412–415].

The usefulness and trustworthiness of the app was limited if experiential stakeholders were unable to recognise their idiosyncratic presentation of back pain in the advice and strategies offered. The findings suggest that the more personalised the information, the more relevant and trustworthy users considered the app to be [CMOC-3].

**3.1.4. Hope**

People with CLBP are often looking for an alternative to painkillers to help them manage their CLBP. This can motivate people with CLBP to try alternate modalities, like an app, in the hope that it will help them manage their condition more effectively. However, the findings indicate that if a self-management app does not provide any information, advice or strategies that the patient has not heard or tried before then this sense of hope can quickly give way to frustration, despair and even bitterness [CMOC-4].

**3.1.5. Adjunct to care**

An initial IRPT hypothesised that HCPs may feel threatened by an app if they thought it would replace them in some way. However, this was not supported in the review findings. Professional stakeholders did not see an app as being capable of replicating the care they provided and therefore

did not consider it to be a threat. Instead, a mobile app was viewed as a tool to help HCPs to “work smarter, not harder” [PS01]. For example, instead of reviewing a patient every four weeks, the HCP could extend this period to six weeks, knowing that the self-management app could provide ongoing support in the interim. In this context, a self-management app was considered an empowering tool, enabling HCPs to work more effectively and efficiently [CMOC-5].

**3.2. Programme theory two: Self-management burden**

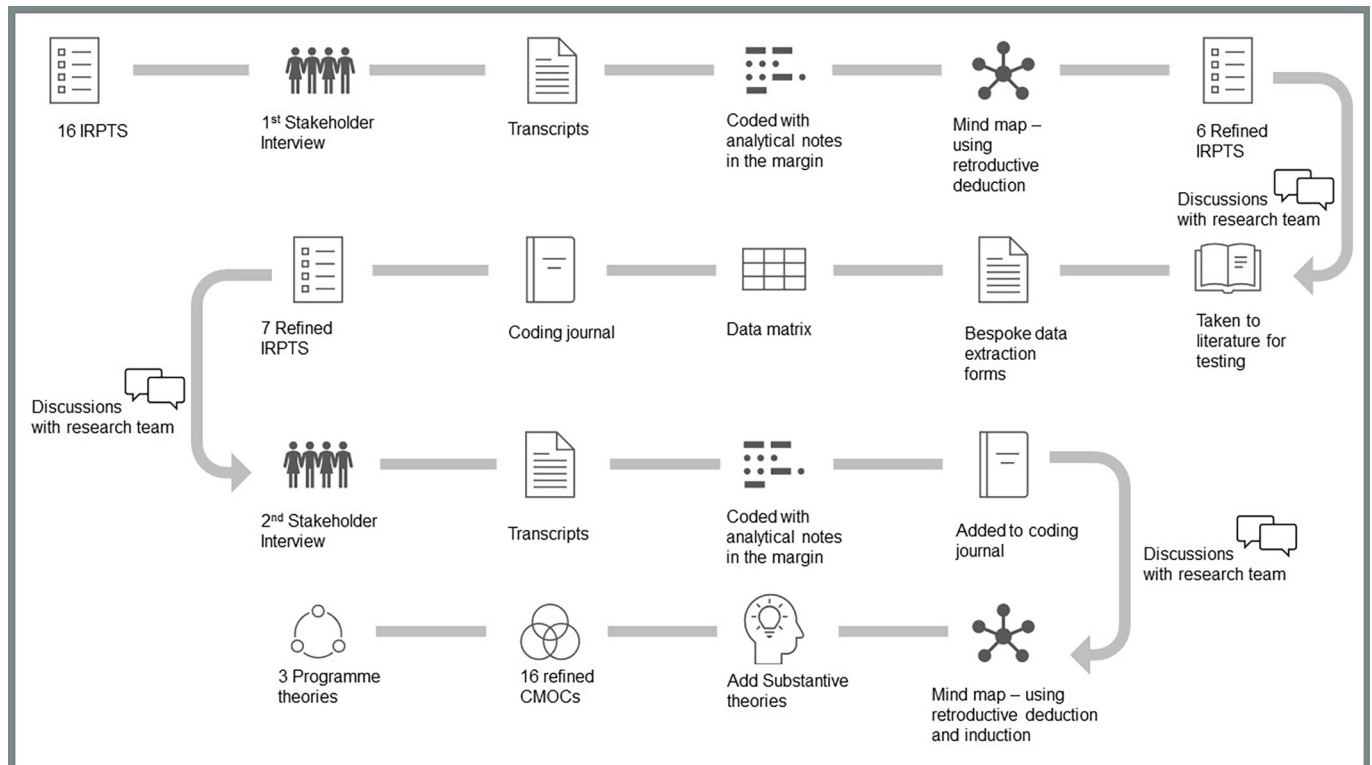
The following CMOCs centre around the challenges inherent in self-managing CLBP and the role a mobile app can have to help or hinder these efforts. This programme theory (Fig. 4) was informed by May et al.’s Burden of Treatment theory [35].

**3.2.1. Burden of treatment/care**

A person’s ability to self-manage their CLBP is influenced by their internal resources (e.g., confidence, motivation, etc) and external resources (e.g., time, financial security, etc). The findings make it clear that expecting a person to self-manage their CLBP and engage with an app without considering these factors is likely to produce failed results. Policy documents highlighted the need for the digital infrastructure to be in a place to support mobile apps alongside initiatives to improve digital literacy. At a personal level, the sources indicated that for people in crisis (both physical or mental) a mobile app would likely add to the stress and burden they are already under. [CMOC-6].

**3.2.2. Ongoing support/monitoring**

Experiential stakeholders spoke of the benefit they would find in having a HCP ‘checking-in’ to monitor their progress and keep them motivated with self-management. They noted however, that the length of time between follow ups usually meant that HCPs did not get a complete picture of how a person was managing their CLBP. Furthermore, it was unlikely they would see the same HCP in successive appointments. Experiential stakeholders complained of the exhaustion they experienced having to go



**Fig. 2.** Steps in data analysis and synthesis.

**Table 4**

16 CMOC's grouped into three related programme theories. Key: BK: Book chapter; ES: Experiential stakeholder; LIT: Academic paper; News: Newspaper; PP: Policy Paper; PS: Professional stakeholder; Thsec: Third sector paper; Twitt: Twitter.

