

Barriers and facilitators to virtual education in cardiac rehabilitation: a systematic review of qualitative studies

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Received 3 September 2021; revised 4 October 2021; editorial decision 8 November 2021; accepted 9 November 2021; online publish-ahead-of-print 23 December 2021

Background

Due to restrictions imposed by the severe acute respiratory syndrome coronavirus 2 pandemic much attention has been given to virtual education in cardiac rehabilitation (CR). Despite growing evidence that virtual education is effective in teaching patients how to better self-manage their conditions, there is very limited evidence on barriers and facilitators of CR patients in the virtual world.

Aims

To identify barriers and facilitators to virtual education participation and learning in CR.

Methods

A systematic review of peer-reviewed literature was conducted. Medline, Embase, Emcare, CINAHL, PubMed, and APA PsycInfo were searched from inception through April 2021. Following the PRISMA checklist, only qualitative studies were considered. Theoretical domains framework (TDF) was used to guide thematic analysis. The Critical Appraisal Skills Program was used to assess the quality of the studies.

Results

Out of 6662 initial citations, 12 qualitative studies were included (58% 'high' quality). A total of five major barriers and facilitators were identified under the determinants of TDF. The most common facilitator was accessibility, followed by empowerment, technology, and social support. Format of the delivered material was the most common barrier. Technology and social support also emerged as barriers.

Conclusion

This is the first systematic review, to our knowledge, to provide a synthesis of qualitative studies that identify barriers and facilitators to virtual education in CR. Cardiac rehabilitation patients face multiple barriers to virtual education participation and learning. While 12 qualitative studies were found, future research should aim to identify these aspects in low-income countries, as well as during the pandemic, and methods of overcoming the barriers described.

Keywords

Patient education as a topic • Cardiac rehabilitation • Telerehabilitation • Systematic review • Cardiovascular disease • Virtual education

Implications of practice

- Virtual education should be delivered using user-friendly technologies.
- Long sessions without video interactions should be avoided.
- Technology support helps to address lack of technology knowledge.

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Introduction

Cardiovascular disease (CVD) is the leading cause of mortality and a major burden of disease and disability worldwide.¹ Cardiac rehabilitation (CR) is a comprehensive programme recognized as a class 1A recommendation for people with CVD.² It is a long-term service involving medical evaluation, physical exercise, risk factor management, patient education, and counselling interventions.³ Evidence suggests benefits associated with CR participation, including reduction in all-cause mortality, hospitalization, and improvement in quality of life.⁴

The ongoing severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic has significantly changed the delivery of healthcare services, with a deep impact in CR.⁵ A global survey investigating the impact of the pandemic on CR delivery around the globe estimated that approximately 4400 CR programmes have interrupted or temporarily closed during the first wave of the SARS-CoV-2 period.⁶ Those who remained open drastically reduced the amount of education delivered to patients (mean of 50.1 ± 47.5 min per session pre-pandemic to 20.2 ± 26.0 min per session during SARS-CoV-2).⁶ Educational delivery models have also changed during SARS-CoV-2 pandemic, being mostly provided via phone, email, online resources, and mail.^{4,7}

Patient education can facilitate learning about treatment and prevention of CVD, and ultimately guide self-management behaviours and lifestyle changes that will positively impact health outcomes.^{8,9} Conversely, inadequate understanding of the disease and treatment may contribute to inappropriate coping behaviours, non-compliance to medical advice, and a worsening cardiovascular prognosis.^{8,9} As SARS-CoV-2 has increased the demand for virtual patient education in CR programmes, there is a need to identify and understand the barriers and facilitators to this type of learning and patients' experiences, in order to design improved future interventions for deployment in this new reality imposed by the pandemic.

Previous literature—including systematic reviews—have provided evidence on the positive effects of virtual interventions for CVD rehabilitation and management,^{10–17} including adherence to prescribed medications,^{10,12} improvement in quality of life,^{11–13,15} decreases in anxiety and depression levels,¹⁶ compliance to behaviour change,^{10,12,18} improvement in knowledge, attitudes, and beliefs,¹⁴ reduction of CVD risk factors,^{19–21} and hospitalization rates.¹⁷ In addition, programme efficiency has also been confirmed, with virtual and centre-based interventions presenting an equivalent effect on functional capacity, physical activity behaviour, quality of life, medication adherence, smoking behaviour, psychological risk factors, depression, and cardiac-related hospitalization.²¹

Despite evidence for clinical effectiveness, participation in virtual programmes remain controversial. While some studies indicate high adherence and acceptance to virtual CR, others indicate reduced compliance of this model of care compared to group supervised trainings.^{22,23} Although a systematic review has identified challenges and opportunities in the design of technology to support CR and self-management,²⁴ no previous study has critically appraised and synthesized the qualitative literature with the aim of identifying patients' barriers and facilitators to virtual education learning and participation in CR. This is the goal of this systematic review in the hope

of informing clinical pathways and thereby improving patients' experiences and outcomes.

Methods

The reporting of this study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist.²⁵ This systematic review was prospectively registered at the Open Science Framework (OSF: <https://osf.io/v8y57/>).

