The needs and preferences of cardiac patients regarding an human-centered eHealth intervention during the perioperative phase – a qualitative analysis

University of Twente - Faculty of Behavioural, Management and Social Sciences
Tessa Markus

First supervisor: Dr. Nadine Köhle
Second supervisor: Dr. Ing. Gert-Jan Prosman

Abstract

Background. A large part of the population suffers from cardiovascular diseases that require surgery. During the perioperative phase of such surgeries, patients have to deal with many physical, psychological and environmental changes that the health care system currently cannot absorb. eHealth offers an effective way to fill the gaps of the health care system since it is accessible anytime and anywhere, offering individual solutions to patients.

Objective. This study aims to analyze the needs and preferences of cardiac patients regarding an eHealth intervention during the perioperative phase in order to create an intervention that is human-centered and therefore, improves the health outcomes of cardiac patients.

Methods. Semi-structured interviews about e.g. the course of the treatment, experiences, needs and preferences with regard to an intervention were conducted with six cardiac patients who varied in terms of sex, age, education and kind of surgery. Transcripts of the interviews were coded through conventional content analysis using Atlas.ti.

Results. The need for an eHealth intervention was low. Half of the participants had no interest due to positive surgery experiences or lack of technology (-knowledge), the other half had ambivalent feelings. Concerning the preconditions and content, participants described a great number of preferences. Participants would like to receive information about the procedure, prognosis or medication. Participants wanted mindfulness, physical exercises, diary writing and self-monitoring to be included. Participants would like support provided through the app like personal or virtual contact with a professional but also independent use and they had timid preferences regarding the conceivable expenditure of time. Some participants could imagine the daily use; the period should start approximately 3 weeks before surgery and last up to one year after.

Conclusion. Cardiac patients do not fully believe in eHealth to manage the shortcomings they experienced during their perioperative phase. Nevertheless, this study provided a deeper insight into the needs and preferences of cardiac patients regarding an eHealth intervention's content. It would be conceivable that care robots would be a medium to unite the needs of the participants. Further research is still needed on one hand to investigate other forms of convenient interventions and on the other hand to investigate how eHealth can be more appealing to the target group.

Keywords: cardiac patients, needs, preferences, interventions, human-centered design, HCD, eHealth, perioperative phase

Samenvatting

Achtergrond. Een groot deel van de bevolking lijdt aan hart- en vaatziekten die een operatie vereisen. Tijdens de peri-operatieve fase van dergelijke operaties hebben patiënten te maken met veel fysieke, psychologische en omgevingsveranderingen die de gezondheidszorg momenteel niet kan absorberen. eHealth biedt een effectieve manier om de hiaten van het zorgstelsel op te vullen, aangezien het altijd en overal toegankelijk is en individuele oplossingen biedt aan patiënten.

Doelstelling. Deze studie heeft tot doel de behoeften en voorkeuren van hartpatiënten met betrekking tot een eHealth-interventie tijdens de perioperatieve fase te analyseren om een interventie te creëren die mensgericht is en daardoor de gezondheidsresultaten van hartpatiënten verbetert.

Methoden. Semi-gestructureerde interviews over o.a. het verloop van de behandeling, ervaringen, behoeften en voorkeuren met betrekking tot een interventie werden uitgevoerd bij zes hartpatiënten die varieerden in termen van geslacht, leeftijd, opleiding en soort ingreep. Transcripties van de interviews werden gecodeerd door middel van conventionele inhoudsanalyse met Atlas.ti.

Resultaten. De behoefte aan een eHealth interventie was laag. De helft van de deelnemers had geen interesse vanwege positieve operatie-ervaringen of gebrek aan technologie (-kennis), de andere helft had ambivalente gevoelens. Ten aanzien van de randvoorwaarden en inhoud beschreven deelnemers een groot aantal voorkeuren. Deelnemers wilden graag informatie over de procedure, prognose of medicatie. Deelnemers wilden dat mindfulness, fysieke oefeningen, dagboekschrijven en zelfcontrole werden opgenomen. Deelnemers wilden ondersteuning via de app zoals persoonlijk of virtueel contact met een professionele maar ook zelfstandig gebruik. Ze hadden schuchtere voorkeuren met betrekking tot de denkbare besteding van tijd. Sommige deelnemers konden zich het dagelijkse gebruik voorstellen; de interventie moet ongeveer 3 weken voor de operatie beginnen en tot een jaar daarna duren.

Conclusie. Hartpatiënten geloven niet volledig in eHealth om de tekortkomingen die ze tijdens hun perioperatieve fase hebben ervaren, te beheersen. Desalniettemin gaf deze studie een dieper inzicht in de behoeften en voorkeuren van hartpatiënten met betrekking tot de inhoud van een eHealth-interventie. Het is denkbaar dat zorgrobots een medium zijn om de behoeften van de deelnemers te verenigen. Verder onderzoek is enerzijds nodig om andere vormen van handige interventies te onderzoeken en anderzijds om te onderzoeken hoe eHealth aantrekkelijker kan worden voor de doelgroep.

Introduction

A large part of the population suffers from cardiac problems. According to the World Health Organization cardiovascular diseases are the number one cause of death on the globe with nearly 18 million deaths per year (WHO," 2017). The American Heart Association found that the prevalence of cardiovascular diseases in the United States in adults ≥20 years of age, including low impact diseases like hypertension, is 48.0% overall and increases with advancing age in men and women (Benjamin et al., 2019). In 2014 nearly 8 million inpatient cardiovascular surgeries and procedures were performed in the US (Benjamin et al., 2019). In comparison, in the Netherlands approximately 1.9 million inhabitants were treated because of cardiac reasons (Centraal Bureau voor de Statistiek, 2015). In 2017 nearly 15,000 open cardiovascular surgeries and more than 40,000 percutaneous coronary interventions were performed in the Netherlands. Percutaneous coronary interventions include minimal invasive procedures like stent placements. Of all open cardiovascular surgeries 63.2% (9,204) were bypass surgeries to the coronary arteries (CABG) and 26.4% (3.852) cardiac valve replacement surgeries (CVS). Detailed descriptions of both procedures can be found in the appendix. Patients having either CABG or CVS are mainly the elderly starting from age 65 (Nederlandse Hartstichting, 2018).