Number	Context-Mechanism-Outcome Configuration	Evidence
Programme theory one: Empowerment		
CMOC-1	Traditional NHS-led self-management programmes for CLBP provide participants with little choice in how, when and where they are delivered (C). A self-management app for CLBP can be accessed at a time and location that is convenient to the user (M) which restores a person's sense of control and autonomy (O).	PP6; PP7; PS03; PS06; PS07; ES02; ES11; ThSec2; ThSec3; LIT08; LIT09; LIT15; LIT18; LIT23; LIT30; LIT34; News08
CMOC-2	Many people with CLBP rely on HCPs for support because they do not know how to manage their symptoms (C). By providing the user with knowledge, advice and strategies to self-manage CLBP a mobile app enables the user to gain confidence and agency (M) to manage their condition on their own (O).	PP1; LIT21; LIT30; LIT33; PS01; ES01; ES09; ES11; ES12
CMOC-3	A person with CLBP needs to be able to recognise themselves in the advice and information the app provides (C) so that they can trust what they are being told (M) otherwise they are unlikely to engage with the app because they do not consider it as being relevant to their situation (O).	LIT09; LIT11; LIT14; LIT15; ES01; ES05; ES09
CMOC-4	If a mobile app fails to provide the user with options that have not been tried before (C) then the initial hope they may have felt at being offered something that might alleviate their pain (M) can turn to bitterness, disappointment and sometimes anger (O).	News20; News 02; News3; PP5; PS12; PS02; RS14; BK1; E008; ES09; LIT14
CMOC-5	If a self-management app was used as an adjunct to care and not a replacement (C) then HCPs are likely to welcome the tool as it helps them to deliver ongoing support remotely (M) thereby enabling them to treat more patients in their limited clinic time (O).	PS01; PS02; PS03; PS04; PS06; ES04; LIT23
Programme theory two Self -management Burden		
CMOC-6	If people with CLBP lack the internal and or external resources to engage with a self-management app (C) then this can cause further stress and frustration (M) which adds to their burden of having to manage long term back pain (O).	BK1; LIT 09; LIT24; PP01; PS02; Blog01
CMOC-7	Monitoring their progress with a mobile app and sharing this data with a HCP (C) can help a person with CLBP convey more of a 'complete picture' of how they are managing their condition (M) and thereby improve the communication and quality of a healthcare consultation (O).	LIT08; LIT 09; LIT25; LIT 30; Art2; ES03; ES04; ES05; ES06; ES09; ES12; PS04
CMOC 8	Using an app to record and share their data with an HCP (either before or during the appointment) (C) can maximise limited consultation time (M) and thereby reduce the frustration felt by patients' valuable consultation is wasted bringing HCPs 'up to speed'(O).	PS01; ES02; ES03; ES08; ES09; PP4; ART2; LIT33; LIT08; Twitt02

**Table 4 (continued)**

Number	Context-Mechanism-Outcome Configuration	Evidence
CMOC-9	By providing support as well as a means by which to contact a HCP if needed (C) a self-management app provides users with the reassurance of a 'safety net' should they feel they need additional support (M) thereby mitigating feelings of abandonment (O).	PP1; Twitt05; Blog1; BK1; ThSec2; ES04; ES03; ES09; PS01; PS04; PS05; LIT11; LIT23; LIT33
CMOC-10	A self-management app that enabled a person with CLBP to maintain contact with a HCP (C) can provide a reassuring 'safety net' (M) leaving them more confident to be discharged from the healthcare service (O).	PS01; PS05; PS06; ES03; LIT33
CMOC-11	In the absence of supportive 'real life' relationships (C) a self-management app with a chatbot feature that has been designed to communicate in a human-like way to offer comfort and reassurance (M) can help someone with CLBP feel less alone (O).	ES08; ES10; ES11; LIT21; LIT24; News07; Thsec1; Art1
Programme theory three: Timing		
CMOC-12	If a person with CLBP remains steadfast in their search to find a cure for their back pain (C) and are unwilling to accept an active role in self-managing their condition (M) then they are likely to be disappointed with a self-management app because it does not rid them of their pain (O).	News01; LIT09; LIT14
CMOC-13	Before a person with CLBP can accept the need to self-manage their condition they need to feel that HCPs believe them (C). Feeling believed triggers a sense of reassurance that they have been taken seriously (M) which makes them trust the HCP (O).	ES01; ES02; ES04; ES05; ES06; ES08 PS08; News04; News13; News 11; News19;
CMOC-14	When a person with CLBP trusts a HCP (C) then they are likely to be more receptive (M) to HCP's recommendation of a self-management app (O).	ES01; ES02; ES04; ES05; ES06; ES08 PS08; News04; News13; News 11; News19
CMOC-15	When a person has been reassured that there is no serious spinal pathology, and they are not likely to do any harm to their backs (C) they become less fearful of movement (M) and are more likely to engage with the strategies offered by a self-management app (O).	News01; News15; Twitt01; PS03; PS04; ES08; LIT11
CMOC-16	Introducing a self-management app early on in a patient's journey — whilst medical management and investigations are ongoing— (C) can provide reassurance and advice to help a person with CLBP return to everyday activities (M) and thereby reduce the risk of maladaptive behaviours developing (O).	PP4; ES04; PS04; ES10; ES11; LIT25

over their medical history repeatedly and their frustration that valuable consultation time was being wasted on getting a new HCP 'up to speed' [CMOC 8].

*“Nowadays we don't get continuity with our GPs and when you go into a new GP, to try and explain all of this, you can't get it all out with your 10min appointment”. [ES08, 202–203].*

The findings suggest that using an app to monitor and evaluate their progress could keep users motivated with self-management. Furthermore,

## Programme theory one: Empowerment

People with CLBP can feel empowered by a self-management app if the app is personal and relevant to their situation, can be accessed when and where they need it and is presented as an adjunct to ongoing care.

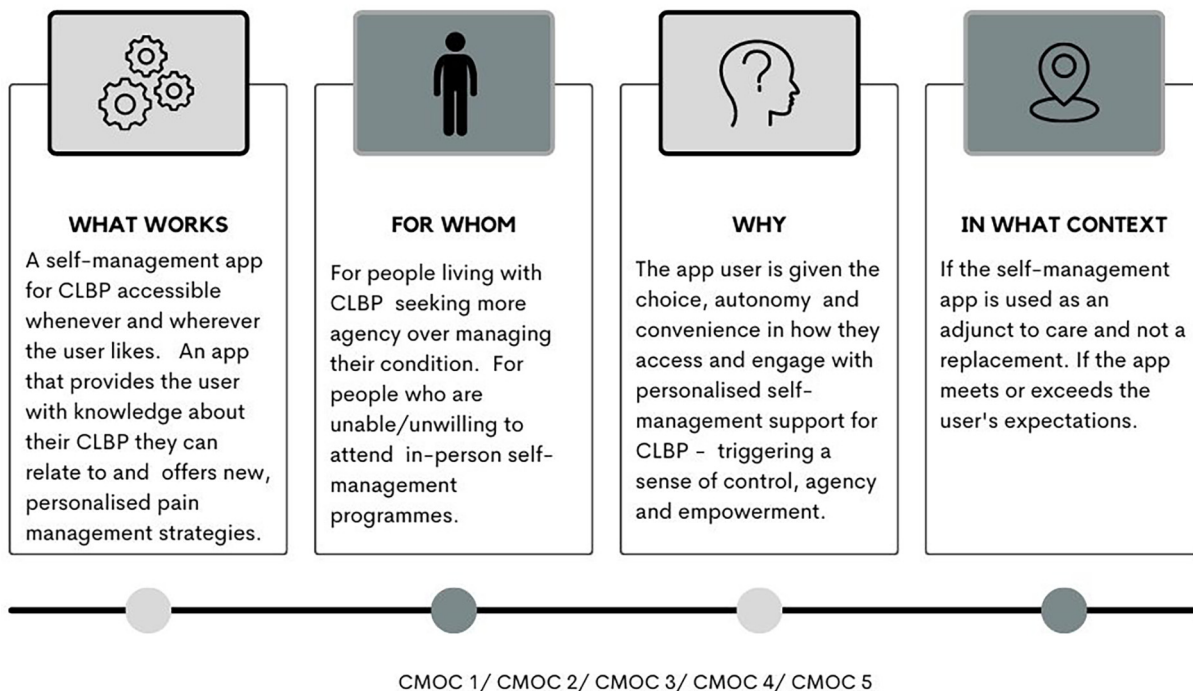


Fig. 3. Programme theory one: Empowerment.