Eligibility criteria

The 'PICO' statement was used to define the search criteria for the review and identify the specifics of the patient population, intervention and the types of studies to be evaluated. The inclusion criteria involved the following: (i) adults with CVD attending CR programmes, (ii) virtual education delivered as part of the programme, and (iii) studies focusing on barriers and facilitators to virtual education participation. Barriers and facilitators reported by family members or healthcare providers were not considered. The CR programme could be centre-based as long as the education component was delivered virtually by the following delivery modes: telephone, video, text message, email, or online resources such as websites and platforms. Components of virtual education were characterized according to the Workgroup for Intervention Development and Evaluation Research (WIDER) reporting guidelines and included characteristics of those delivering the intervention, detailed description of the intervention content, intensity, mode of delivery, duration, the setting, and adherence to delivery protocol.^{26,27} Studies of any methodological design were considered for inclusion in this study (i.e. quantitative, qualitative, and mixed methods); however, the one quantitative study identified was not included as its results addressed the same themes included in the qualitative studies.²⁸ Narrative, systematic, and scoping reviews were considered as a source of additional primary studies. Pilot and case report studies, non-peer-reviewed literature, and studies published in a language other than English, Portuguese, or Spanish were excluded.

Information sources

The following databases were searched from their inception to April 2021: Medline (Ovid), Embase (Ovid), Emcare (Ovid), CINAHL (Cumulative Index to Nursing and Allied Health Literature; EBSCO), PubMed (non-Medline), and APA PsycInfo. The search strategy was developed by an Information Specialist utilizing the PICO framework listed above, subject headings as appropriate for each database, and free-text terms relevant to the topical concepts. Potential studies identified through a snowball hand-search were also considered for inclusion. The full Medline search strategy is shown in [Supplementary material](#) online, *File S1*.

Selection and data collection process

Two reviewers (L.M.V. and G.L.d.M.G.) independently screened all references identified by the search strategy (title and abstract). To be selected, abstracts had to identify barriers and facilitators to virtual education identified by patients participating in technology-based CR programmes. Full text of possible eligible articles was then obtained and assessed independently for eligibility by the two reviewers. The screening process was done based on the inclusion and exclusion criteria following the COREQ (Consolidated Criteria for Reporting Qualitative Health Research),²⁹ a tool that includes reporting items specific to the research team, study methods, context of the study, analysis and interpretations. Potential disagreements in any part of the screening process were discussed and used to refine results.

Risk of bias—Critical Appraisal Skills Program (CASP)

Two reviewers (L.M.V. and G.L.d.M.G.) used the Critical Appraisal Skills Program (CASP) to assess the quality of the studies that were included in this scoping review.³⁰ This includes two screening questions and eight detailed questions regarding study design, sampling, data collection, reflexivity, ethical issues, data analysis, findings, and values of the research.³¹ A third reviewer (P.O.) was available to solve disagreements between two reviewers if needed. Studies were ranked in low (0–3 points), medium (4–7 points), and high quality (8–10) points. Low-quality studies were not excluded, but caution was taken when interpreting their results.

Data synthesis and analysis

Data from qualitative studies included in this systematic review were synthesized by utilizing a thematic analysis approach.³² Textual summaries and tables were developed based on the extracted results. From that, we identified emerging themes that described meaning and content of the included studies. Two reviewers (L.M.V. and G.L.d.M.G.) reviewed differences and similarities between textual summaries and agreed on the final list of themes through discussion and consensus. A theoretical domains framework (TDF) was used to guide thematic analysis. It is an integrative framework developed by Michie and colleagues that addresses behavioural organizational factors that influences implementation outcomes.^{33,34} Themes identified from qualitative studies included in this systematic review were grouped and incorporated into determinants of the TDF, which includes the following: knowledge; skills; social/professional role and identity; beliefs about capabilities; optimism;

reinforcement; intentions; goals; memory; attention and decision; environmental context and resources; social influence; emotion; and behavioural regulation.^{33,34}

Results

Characteristics of included studies

The initial database searches yielded 6662 records and 1 was identified through a snowball hand-search. A total of 68 full articles were assessed for eligibility. Overall, 12 studies were included in the study, all written in English.^{35–46} Figure 1 shows the PRISMA flow diagram depicting the search results, reasons for exclusion and study selection.

Table 1 shows the characteristics of included studies. They were all qualitative in design, with interviews used in 9 (75%)^{35–37,40–42,44–46} studies, focus group sessions used in 2 (16%)^{38,43} studies, and open ended questions in 1 (8%)³⁹ study. Studies included a recruited total of 296 patients receiving virtual education during CR, with sample sizes ranging between 8 and 60 patients (median = 29; Table 1). Studies were performed in 11 countries—Dublin and Belgium (n = 60 participants in 1 study),³⁷ China (n = 48 participants in 1 study),⁴⁵ Canada (n = 43 participants in 2 studies),^{36,46} New Zealand (n = 38 participants in 1 study),³⁸ Sweden (n = 30 participants in 1 study),³⁵ Australia (n = 28 participants in 1 study),^{40,44} Denmark (n = 14 participants in 1 study),⁴² United Kingdom (n = 27 participants

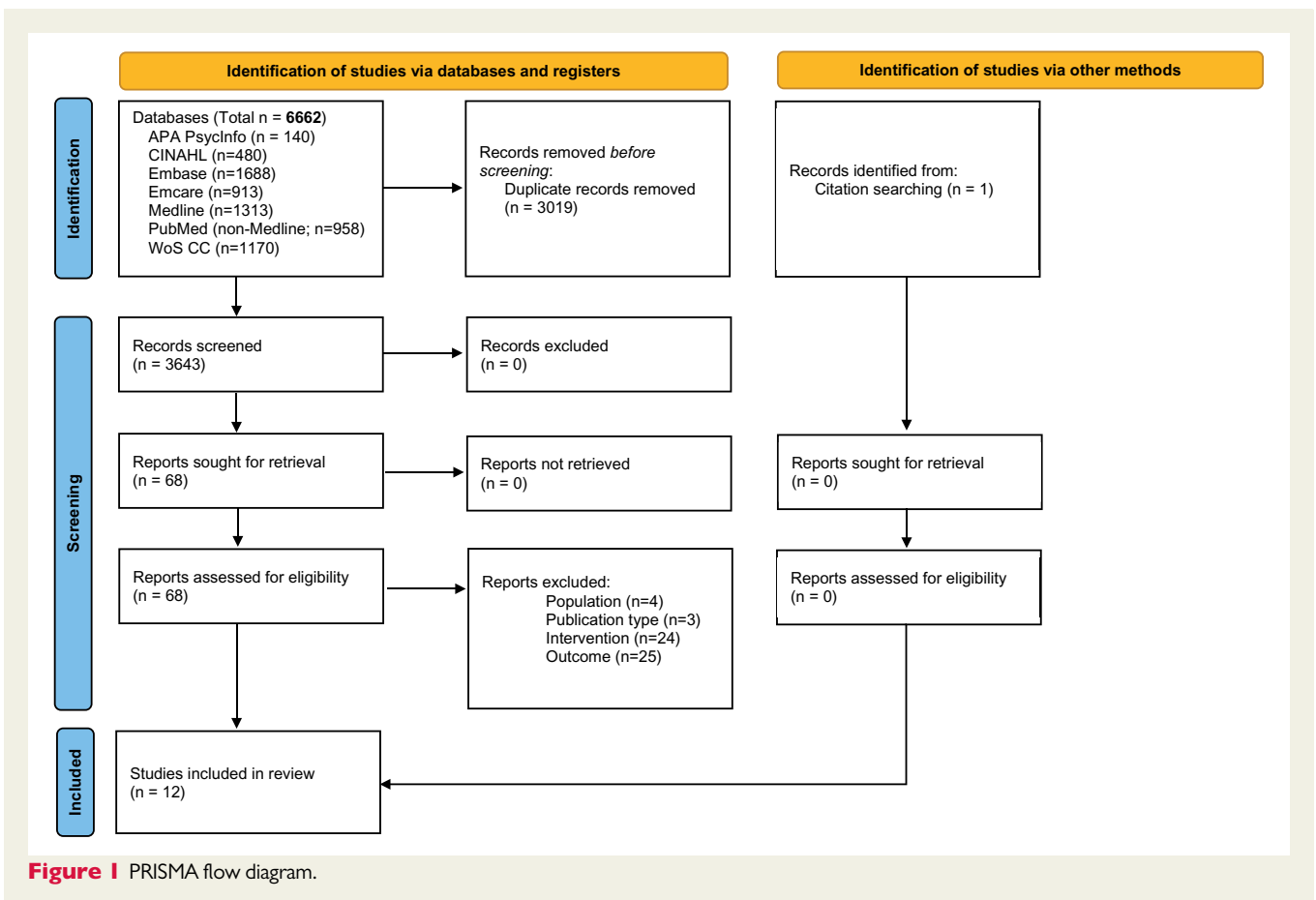


Figure 1 PRISMA flow diagram.

Table 1 Summary of study characteristics (n = 12)

Author Year Country	Aim	Study design Method of data extraction Quality assessment	Theory based	Participants and sample selection clinical and socioeconomic characteristics	Characteristics of the virtual education delivered
Anttila et al., 2021 Sweden	'To explore the different meanings patients given to the rehabilitation process using a grounded theory approach'	Qualitative study Individual semi-structured interviews using thematic topic guidelines High Quality (9) ^a	Glaserian grounded theory method	30 participants Cardiac patients who had undergone coronary artery bypass graft or coronary artery bypass graft (n = 4) approximately 3–12 months prior to rehabilitation 22 (73%) males Mean age = 55 years old, standard deviation ND	Provider: doctor, a physiotherapist and a nurse, and optionally, a social worker, a psychologist, and a dietitian. Setting: outpatient CR Mode of delivery: web-based coaching via remote connection using web-based software and an activity tracker accelerometer Intensity: ND Duration: 12 months Adherence to delivery protocol: ND Content: guidance on various topics related to a changed life situation due to cardiovascular disease
Banner et al., 2015 Canada	'To examine the impact of a virtual cardiac rehabilitation program compared to usual care in patients living in small urban and rural communities without access to standard CRP and to explore the acceptability and uptake of the program'	Mixed methods Qualitative component: individual semi-structured interviews Medium (5) ^a	ND	78 participants, 22 (28%) completed qualitative part of the study Participants of an in-patient CR programme, with diagnosis of acute coronary syndrome or following a revascularization procedure N (%) males ND Mean age = ND	Provider: ND Setting: in-patient CR Mode of delivery: virtual cardiac rehabilitation Intensity: weekly Duration: 12 weeks Adherence to delivery protocol: assessed by the number of logins to the website and individual chat session Content: ND
Brewer et al., 2017 United States of America	'To assess the feasibility and acceptability of a VW-based CR program as an extension to medical center-based CR'	Pilot, mixed methods Open-ended questions Medium (7) ^a	Ethnomethodology	8 participants Individuals eligible for an outpatient CR 6 (75%) males Mean age = 67 ± 7 years old	Provider: health professionals specializing in CR delivery Setting: outpatient CR Mode of delivery: education was delivered on a secure platform via an established Mayo Clinic infrastructure