## Programme theory two: Self-management Burden

If people with CLBP have the capacity to engage with a mobile app then it can reduce the burden of having to self-manage CLBP by providing ongoing support, facilitating communication with HCPs, and mitigating feelings of abandonment.

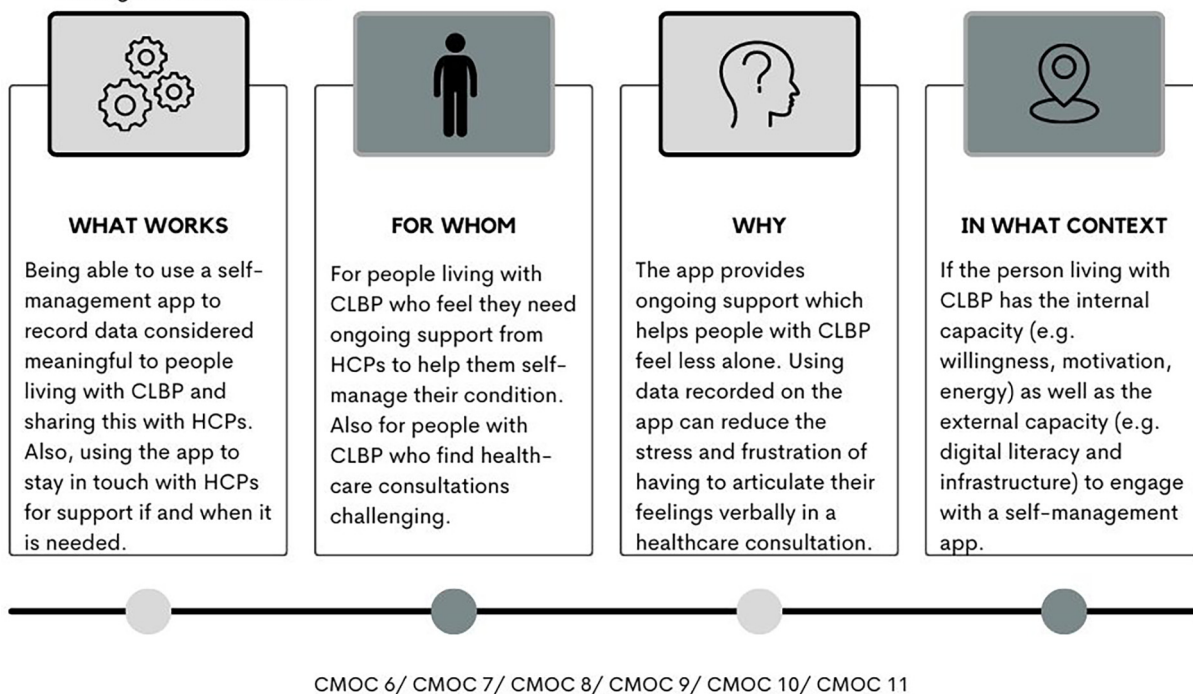


Fig. 4. Programme theory two: Self-management burden.



## Programme theory three: Timing

A person with CLBP is likely to benefit from a self-management app early on in their patient journey but not before they feel believed and reassured by HCPs and have accepted their condition cannot be cured.

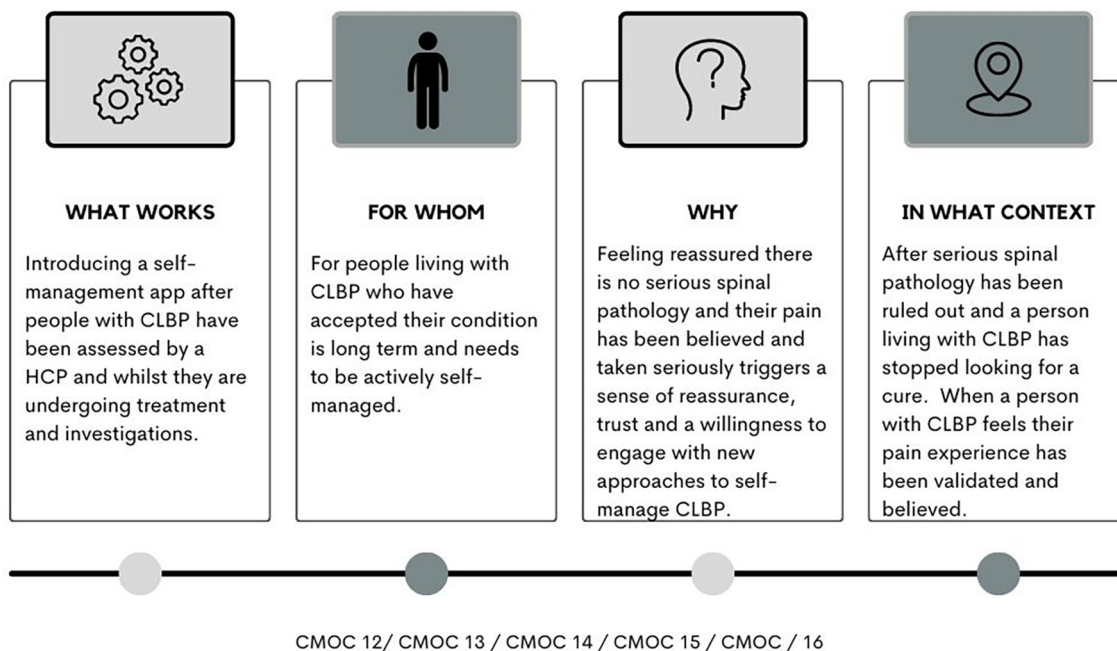


Fig. 5. Programme theory three: Timing.

being able to share this data with HCPs was thought to empower patients by improving their ability to communicate with HCPs. Both the patient and HCP could see the ‘complete picture’ rather than a ‘snapshot’ of how they were managing [CMOC-7].

### 3.2.3. Abandonment/safety net

The word ‘self’ in ‘self-management’ can imply that the responsibility for ongoing healthcare management is the sole responsibility of the individual and not, as it was meant to be, an ongoing collaboration between patient and HCP. Many sources in the synthesis described feelings of abandonment at being discharged by the healthcare service to manage CLBP on their own. By providing ongoing support in the form of advice, reassurance, education, and self-management strategies— as well as access to HCPs via text message or communication portals—a mobile app could mitigate these feelings of abandonment. Stakeholders spoke of the app as a form of ‘safety net’ and several studies noted the benefits of having the ‘best of both worlds’ – a digital intervention with the ability to contact a HCP [CMOC-8].