Continued

Table 1 Continued

Author Year Country	Aim	Study design Method of data extraction Quality assessment	Theory based	Participants and sample selection clinical and socioeconomic characteristics	Characteristics of the virtual education delivered
Clark et al., 2013 Australia	'To evaluate the feasibility of an Internet-based, electronic Outpatient Cardiac Rehabilitation'.	Pilot, mixed methods Qualitative component: telephone interviews High quality (8) ^a	ND	24 participants, 11 (45%) completed the qualitative part of the study Cardiac patients from rural primary practices. 22 (91%) males Mean age = 62 years old, standard deviation ND	<i>Intensity:</i> weekly <i>Duration:</i> 12 weeks <i>Adherence to delivery protocol:</i> assessed by the number of session attended by participants <i>Content:</i> healthy behaviour change given its focus on an individual's beliefs and effectiveness in performing behaviours (competence), connection with others (relatedness), and perceived control over behaviours (autonomy) <i>Provider:</i> cardiac case-manager <i>Setting:</i> electronic outpatient CR <i>Mode of delivery:</i> electronic (web-site) <i>Intensity:</i> weekly <i>Duration:</i> 6 weeks <i>Adherence to delivery protocol:</i> system controlling patients' access (requirement of minimum of once a week) <i>Content:</i> a total of 27 library articles about risk factors <i>Provider:</i> cardiac rehabilitation nurses <i>Setting:</i> web-based CR <i>Mode of delivery:</i> delivered through a secure and password-protected internet site designed for participants to use at home <i>Intensity:</i> 3–4 times per week <i>Duration:</i> 6 weeks <i>Adherence to delivery protocol:</i> ND <i>Content:</i> setting and reviewing behavioural goals; self-monitoring.
Devi et al., 2014 United Kingdom	'To explore patient experiences of using a new web-based cardiac rehabilitation programme'.	Qualitative Semi-structured interviews High quality (8) ^a	ND	12 participants Primary care angina population: 5 participants were treated with medication only, 6 with angioplasty, 3 with coronary artery bypass surgery, 1 with both angioplasty and coronary artery bypass surgery, and 1 with balloon inflation during percutaneous coronary intervention. N (%) males ND	

Continued

Table 1 Continued

Author Year Country	Aim	Study design Method of data extraction Quality assessment	Theory based	Participants and sample selection clinical and socioeconomic characteristics	Characteristics of the virtual education delivered
Dinesen et al., 2019 Denmark	'To explore the experiences of cardiac patients and their partners of participating in the Teledialog Telerehabilitation Program'.	Qualitative Interviews using a triangulation of data collection techniques Medium (6) ^a	Self-determination theory	14 cardiac participants History of acute coronary syndrome, heart failure, or coronary artery bypass surgery/valve surgery; living in an area with mobile coverage; and user-level competence in information and communication technologies 9 (64%) males Mean age = 60 ± 10 years old	feedback on behaviour; graded tasks; social reward; providing information about health consequences; reducing negative emotions Provider: nurses, doctors, physiotherapists Setting: in-patient and outpatient telerehabilitation Mode of delivery: ActiveHeart Web portal, an interactive information site with text and videos on rehabilitation issues. The portal also has a Web forum that enables patients and their partners to communicate with each other Intensity: ND Duration: 12 weeks Adherence to delivery protocol: ND Content: individual and group-based education within the following themes: self-management, physical activity, nutritional counselling, medications, psychosocial support, and managing a new lifestyle Provider: ND Setting: outpatient web-based CR Mode of delivery: Help Yourself Online developed using content translated from 2 workbooks developed to support the Beating Heart Problems trial. Intensity: ND
Higgins et al., 2015 United Kingdom	'To translate the existing Beating Heart Problems group program into an online format, Help Yourself Online, and second, to pilot test the Help Yourself Online program with a sample of cardiac patients in order to determine patients' perceptions of the	Mixed methods Qualitative component: focus group sessions or telephone interviews using thematic topic guidelines Medium (8) ^a	Constant comparison methods	21 participants, 15 (71%) completed the qualitative part of the study Patients consecutively admitted to a private hospital, Cabrini Health, Victoria, Australia, for a cardiac event were recruited to undertake the Help Yourself Online programme. Individuals were recruited	

Continued

Table 1 Continued

Author Year Country	Aim	Study design Method of data extraction Quality assessment	Theory based	Participants and sample selection clinical and socioeconomic characteristics	Characteristics of the virtual education delivered
Hwang et al., 2017 Australia	acceptability and utility of online support for patients after an acute cardiac event and to determine improvements and modifications that could be made to the Help Yourself Online program'.	Mixed methods Qualitative component: semi-structured inter-views High quality (9) ^a	ND	17 participants The sample included at least two patients from each of the following: sex, age (under 60 years old, between 60 and 80 years and over 80 years); previous and no previous experience with centre-based cardiac rehabilitation programmes (to allow comparison between two different programme delivery models); previous and no previous experience with computers; and with previous and no previous experience with exercise. 14 (88%) males Mean age = 69 ± 12 years old	<i>Duration:</i> 2 months on average <i>Adherence to delivery protocol:</i> ND <i>Content:</i> eight modules covering health behaviours (healthy eating, physical activity, medication adherence, smoking cessation) and emotional management (depression, anxiety, anger), as well as a module on social support <i>Provider:</i> ND <i>Setting:</i> outpatient centre and web-based CR <i>Mode of delivery:</i> real-time video-based telerehabilitation <i>Intensity:</i> 2 times per week <i>Duration:</i> 12 weeks <i>Adherence to delivery protocol:</i> ND <i>Content:</i> self-management, nutritional and physical activity counselling, medications and managing lifestyle and relationship
Jenny et al., 2001 China	'To evaluate the effectiveness of a educational package through assessing the learning outcome (knowledge and self-efficacy) of the patients; and to compare the computer-assisted instruction program with a conventional tutorial-based patient education program'.	Mixed method study Qualitative component: face-to-face interviews Poor (3) ^a	ND	96 participants, 48 (50%) were assigned to web-based CR Individuals with various heart diseases who were joining the cardiac rehabilitation programme. 30 (62%) males Mean age = 56 ± 13 years old	<i>Provider:</i> ND <i>Setting:</i> inpatient web-based CR <i>Mode of delivery:</i> videos, animations, sounds, pictures, and symbols delivered through desktop or laptop computer <i>Intensity:</i> 30 min on average <i>Duration:</i> programme was run once <i>Adherence to delivery protocol:</i> ND

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Table 1 Continued

Author Year Country	Aim	Study design Method of data extraction Quality assessment	Theory based	Participants and sample selection clinical and socioeconomic characteristics	Characteristics of the virtual education delivered
Mendell et al., 2019 Canada	'To analyse the content of the chat sessions to under-stand some of the major needs and challenges patients have with cardiac rehabilitation and the virtual CR program in particular'.	Qualitative study One-o-one 1-hour chat sessions High quality (8) ^a	ND	78 participants, 38 were assigned to the virtual CR intervention, and 21 participated in at least 1 chat session Cardiac in-patients admitted for acute coronary syndrome, residing in areas with no outpatient CR programmes, having regular Internet access, no limitations for physical activity and fluent in English 34 (90%) males Mean age = 61 years old, standard deviation ND	<i>Content:</i> introduction to the benefits of exercise for patients with heart disease, explaining the exercise principles, points to remember when performing exercise, developing an exercise habit in the daily routine, and a quiz on the content <i>Provider:</i> health care providers, details ND <i>Setting:</i> in-patient virtual or usual CR <i>Mode of delivery:</i> website and chat sessions <i>Intensity:</i> participants could freely log into the virtual CR programme at their discretion and were asked to upload their exercise heart rate sessions at least twice weekly. <i>Duration:</i> 16 weeks <i>Adherence to delivery protocol:</i> ND <i>Content:</i> online intake forms (medical, risk factor, and lifestyle forms), exercise heart rate monitoring, monthly one-on-one synchronous chat sessions with the programme nurse, exercise specialist, and dietitian, weekly online education presentations, data capture for exercise stress test and blood test results, health care providers progress notes, and monthly online ask-an-expert group sessions

Continued

Table 1 Continued

Author Year Country	Aim	Study design Method of data extraction Quality assessment	Theory based	Participants and sample selection clinical and socioeconomic characteristics	Characteristics of the virtual education delivered
O'Shea et al., 2020 Dublin and Belgium	'To evaluate the acceptability, feasibility and clinical effectiveness of an eHealth phase 3 CR intervention: Physical Activity Towards Health'.	Mixed methods randomized controlled multicentre trial Semi-structured interviews High quality (9) ^a	ND	120 participants, 60 individuals were assigned to the Physical Activity Towards Health group Patients participating in outpatient CR were invited during the last four weeks of outpatient CR to take part in the trial 34 (56%) males Mean age = 61 ± 10 years old	Provider: ND Setting: outpatient CR Mode of delivery: portable PC including Physical Activity Towards Health software, Microsoft Kinect camera, Microsoft Band 2 heart rate monitor, Blood pressure device, Zensor 3-lead ECG device, a headset Intensity: ND Duration: 24 weeks Adherence to delivery protocol: ND Content: Physical Activity Towards Health targeted specific lifestyle behaviours (diet, physical activity, smoking cessation, alcohol, stress reduction and medication adherence) which were personalized to each individual based on the results obtained from baseline assessments
Pfaeffli et al., 2012 Country ND	'To outline the content development process of the mHealth exercise-based CR intervention and includes the results from formative and pre-testing studies'.	Qualitative study Focus group sessions and telephone interviews High quality (8) ^a	ND	38 participants, 28 attenders Individuals with cardiovascular disease who had attended (attendees), and those who were invited but never attended (non-attenders) a CR programme 24 (63%) males Mean age = ND	Provider: ND Setting: outpatient web-based CR Mode of delivery: SMS, video messages, and an interactive website Intensity: ND Duration: 8 weeks Adherence to delivery protocol: ND Content: ND

CR, cardiac rehabilitation; ND, not described.

^aLow (0–3 points); medium (4–7 points), and high quality (8–10) points. Low-quality studies were not excluded, but caution was taken when interpreting their results.

in 2 studies),^{41,43} United States of America ($n=8$ participants in 1 study).³⁹ With regard to country income classification, only one was conducted in a middle-income country⁴⁵ and none in a low-income country.

Most of the included studies were classified as high quality ($n=7$; 58%),^{35,37,38,40,41,44,46} and medium quality ($n=4$; 33%).^{36,39,42,43} One study (12%)⁴⁵ was classified as poor quality.

Characteristics of virtual education delivery

Characteristics of virtual education delivery in CR programmes described according to WIDER were reported by the following number of studies: settings by 12 (100%) studies, mode of delivery by 12 (100%) studies, duration by 10 (83%) studies, content by 10 (83%) studies, intensity by 7 (58%) studies, provider by 6 (50%) studies, and adherence to delivery protocol by 4 (33%) studies. Overall, five studies reported five characteristics (41%)^{35,36,42,44,45}; two (16%)^{39,40} studies reported all seven characteristics of the virtual education programme; two studies reported four characteristics (16%)^{37,43}; one study reported six characteristics (8%)⁴⁶; and one study reported three characteristics (8%).³⁸ In summary, the included studies identified that virtual education is mostly delivered by doctors, physiotherapists, nurses, social workers, psychologists, and dietitians on a weekly basis via different online platforms and websites, as part of outpatient CR programmes.

Barriers and facilitators to virtual education participation and learning in cardiac rehabilitation programmes

Table 2 shows an overview of barriers and facilitators to virtual education learning and participation in CR identified in the studies included in this systematic review. Multiple determinants that affect virtual education learning and participation were identified across studies. The most common facilitators were the following: accessibility ($n=7$, under skills category of TDF); empowerment ($n=6$, under beliefs about capabilities); technology ($n=4$, under environmental context and resources); and social support ($n=4$, under social influences). The most common barriers identified by participants were the following: format of the delivered material ($n=4$, under behaviour regulation); technology ($n=3$, under environmental context and resources); and social support ($n=1$, under social influences). The connection between emerged themes and TDF determinants, as well as representative quotes can be found in Figure 2.