### 3.2.4. Dependency

Some professional stakeholders felt offering ongoing support to people with CLBP would exacerbate the healthcare burden whilst others felt a ‘safety net’ would result in less healthcare contact. Only one study in the review mentioned the impact of mobile app usage on healthcare utilisation [Lit33]. They concluded there were mixed results when it came to the number of telephone contacts app users made to HCPs. This lends support to concerns that app users may burden the service with text enquiries and instant chat messages. However, this form of support — delivered via a mobile app — maybe less burdensome than a re-referral back into the healthcare service [CMOC-9].

### 3.2.5. Social isolation

The data made clear that people with CLBP often feel socially isolated. Many are too exhausted and sore to leave the house. Several experiential stakeholders spoke of feeling judged by others and were made to feel like

they were ‘faking’ their pain. For people in this situation the thought of conversing with a chatbot (a computerised conversational agent) that communicates in an empathetic, human-like style, was seen as a source of comfort and support.

“...that actually gave me goose bumps because I feel like – this sounds rubbish – I’d feel there was somebody there that is listening to me but not actually, judging me”. [ES08, 285–286].

Even those who considered a parasocial relationship with a chatbot to be a poor proxy for ‘real’ human interaction saw the value of it at certain times, for example, when the thought of communicating with friends and family was too effortful [CMOC-10].

### 3.3. Programme theory three: Timing

This final programme theory (Fig. 5) introduces CMO configurations that consider what needs to happen before a person with CLBP is likely to engage with a self-management app.

#### 3.3.1. Acceptance

The findings suggest that if a person fails to accept their long-term back pain and remains fixated on becoming completely pain-free, they are unlikely to fully engage with a self-management app. Self-management apps are designed to offer advice and support to help them live well with pain [LIT08] [LIT11], but they do not offer a cure [LIT21].

“... Individuals must be aware that no medical authority, no miraculous drug, or other passive therapy might cure the illness, and have to accept becoming actively involved in their care” [LIT14, p.32].

Throughout the review, sources stressed that people with CLBP needed to take an active role in self-managing their condition. Those people who were unable to accept this, were unlikely to use or benefit from a self-management app for CLBP [CMOC-11].

### 3.3.2. Believed

In reviewing the data, it became clear that people with CLBP feel that others, particularly HCPs, do not believe the pain they are in. As a result, many people with CLBP focus their energies seeking validation of their pain experience.

*“... I came to realise, and it took me a long time to do it, that actually what I wanted was somebody just to say ‘you are telling me you’ve got back pain, I believe you’.” (ES01, lines 255–257).*

When a person with CLBP feels believed and taken seriously by a HCP they can begin to trust them. When trust has been established, the patient is likely to be more receptive to a HCP recommending a self-management app. Thus, feeling believed is an important precursor to engaging with a self-management app. However, it was interesting to note that none of the Government papers; third sector reports and academic literature mention the significance of feeling believed [CMOC-12, CMOC-13].

### 3.3.3. Fear/reassurance

Back pain generates a powerful, instinctive, fear response. There is something viscerally more frightening about something happening to the back in comparison to other parts of the body, as one Twitter thread revealed.

*“we’re scared of back pain because it’s inherently more intimidating/disabling than other common problems.” (Twitt 01, 8).*

*“Unlike other peripheral injuries, some back injuries can indeed leave you quadriplegic or paraplegic” (Twitt 01, 20).*

Sources commented on their concerns about doing something that might endanger their back and make their pain worse.

*“People don’t understand their physical, human biology, therefore they are frightened about what they might do to themselves if they do it wrong. .... “have I done too much?” “Should I be doing that?” “It doesn’t feel right, oh my goodness!” [PS01, 267–269].*

A mobile app could show users the correct way to do their exercises, provide reassurance on what is ‘normal’ and thereby reduce the fear of engaging with activities to manage their back pain [CMOC-15].

### 3.3.4. Timing of introduction

The longer a person lives with CLBP the more likely maladaptive health behaviours (such as fear avoidance, learned helplessness or an over reliance on pain medication) will become embedded in their pain response. Many stakeholders wished they had been introduced to self-management sooner.

*“My personal experience, if I’d of had the self-management earlier I would probably not have been stuck on painkillers, as much painkillers, for so long.” (ES011, 256–257).*

*“... I do believe the sooner the better, absolutely the sooner the better, If had I had access to this 22 years ago....I should’ve had access... ideally right at the start would have been perfect.” [ES10, 159–163].*

Introducing a self-management app earlier on in a person’s treatment, once they have been reassured nothing is wrong [CMOC-14], starts the process of learning to live well with back pain. In so doing, it may prevent maladaptive behaviours from developing and/or becoming an entrenched response to CLBP. [CMOC-15].

## 4. Discussion and conclusion

### 4.1. Discussion

Despite political assurances to the contrary many studies, including this one, report that people with CLBP often feel abandoned to self-manage

their condition on their own. Lack of ongoing support due to resource constraints in the healthcare service has been described as ‘care left undone’ [61]. There is also debate in the literature as to whether self-management under the guise of ‘empowerment’ places an onerous moral obligation on the patient [62,63]. Considering the scepticism and confusion around the term ‘self-management’ this study highlights the importance of using a mobile app as an adjunct to ongoing care and not as a replacement. This finding is in line with Vo et al.’s [64] meta-ethnographic review of patient’s perceptions of mHealth apps. Whilst they acknowledged apps helped users become more engaged with self-management, patients in the review were keen to stress that apps should be a complimentary tool and not a replacement for HCP input. However, Vo et al. [64] offer no further explanation as to why patient’s felt this way. This research — in keeping with its realist nature— looked for causal mechanisms to explain why people with CLBP wanted an app as an adjunct to care. This study found that if people with CLBP are discharged with only a mobile app for support they are likely to feel abandoned rather than empowered. Not knowing why an outcome occurs makes it difficult to replicate desired results, or in this instance, avoid unintended consequences.

Recent surveys evaluating remote consultations make it clear that some clinicians and patients prefer in-person care [65,66]. However, it is well recognised that patients with CLBP often feel their pain is not taken seriously by HCPs [67-71]. This study supports the literature that people with CLBP need to feel believed by a HCP. This has implications on user engagement with a self-management app for CLBP. Introducing an app before a person with CLBP feels they have been believed or taken seriously may be interpreted as further evidence that they have been ‘fobbed off’ by the healthcare profession. This feeling of not being taken seriously is compounded by the fact that many HCPs often lack the time and training [72,73] to deliver good quality pain management. As a result, many people with CLBP are left disappointed and frustrated by their medical consultations. In this context, some people with CLBP would prefer the utility of a mobile app if it meant avoiding healthcare appointments. A mobile app could provide, quick, reliable, and reassuring answers to a person’s query about their back pain. However, the information provided by the app must be personalised if users are to consider it trustworthy and relevant. Similar concerns over the generic nature of an app’s information have been found in the literature with users expressing a desire for the app to be both specific to their particular complaint and to their user preferences [74,75]. A counter argument, however, is that HCPs consultations need to be improved with better pain education and a departure from the biomedical model of treating CLBP [76]. Although this research does not refute the need for HCPs to deliver better pain management it suggests that for some, the face-to-face encounter with a medical professional is not always the superior experience many assume it to be.

For some people with CLBP, communicating with a mobile app via a chatbot may provide a non-judgemental and comforting relationship many find lacking in ‘real person’ interactions. While Baptisa et al.’s [77] studied people with type two diabetes there were similarities in the needs of people with CLBP such as social isolation and feeling negatively judged. In their study, Baptisa et al. reported users of the self-management app felt the embodied conversational agent (a.k.a chatbot) provided them with ongoing, non-judgemental, emotional support and reduced diabetes-related stigma. Whilst not all stakeholders in this study agreed, some did support the growing body of evidence that suggests people can develop meaningful relationships with computerised agents which can reduce feelings of social isolation [78,79] and support self-management of long-term conditions [80].

### 4.1.1. Strengths/limitations

This realist review was guided by the RAMESES quality standards for realist synthesis and metanarrative reviews [81] to ensure the research was conducted systematically and transparently. However, there are some limitations which should be noted. Due to its iterative nature, this research followed early advice on realist reviews to avoid pre-publication [82]. As a result, the protocol for this review was not publicly registered.

There is an acknowledgment that it is not possible nor desirable to extricate the researcher from the research process. However, integrity and rigour of the findings was enhanced by regular stakeholder input, research team discussions and peer review.

Many of the sources in the synthesis could be described as opinion pieces or commentaries leading to questions of the trustworthiness of the findings. A process of triangulation [83] crystallisation [84] and purposively looking for the ‘disconfirming case’ [85] was employed to add credibility and plausibility to the CMOCs and programme theory.

Since managing CLBP is a global concern, academic research from across the world was included in the review. However, the Government policy documents, third sector reports and stakeholders mainly come from Scotland (the study location). That said, many of the findings resonate with the policy directions across the UK and beyond.

#### 4.2. Innovation

To our knowledge this is first realist review that seeks to address why, for whom and in what circumstances a mobile app might help someone to self-manage CLBP. Furthermore, it uses a novel approach to realist synthesis by conducting realist interviews with key stakeholders and including them as primary data in the synthesis. Using stakeholder input in this way helped to identify significant contextual factors and hidden generative mechanisms likely to bring about the success or failure of using a mobile app to self-manage CLBP. Furthermore, it increased the likelihood that the research findings would be meaningful to people living with CLBP.

The importance of patient empowerment in the use of self-management apps has been explored in research around diabetes [86] but to our knowledge, this is the first review to apply a conceptual definition of empowerment to mobile app use in self-managing CLBP. In addition, the research drew on substantive theories and created programme theories in the middle range of abstraction which enhances the transferability of the findings. Middle range theories can be used to explain patterns of causation across different programmes and settings [29]. As a result, the findings from this review can be used to inform research and development of similar mobile apps designed to help people self-manage other long-term pain conditions.

Finally, this study has important implications for clinical practice. It highlights the need for people with CLBP to feel believed and taken seriously by a HCP before introducing a self-management app. This requires good communication skills, up to date knowledge on chronic pain and a biopsychosocial approach to pain management. A list of recommendations and areas for innovation can be found in [Box 1](#).

#### 4.3. Conclusion

With growing numbers of people living with CLBP and limited access to pain self-management programmes it is essential that innovative new ways are found to deliver this care. The Covid-19 pandemic highlighted the utility of using digital healthcare technology. If self-management apps are to be most effective, then they should be considered as an adjunct to care and not replacement. In this way, mobile apps can help to reframe the term self-management, so it no longer feels like abandonment. If a self-management app can be introduced early in a patient's journey and delivered in a personal way that offers choice and does not add to a person's burden of care, then the term ‘patient empowerment’ can be a meaningful promise for people self-managing CLBP. Together these three programme

Box 1: Key recommendations and areas for innovation.

Key recommendations and areas for innovation	
For policy makers	To utilise the potential of mobile apps people with CLBP must have the external and internal resources to engage with it. Policies aimed at promoting the use of mobile apps should ensure there is access to the latest wireless technology and should be rolled out alongside initiatives to improve digital health literacy.
For health care practitioners	Recognise that patients with CLBP need to feel believed and that their pain has been taken seriously before introducing a self-management. Furthermore, a mobile app should be used as an adjunct to care and not a replacement.
For patients	Recognise the potential mobile apps have in helping people with CLBP to stay motivated with self-management. Recording data can via a mobile app can help to enhance communications with HCPs. In addition, ongoing support offered by an interactive communication portal can help to mitigate feelings of abandonment.
For mobile app developers	Consider incorporating computerised conversational agents (chatbots) into the app design to provide users with an empathetic and supportive character. Recognise the need for the information to be personalised to the user. Consider having an interactive communication portals or text messaging functions in the app to enable users to keep in touch with HCPs.
For researchers	Further research is needed to see if mobile app self-management reduces the burden on healthcare services.

theories provide a better understanding of how mobile apps can fulfil the promise of digital health technology for people self-managing CLBP.

#### Disclosure statement

The authors confirm that there are no relevant financial or non-financial competing interests to report.

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#### Declaration of Competing interest

The authors have no conflict of interest.