Facilitators to virtual education participation and learning in cardiac rehabilitation programmes

Accessibility (TDF's determinant: skills)

Accessibility emerged as a facilitator to virtual learning in seven studies.^{36,38–44} Participants of CR programmes have identified virtual learning as convenient since they have access to specialized information and have the ability to ask questions to many experts at set time, without location restriction.^{36,38–44} Participants also identified the technology used was easy to locating, reading, and listening to information housed on platforms as a facilitator to virtual learning.³⁹

Empowerment (TDF's determinant: beliefs about capabilities)

Empowerment emerged as a facilitator to virtual learning in seven studies.^{35–37,41,42,44,46} Individuals receiving virtual learning while participating in CR programmes self-reported that they were able to gain self-care knowledge,^{35–37,46} find relevant information about exercise,⁴² and were more willing to manage cardiovascular symptoms.⁴¹ Having self-discipline to participate in CR programmes and building self-confidence necessary to control their habits and their behaviours have also emerged as facilitators to virtual education,⁴⁵ although this factor was only reported in a study qualified as poor in quality.

Technology (TDF's determinant: environmental context and resources)

Technology emerged as a facilitator to virtual learning in four studies.^{35,42,43,45} Websites that are easy and simple to navigate are considered a facilitator to virtual learning by CR participants.⁴³ The use of animation tools was considered attractive and interesting.⁴⁵ It also helped enhance participants' concentration and enabled them to better memorize the application strategies.⁴⁵ Although reported in a study classified as poor in quality, video clips were also considered useful for patients to learn exercise concepts and skills needed in real-life situations.⁴⁵ For the large majority of the participants, technology emerged as a useful adjunct to standard care^{42,43} and as an important key to seeking information and facilitating behaviour change.³⁵

Social support (TDF's determinant: social influences)

Family support emerged as a facilitator to virtual learning in four studies.^{35,37,39,44} Individuals receiving virtual learning in CR programmes described having the opportunity to interact with individuals that are experiencing similar conditions, which was helpful to their own understanding of how to live with CVD after being diagnosed.^{35,39} Participants reported that some family members provided emotional and technical support. Those participants have also been directly involved in the virtual education, gaining direct health benefits from it (i.e. learning and changing their behaviours along with family members).⁴⁴ Social support was considered as a key motivation for virtual learning in CR programme, only if delivered in groups and in real-time, hence needs to be qualified.⁴⁴

Barriers to virtual education participation and learning in cardiac rehabilitation programmes

Format of the delivered material (TDF's determinant: behaviour regulation)

Format of the delivered material as a barrier in four studies.^{39–41,43} Although virtual educational programmes allow individuals to manage their timing so they learn according to their availability,⁴¹ participants of those programmes indicated that some of the sessions were too long. It posed difficulties for participants to complete all of the modules and effectively learn while participating in virtual CR programmes.⁴³

PowerPoint presentation-based virtual programmes may also pose barriers to virtual learning and participation in CR. Some participants identified that, because of its mode of delivery, presenters are sometimes unable to adjust their presentation styles based on audience gestural feedback (i.e. slow presentation speed), which impacts participant's ability to learn.³⁹

Table 2 Overall view barriers and facilitators to online learning

Theme	Subthemes	Antilla et al. 2021	Banner et al. 2015	O'Shea et al. 2020	Pfaeffli et al. 2012	Brewer et al. 2017	Clark et al. 2013	Devi et al. 2014	Dinesen et al. 2019	Higgins et al. 2017	Hwang et al. 2017	Jenny et al. 2001	Mendel et al. 2019
Knowledge	Skills												
	Accessibility												
Social/ Professional role and identify	Optimism												
	Empowerment												
Reinforcement Intentions	Goals												
	Memory, attention and decision												
Environmental context and resources	Technology												
	Social Influences												
Emotion Behavioural regulation	Social support												
	Format of delivered material												

All TDF determinants have been included in this table as themes, but only the ones with boxes were identified in the studies included in this systematic review.
 = Facilitator = Barrier.