## Appendix A. RAMESES publication standards: realist syntheses – evidence of its use

Section	Publication standard	Evidence
<b>TITLE</b>		
1	<i>In the title, identify the document as a realist synthesis or review</i>	Title: Has realist synthesis in it
<b>ABSTRACT</b>		
2	<i>While acknowledging publication requirements and house style, abstracts should ideally contain brief details of: the study's background, review question or objectives; search strategy; methods of selection, appraisal, analysis and synthesis of sources; main results; and implications for practice.</i>	Abstract: Acknowledgement of burden of CLBP, Objective clearly stated. Coding method noted, Conclusion highlights the utility of mobile apps for people with CLBP. Value of including stakeholder data within synthesis highlighted.
<b>INTRODUCTION</b>		
3	<i>Rationale for review Explain why the review is needed and what it is likely to contribute to existing understanding of the topic area</i>	Section. 1 Need to innovate pain services using digital technology but insufficient research to date
4	<i>Objectives and focus of review State the objective(s) of the review and/or the review question(s). Define and provide a rationale for the focus of the review</i>	Section 1-Aim to understand what works, for whom and in what circumstances – objective to include lived experiences. Stakeholder consultation helped to narrow focus of review to 6 IRPTS
<b>METHODS</b>		
5	<i>Changes in the review process Any changes made to the review process that was initially planned should be briefly described and justified</i>	Section 2 it was noted that the design of synthesis was modified to include primary data from stakeholder consultations.
6	<i>Rationale for using realist synthesis Explain why realist synthesis was considered the most appropriate method to use.</i>	Section 2 Goes beyond remit of traditional systematic review, look for mechanism to explain how, for whom and in what context
7	<i>Scoping the literature Describe and justify the initial process of exploratory scoping of the literature.</i>	Section 2.1 Explains that multiple perspectives were sought from a diverse range of sources to sensitise research team to the area. Supplementary material [5]
8	<i>Searching processes While considering specific requirements of the journal or other publication outlet, state and provide a rationale for how the iterative searching was done. Provide details on all the sources accessed for information in the review. Where searching in electronic databases has taken place, the details should include, for example, name of database, search terms, dates of coverage and date last searched. If individuals familiar with the relevant literature and/or topic area were contacted, indicate how they were identified and selected.</i>	Section 2.5 Justification given for using non-academic sources and why stakeholder interviews were included in the research.  Table 3 – details of non-academic sources searched and included
9	<i>Selection and appraisal of documents Explain how judgements were made about including and excluding data from documents and justify these.</i>	Section 2.4.2 and supplementary material [4] and 5]
10	<i>Data extraction Describe and explain which data or information were extracted from the included documents and justify this selection.</i>	Section 2.5
11	<i>Analysis and synthesis process Describe the analysis and synthesis processes in detail. This section should include information on the constructs analysed and describe the analytic process.</i>	Section 2.8 and supplementary material [6]
<b>RESULTS</b>		
12	<i>Document flow diagram Provide details on the number of documents assessed for eligibility and included in the review with reasons for exclusion at each stage as well as an indication of their source of origin (for example, from searching databases, reference lists and so on). You may consider using the example templates (which are likely to need modification to suit the data) that are provided.</i>	Fig. 1
13	<i>Document characteristics Provide information on the characteristics of the documents included in the review</i>	Table 2 and Table 4
14	<i>Main findings Present the key findings with a specific focus on theory building and testing.</i>	Section 3 and Table 5
<b>DISCUSSION</b>		
15	<i>Summary of findings Summarize the main findings, taking into account the review's objective(s), research question(s), focus and intended audience(s).</i>	Section 5.1 Key findings presented in an infographic
16	<i>Strengths, limitations, and future research directions Discuss both the strengths of the review and its limitations. These should include (but need not be restricted to) (a) consideration of all the steps in the review process and (b) comment on the overall strength of evidence supporting the explanatory insights which emerged. The limitations identified may point to areas where further work is needed.</i>	Sections 4.1.4 and 4.2 – strengths, limitations and innovation discussed.
17	<i>Comparison with existing literature Where applicable, compare and contrast the review's findings with the existing literature (for example, other reviews) on the same topic.</i>	Section 4.1 Discussion – findings of the review are situated in the published literature around this area.
18	<i>Conclusion and recommendations List the main implications of the findings and place these in the context of other relevant literature. If appropriate, offer recommendations for policy and practice.</i>	Box 1: Key recommendations and areas for innovation
19	<i>Funding Provide details of funding source (if any) for the review, the role played by the funder (if any) and any conflicts of interests of the reviewers.</i>	Not applicable

## Appendix B. Mind mapping to refine initial rough programme theories

This figure depicts the creation of the refined programme theory 1 'face to face vs. virtual' by extracting elements from the five initial programme theories (highlighted in blue). Annotated loops with causal inferences converge to create a refined programme theory.

Six initial rough programme theories taken to empirical literature for testing

### 1. Face to face vs. virtual

Being assessed face-to-face gives both the HCPs and the patients the reassurance that they have been 'assessed properly', and that 'nothing has been missed'. In addition, for many patients living in long-term pain, a face-to-face assessment gives them further reassurance, that their symptoms - although not visible - have been taken seriously and they are not being 'fobbed off' (Context). If a digital app can provide the empathy, reassurance,



If people with CLBP are not given a specific diagnosis that validates their condition then they are made to feel like a malingering, or someone who is making their illness up, that it is "all in their head". This breaks down the trust between the patient and health-care provider, which detrimentally affects the patient's ability to accept the therapist's endorsement of a self-management app.

If someone is made to feel like they are making their symptoms up or that their pain 'is all in their head' then a self-management app could be seen as a way of getting rid of a nuisance patient.

If a self-management app was able to reassure and reduce a person with chronic low back pain's fear about their condition then the self-management app will have more utility and meaning for the user and therefore it will be more likely to be accepted.

If people with CLBP are given a self-management app to help them self-manage their condition and believe they are no longer entitled to ongoing care or think there is some alternative agenda at play—like a means of getting rid of a nuisance patient, or it is a cost saving exercise then an unintended consequence could be a feeling of resentment amongst this patient group and a failure to engage with the self-management app.

*What makes CLBP so difficult to self-manage is that it is invisible - you can't see pain. This makes it difficult to 'prove' you are sick and in need of care. There is the idea here that the person needs to be 'seen to be believed' before they will accept tools like an app to manage their CLBP.*

*An assessment from a HCP provide validation and reassurance in a way that a self-management app can't?*

Being assessed face-to-face gives both HCPs and people with CLBP the reassurance they have been 'assessed properly', and that 'nothing has been missed'. In addition, for many people with CLBP, a face-to-face assessment gives them further reassurance, that their symptoms - although not visible - have been taken seriously and they are not being 'fobbed off' (their words) (Context). If a mobile app can provide the empathy, reassurance, validation, and trust (Mechanism) that they get from a face-to-face therapeutic encounter with an HCP then they will find a mobile self-management app beneficial (Outcome).

*Reassurance is two-fold - reassurance there is nothing wrong, reassurance they have been believed and taken seriously*

*The idea of cost-saving and some ulterior motive didn't come up in the first stakeholder consultations. There was more emphasis on the idea that they are not believed - they need reassurance they have been taken seriously*

*Rather than a programme theory this is more of a contextual backdrop - this feeling of being fobbed off keeps coming up - an app needs to make someone with CLBP feel they are being supported to self-manage not fobbed off.*

**All in my head**  
IRPT #5

**Reassurance**  
IRPT #2

**Fobbed off**  
IRPT #3

**Face to Face**  
IRPT #13

**Confusion in the term self-management**  
IRPT #1

If a self-management app was offered after a patient had been seen face to face by a healthcare practitioner and discharged to self-manage then it may be more readily accepted by patients because they have had the reassurance that comes from a face to face contact and have been provided with a resource (the self-management app) that gives them ongoing support at home.

If a self-management app was given to a patient after they have been assessed by a doctor or physiotherapist face to face then it could be useful

If there is confusion in the term 'self-management' between policy makers believing it is an adjunct to ongoing healthcare treatment health care professionals who regard it as a successful outcome of treatment with the patient unlikely to return and patients seeing self-management as a means by which they are 'fobbed off' then this confusion undermines the self-management agenda because no one is really clear as to what the outcome is supposed to be.

validation and trust (Mechanism) that they get from a face-to-face therapeutic encounter with their HCP then they will find a DSMP beneficial (Outcome).