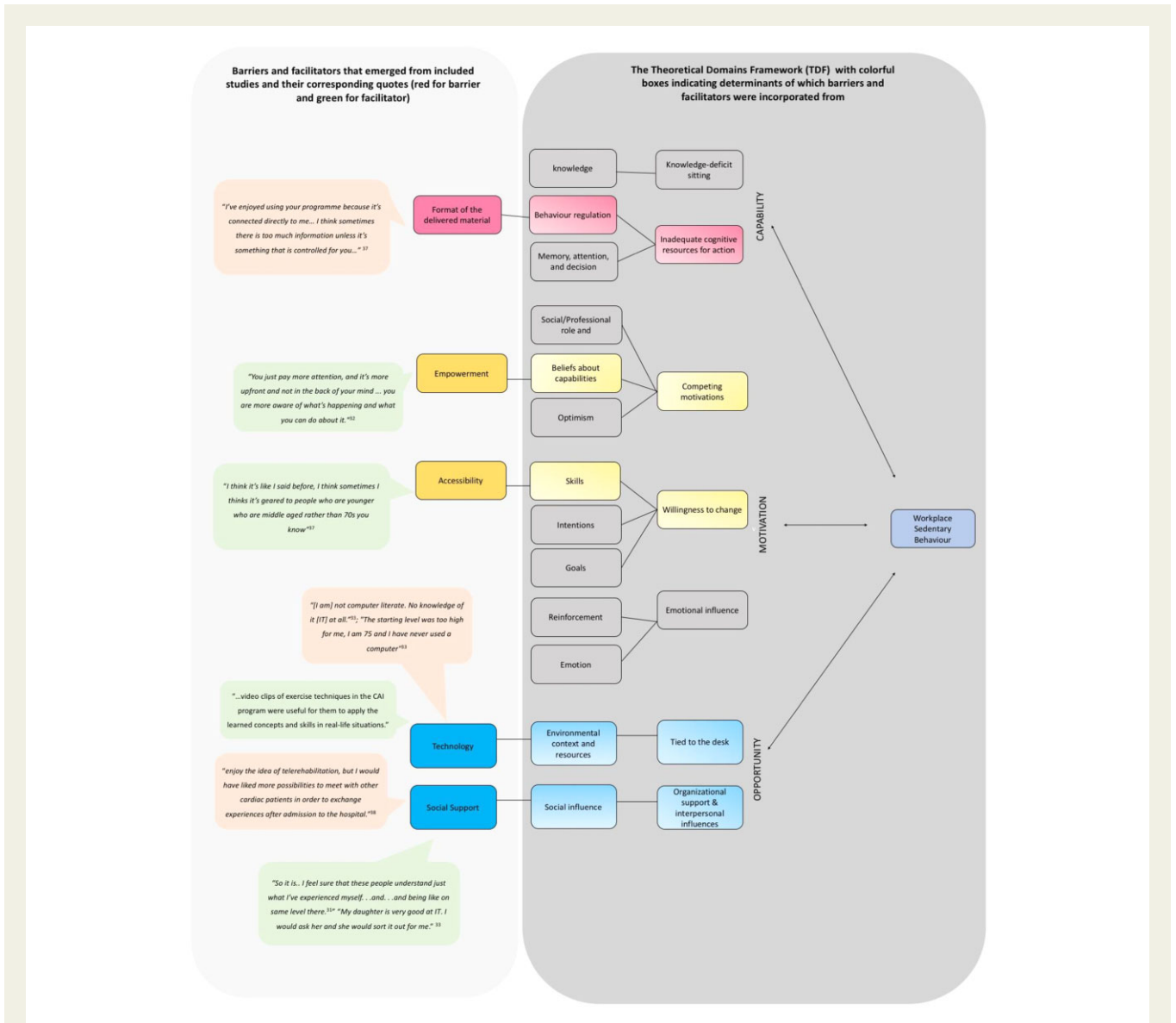


Figure 2 Emerged themes and quotes based on Theoretical Domains Framework's determinants.

Technology (TDF's determinant: environmental context and resources)

Technology emerged as a barrier in two studies.^{36,37} This was mostly associated with lack of access to an internet-connected computer,^{36,37} use of non-user-friendly technology—i.e. PATHway system, that contains 'too many complicated features',^{36,37} poor performance of the equipment used for virtual education—technical issues such as audiovisual and connectivity difficulties,³⁷ and lack of knowledge and computer literacy—individuals identified that sometimes the programme was too complicated for someone that 'Have never used a computer' which makes them choose not to utilize the technology (i.e. websites) while participating in the CR programme.³⁷

Although technology was considered accessible by the large majority of the individuals participating in virtual education, one study indicated that older individuals might be more reluctant to make lifestyle

changes and perhaps focus less on addressing health issues due to barriers to the accessibility of virtual education programmes.⁴¹

Social support (TDF's determinant: social influences)

Social support emerged as a barrier to virtual learning in one study.⁴² Although it was recognized as a facilitator, some individuals also indicated that there was a lack of interaction in virtual interventions, which can negatively impact the support received by others. For them, having in-person contact with other CR participants would help the exchange of views and experiences between patients about topics related to CVD or lifestyle changes.⁴² For those individuals, virtual educational sessions delivered in CR seemed to not build the same level of connectivity and interaction as observed with in-person sessions.⁴²

Discussion

This systematic review investigated barriers and facilitators affecting virtual education learning and participation in CR as identified in 12 qualitative studies from 11 high-income countries (in one study the country was not described), totalling 296 patients. The most common facilitator was accessibility, followed by empowerment, technology, and social support. Format of the delivered material was the most common barrier. Technology and social support also emerged as barriers to virtual education learning and participation. This review is the first, to our knowledge, to provide a synthesis of qualitative studies that identify barriers and facilitators to virtual learning in CR. Those barriers and facilitators were embedded into the following TDF determinants: skills, beliefs about capabilities, environmental context and resources, social influences, and behaviour regulation. Overall, few studies provided detailed information on how virtual education is delivered within CR programmes, which makes it difficult to better understand barriers and facilitators for specific modes of delivery. Furthermore, none of the studies included in this systematic review was developed in low- and middle-income countries, so our results cannot be extrapolated to that population.