## 2. Timing

In the same context patients are much more willing to accept DSMP for ongoing support and treatment at home (Outcome) than they would have been had they have been given a DSMP right from the start of treatment with no face-to-face assessment (Context) because they needed to have the 'reassurance' (Mechanism) that comes from a face-to-face assessment before they are able to fully engage with a DSMP.

## 3. Patient journey

Having a persistent pain condition that is not visible to the outside world makes some patients feel like their symptoms are not 'real' or that they are not believed when they try to explain the impact pain is having on their life. Furthermore, some patients find it hard to accept a diagnosis that has no known anatomical pathological cause. (Context) If a patient invests their energies on pursuing different treatment options and seeking second opinions from a multitude of HCPs in order to gain the reassurance that their condition is 'real' and that it is not 'all in their head' (Mechanism) then it is unlikely that they are ready to engage with a DSMP (Outcome).

## 4. Covid

Although digital healthcare appointments were being used in the NHS before the Covid-19 pandemic, the number of healthcare services going

'virtual' has significantly increased because of the social distancing measures introduced to stop the spread of the virus. As a result, both HCPs and patients, are becoming more accustomed to delivering and receiving digital healthcare (Context). If digital health becomes a ubiquitous form of healthcare delivery, then, patients will be more familiar with using mHealth (Mechanism), may trust it more (Mechanism) and, as a result, find a DSMP more acceptable (Outcome).

## 5. Self-efficacy

In the UK there are insufficient HCPs to treat the growing number of patients living with long term pain. As a result, there are lengthy waiting times to access pain services. In addition, for those people living in geographically remote areas, such as the Scottish Highlands, there may have to travel long distances to attend pain clinics. (Context) If a DSMP could expedite patient access to pain education, advice and reassurance thus giving them the confidence to manage their condition on their own (Mechanism) then it may serve to reduce waiting times to access pain clinics and negate the need to travel long distances (Outcome).

## 6. Control

In addition, if a DSMP that a patient can access when they want, from a location of their choosing (Context) then the DSMP gives them back a sense of control (Mechanism), in that they no longer have to wait for an appointment to see a HCP to get the treatment and advice they are looking for to help them self-manage (Outcome).

Appendix C. Example of literature search



Scopus



31	((TITLE-ABS-KEY ("mobile app" OR "mobile application" )) OR (TITLE-ABS-KEY ("apps" )) OR (TITLE-ABS-KEY ("smartphone" OR "smartphone app" OR "smartphone application" )) OR (TITLE-ABS-KEY ("telehealth" OR "ehealth" OR "mhealth" )) OR (TITLE-ABS-KEY ("digital app" OR "digital application" ))) AND ((TITLE-ABS-KEY ("self manag*" OR self AND management )) AND ((TITLE-ABS-KEY ("back pain" )) OR ((TITLE-ABS-KEY ("chronic pain" )) OR (TITLE-ABS-KEY ("persist... View More	154 document results				
30	((TITLE-ABS-KEY ("self manag*" OR self AND management )) AND ((TITLE-ABS-KEY ("back pain" )) OR ((TITLE-ABS-KEY ("chronic pain" )) OR (TITLE-ABS-KEY ("persist* pain" OR "pain persist*")) OR (TITLE-ABS-KEY ("long term pain" ))) OR (TITLE-ABS-KEY ("fibromyalgia" OR "fibromyalgia syndrome" )) OR (TITLE-ABS-KEY ("chronic fatigue" OR "Chronic fatigue syndrome" )) OR (TITLE-ABS-KEY ("irritable bowel syndrome" OR "irritable bowel" )) OR (TITLE-ABS-KEY ("fibromyalgia" OR "fibromyalgia s... View More	4,479 document results				
29	((TITLE-ABS-KEY ("mobile app" OR "mobile application" )) OR (TITLE-ABS-KEY ("apps" )) OR (TITLE-ABS-KEY ("smartphone" OR "smartphone app" OR "smartphone application" )) OR (TITLE-ABS-KEY ("telehealth" OR "ehealth" OR "mhealth" )) OR (TITLE-ABS-KEY ("digital app" OR "digital application" )))	149,534 document results				
28	((TITLE-ABS-KEY ("back pain" )) OR ((TITLE-ABS-KEY ("chronic pain" )) OR (TITLE-ABS-KEY ("persist* pain" OR "pain persist*")) OR (TITLE-ABS-KEY ("long term pain" ))) OR (TITLE-ABS-KEY ("fibromyalgia" OR "fibromyalgia syndrome" )) OR (TITLE-ABS-KEY ("chronic fatigue" OR "Chronic fatigue syndrome" )) OR (TITLE-ABS-KEY ("irritable bowel syndrome" OR "irritable bowel" )) OR (TITLE-ABS-KEY ("fibromyalgia" OR "fibromyalgia syndrome" )) ... View More	208,615 document results				
27	((TITLE-ABS-KEY ("chronic pain" )) OR (TITLE-ABS-KEY ("persist* pain" OR "pain persist*")) OR (TITLE-ABS-KEY ("long term pain" )))	84,438 document results				
26	TITLE-ABS-KEY ("long term pain" )	1,433 document results				
25	TITLE-ABS-KEY ("persist* pain" OR "pain persist*")	8,147 document results				
24	TITLE-ABS-KEY ("digital app" OR "digital application" )	2,824 document results				
23	TITLE-ABS-KEY ("telehealth" OR "ehealth" OR "mhealth" )	33,346 document results				
22	TITLE-ABS-KEY ("smartphone" OR "smartphone app" OR "smartphone application" )	68,271 document results				
21	TITLE-ABS-KEY ("apps" )	26,398 document results				
20	TITLE-ABS-KEY ("mobile app" OR "mobile application" )	46,989 document results				
19	TITLE-ABS-KEY (" Myalgic encephalomyelitis" )	1,324 document results				
18	TITLE-ABS-KEY ("chronic fatigue" OR "Chronic fatigue syndrome" )	12,094 document results				
17	TITLE-ABS-KEY ("fibromyalgia" OR "fibromyalgia syndrome" )	19,446 document results				
16	TITLE-ABS-KEY ("irritable bowel syndrome" OR "irritable bowel" )	18,581 document results				
7	TITLE-ABS-KEY ("self manag*" OR self AND management )	182,163 document results				
6	TITLE-ABS-KEY ("persist* pain" OR "pain persist*")	8,147 document results				
3	TITLE-ABS-KEY ("chronic pain" )	77,213 document results				
1	TITLE-ABS-KEY ("back pain" )	93,985 document results				

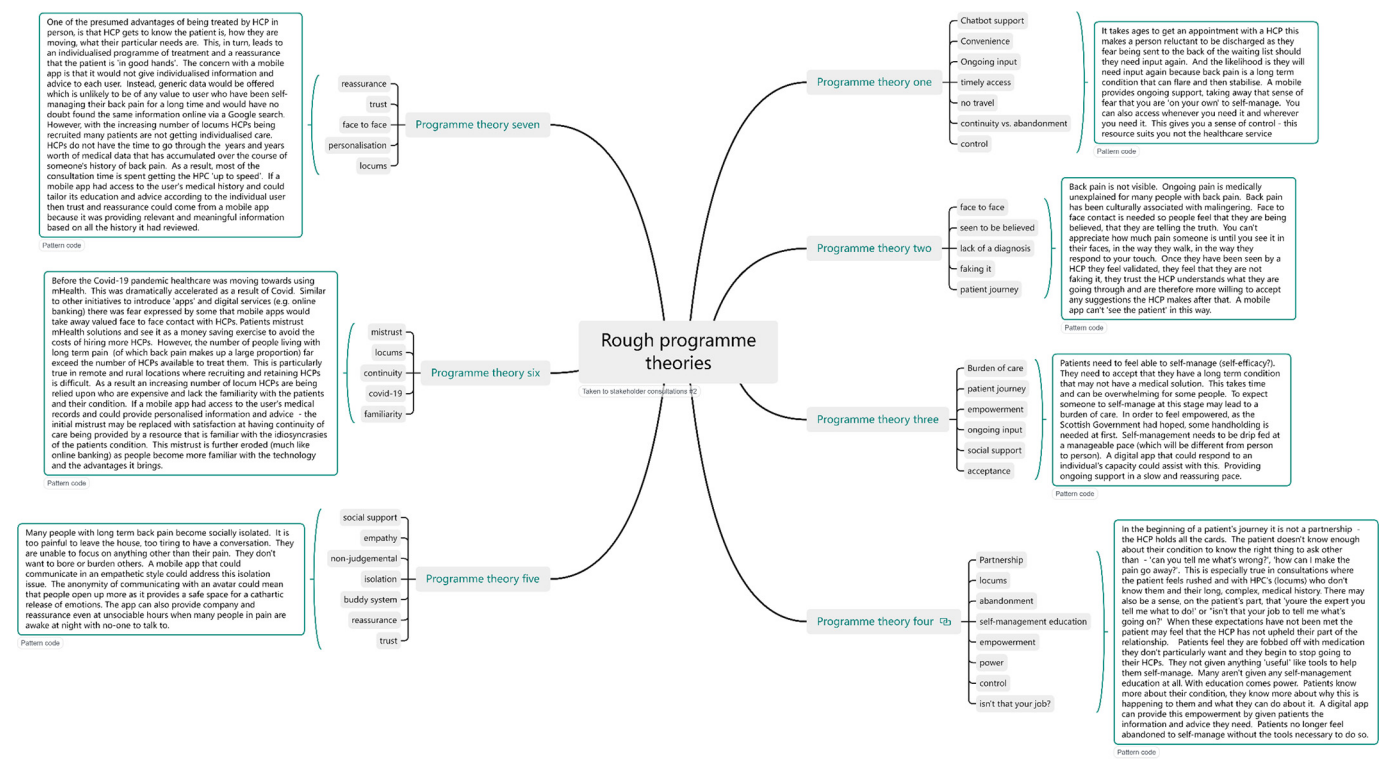
### Appendix D. Screening tool for relevancy

Relevancy rating	Description
1 – Highly relevant	Any digital mobile app for adults with long term/chronic back pain discussing either the intervention or an investigation relevant to the experience of using a digital self-management app.
2 – Probably relevant	Any digital self-management technology for adults with long term/chronic back pain discussing either the intervention or an investigation relevant to the experience of using a digital self-management technology
3 – Possibly relevant	Any digital mobile app for adults with chronic condition of interest (CLBP; FMS; CFS; IBS; CP) discussing either the intervention or an investigation relevant to the experience of using a digital self-management app.
4 – Less relevant (but retain)	Any digital self-management technology for adults chronic condition of interest (CLBP; FMS; CFS; IBS; CP). Might be unclear in some way as to how it relates to self-management. Programme may include acute and chronic participants. Programme can be directed at participants described as 'low back pain' (i.e no mention of duration of symptoms) Might be more focused on usability and design of the app itself. Can be a generalised discussion around what it is like to manage a chronic condition (of any type) using digital technology
5 – Likely irrelevant	not related to digital self-management of chronic condition; not adults; not condition of interest

### Appendix E. Screening tool for relevancy, rigour and richness

Rating	Criteria
High	Papers in this category make several contributions towards theory development and have a good amount of detail. Regardless of the overall quality of the study, the extracts that have been used to build programme theory are of sufficient quality to support the inferences.
Moderate	Papers in this category make one or two contributions towards theory development and have a fair amount of detail. Regardless of the overall quality of the study, extracts that have been used to build programme theory are of sufficient quality to support the inferences.
Low	Although relevant in respect to the programme intervention (mobile apps) papers in this category make little contribution to theory development and/or have results that lack credibility raising uncertainty as to whether extracts from the study are of sufficient quality to use in the programme theory building or refinement. These papers may also lack enough detail to make them useful to the study.
None	Although relevant in respect to the programme intervention (mobile apps) papers in this category make no contribution to theory development.

### Appendix F. Seven 'big picture' pattern codes with constituent codes attached







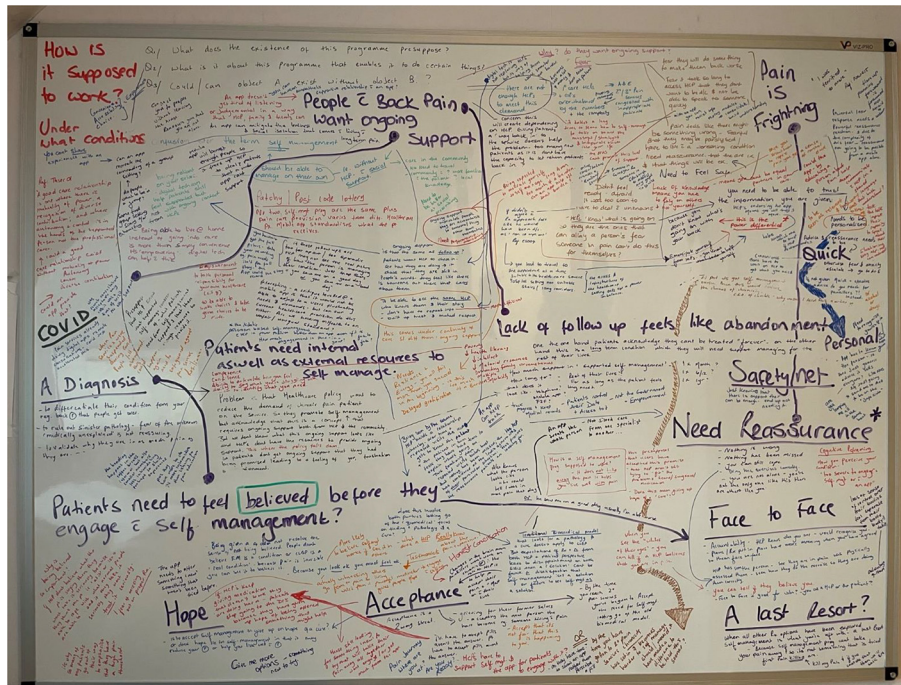


Fig. G.3. Mind mapping programme theories on white board with free writing.

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