One of our main findings of this review is related to different perceptions regarding technology that influence virtual education learning and participation in CR programmes. Lack of computer literacy and knowledge are highlighted as barriers not only for virtual education learning but also to participation in CR programmes in general.^{36,37} An older age seems to be a key contributor to this fact. Patients in older age groups have limitations in using technology as a means of receiving health care (e.g. due to low computer literacy or vision and hearing problems), with some of them noting a lack of interest and others finding it burdensome.⁴⁷ These individuals require more technical assistance to participate in virtual programmes and to overcome inhibiting factors for rehabilitation.⁴⁴

Usability tests can help overcome factors associated with computer literacy and preferences for formats of the delivered material, as well as help to improve outcomes associated with virtual learning for older individuals.^{43,45} Studies have suggested that the easier or simpler the technology, the higher the acceptance and willingness to learn and get familiar with different types of digital intervention.^{48,49} In this systematic review, the use of animation tools and websites that were easy and simple to navigate facilitated the learning process in CR programmes.^{43,45} Lack of internet connectivity or technical equipment such as access to a computer, smartphones or other technology devices may also be considered as barriers to be addressed while considering virtual education delivery in CR programmes.⁵⁰

Studies have shown that virtual education can improve patients' understanding of their disease, motivate behaviour change, and improve self-management.^{35,51} Individuals participating in the studies included in this systematic review identified that technology helped them take control of the rehabilitation process, increase their self-confidence and become actively involved in the management of their care.^{35,36} Those factors are represented as patient empowerment and are largely influenced by knowledge acquisition and participation in decision-making.⁵² Patient empowerment enhances communication between patients and health care professionals, improves adherence to treatment and self-care and leads to better health outcomes including reduction of stress and anxiety.^{41,52–54}

Several studies have reported timing and geographical barriers to patient participation in onsite CR programmes, including lack of transportation, travel time, scheduling, and commitments associated with returning to work.⁵⁵ More recently, public health policies developed to avoid the spread of the SARS-CoV-2 pandemic, such as physical social distancing, are also creating challenges for patient participation in onsite CR programmes.^{6,7} As previously described, many CR programmes are closed due to the pandemic.^{6,7} Those who remained opened had to find different ways to provide rehabilitation care other than in-person. Virtual education emerged as a solution to overcome barriers associated with those restrictions. In addition, virtual rehabilitation might also help address timing and geographical barriers, as patients can participate in CR programmes from the comfort of their home, and better accommodate the timing of their participation.⁴⁹

Cardiovascular disease patients have a need to connect with others living with the same condition.⁵⁶ They use these interactions to understand how to live with a cardiovascular condition, to validate their assumptions about self-care, and to obtain emotional support.⁵⁶ Several studies have shown that peer, family, and institutional support help increase completion rates in CR programmes, optimize knowledge and lifestyle behavioural changes^{57,58} and improve the success of virtual education strategies.⁵⁹ Although some participants still identify lack of in-person interaction as a barrier to virtual education learning and participation, others identify digital interventions as an easy way to connect with others with similar health conditions as well as with health care professionals that assist with the management of their health care.⁴⁹ The peer support provided by virtual interventions was helpful during the pandemic time when social distancing was highly reinforced. In addition, partnerships between care managers (specially trained nurses) and doctors in the management of patients with CVD has also been shown as an effective way to socially support patients and help them to make lifestyle changes, monitoring their conditions, and providing the necessary information and advice to promote patient empowerment, enhance self-management skills, and achieve better compliance with care recommendations,⁶⁰ especially in delicate circumstances like the SARS-CoV-2 pandemic.⁶¹

Format of the delivered material that emerged as a theme in this systematic review.^{36,39,41} The literature suggested that personal preferences must be taken into consideration in all types of education programmes—including virtual ones—as it can also influence the acquisition of knowledge as well as patients' adherence and completion of CR programmes.^{62–64} However, little is known about patients' preferred learning models in CR programmes. Studies included in this review show that participants experienced challenges in learning while attending long virtual sessions, or receiving education by PowerPoint presentations when the presenter cannot gather gestural feedback from the audience.^{39,40}

Within the list of themes that emerged from this systematic review as facilitators and barriers to virtual education in CR, two of them (named social support and technology) were considered both (i.e. a facilitator and a barrier). While some participants see virtual sessions as a way to communicate and engage with peers, others are not able to connect virtually and need in-person contact and support. In addition, while technology makes it more accessible to some, it also creates a barrier for others. It is important for healthcare professionals

to clearly understand how their patients feel about the use of technology to treat them, in order to emphasize the facilitators and minimize or eliminate the barriers to ensure the delivery of effective virtual education to their patients. Future work should focus on what patients' characteristics can influence these views.

We acknowledge that results from this review should be interpreted with caution. First, results cannot be generalizable to all CVD patients; it is likely more socio-economically advantaged, healthier patients are accessing CR virtually, including the fact that studies were developed in high-income countries. Second, most of the studies showed barriers and facilitators to virtual learning without providing details about the intervention, which makes it difficult to understand how care was delivered and how to address these factors. There is a need for a better understanding of how virtual learning is delivered in low- and middle-income countries as well as the barriers and facilitators identified by healthcare providers in delivering these interventions to patients.

Some recommendations to improve virtual education strategies in CR programmes can be extracted from our results, including the implementation of user-friendly websites and platforms that allow patient-patient and patient-health care provider interactions^{45,46}; avoidance of long sessions or PowerPoint presentations when the speaker cannot gather feedback from the audience^{39,40}; provision of initial training and technology support to help address lack of technology literacy and knowledge^{45,46}; and creation of strategies to focus on patient empowerment during virtual learning (e.g. delegating responsibilities to behaviour change while educating), to assist individuals in becoming self-aware of their needs and barriers to change their lifestyle, manage their illness, and use resources to solve problems in their daily lives.⁶⁵

In conclusion, this was the first study to critically appraise and synthesized the qualitative literature on patients' barriers and facilitators to virtual education learning and participation in CR. Overall, 12 qualitative studies were found addressing five major barriers and facilitators, including technology, empowerment, accessibility, social support, and format of the delivered material. The lack of studies identifying these aspects in low- and middle-income countries (where CR access is lower overall), as well as in overall countries during the pandemic underscore a research gap. Future studies aimed to address those gaps are needed.

Supplementary material

Supplementary material is available at *European Journal of Cardiovascular Nursing* online.

Conflict of interest: none declared.

Data availability

The data underlying this article are available in the article and in its online supplementary material.

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