Cardiovascular diseases and their treatment are often a difficult and long-during process that can affect the lives and health of the patients. Cardiovascular surgeries are no short term surgeries like appendectomies for which patients are admitted to hospital, get the appendix removed and leave without changes in their physical or mental condition - the preparations and recovery from cardiovascular surgeries take much longer ("Alles over bypass- of omleidingsoperatie" | Nederlandse Hartstichting, 2018). Patients are prepared for surgery, are then hospitalized and have a long phase of recovery afterwards which can last several months up to years. The whole process of surgery (before, during and after surgery) is defined as the "perioperative phase".

Limitations of Physical Care for Cardiac Patients

Research has shown that cardiac patients report uncertainties about the surgery based on the lack of good preparation and explanation about procedures, expectations, risks and consequences from health services (Anderson, 1987; Zanetti, Flanagan, Cohn, Giardina, & Platt, 2014). Being under cardiac arrest for example can be frightening for cardiac patients and result in fear of death (Anderson, 1987; Zanetti et al., 2014). Due to fears, worries and

uncertainties about the surgery, cardiac patients experience significant physical and psychological stress, including high levels of depression and anxiety (Fitzsimons, Parahoo, & Stringer, 2000; Gallagher & McKinley, 2007).

Furthermore, the patients' stay at the hospital demands a lot. The patients, for example have to deal with pain, a new diet, a reduced and decompensated physical condition, new medication plans etc. (Lapum et al., 2016). Especially patients with difficulties adapting to the new environment and remembering the information given in the hospital often experience troubled and stressful discharge (Zanetti et al., 2014). Commonly, this is based on the lack of time of the medical staff and the primary focus on the physical health condition of patients (Lapum et al., 2016). The emotional complaints and the need for education of cardiac patients are not sufficiently addressed (Lapum et al., 2016). Consequently, the stay at the hospital is overwhelming for patients and often leads to distress. After the stationary treatment, more than 50% of cardiac patients had worsened physical conditions and strong emotional reactions like concern, anxiety or depressive thoughts (Jaarsma, Kastermans, Dassen, & Philipsen, 1995). Concluding, the lack of education, preparation and emotional support during hospitalization leads to high levels of stress and symptoms of depression and increased insecurities in cardiac patients (Contrada et al., 2008; Fitzsimons et al., 2000; Guo, East, & Arthur, 2012a).

Research has shown that the depression score one month after the cardiovascular surgery is a crucial indicator for morbidity up to five years later (Borowicz et al., 2002). Furthermore, high stress levels are highly associated with symptoms of depression (Contrada et al., 2008). Beyond that, high levels of depression or anxiety have negative impacts on treatment and surgery outcomes (Dubois et al., 2012) and higher levels of stress and symptoms of depression can impair the wound healing, prolong the recovery or can cause sudden death (Andrew, Baker, Kneebone, & Knight, 2000; Borowicz et al., 2002; Duits, Boeke, Taams, Passchier, & Erdman, 1997; Pignay-Demaria, Lespérance, Demaria, Frasure-Smith, & Perrault, 2003; Salzmann et al., 2017). This demonstrates the need to support patients in their perioperative process to ensure better health outcomes.

Interventions for Cardiac Patients

Despite the enormous consequences of the disease and its treatment on the lives of the patients and the possible effects of stress, anxiety or depressive symptoms on the recovery of the patients, only a few interventions, that would address the difficulties of patients during the perioperative phase as a whole, are available for this group. A study we found, for example in

which nurses have conducted home CBT in patients early after cardiac surgery, could show positive effects on depressive symptoms (Doering, Chen, Cross, Nyamathi, & Irwin, 2013). However, this study was only carried out with patients who were classified as clinically depressed prior to treatment. It is questionable how generalizable the successes of CBT treatments are for non-clinically depressed cardiac patients. In addition, CBT treatment focuses primarily on psychological recovery and can hardly address physical health. Mullaney, Pettersson, Nyholm & Stolterman (2012, p.37) stated that "it is well known that patients can experience anxiety during their interactions with medical environments, and healthcare providers are increasingly realizing that what they're offering is not enough to meet the needs of their patients". This underlines the suffering of patients and the need for a solution that offers enough support for patients. Despite the great potential of interventions for cardiac patients, it is not exploited until now.

Prior attempts in creating interventions only showed minimal and inconsistent success in supporting the group of cardiac patients. A literature review by Guo (2015) for instance showed conflicting results regarding the effectiveness of preoperative education on improving physical and psychological recovery of cardiac patients. Trials, in which nurse-led shared care groups, health education, motivational interviews and/ or individualized information was provided to the participants, showed positive effects on physical and psychosocial recovery like reduced anxiety. However, other trials of the review with similar interventions could not show any effects. Other studies showed that interventions that aim to decrease anxiety of cardiac patients also led only to small positive effects on patient contentment and anxiety by teaching and informing about the operative process (Asilioglu & Celik, 2004; Guo, East, & Arthur, 2012b; Reaza-Alarcón & Rodríguez-Martín, 2019). It was striking that the studies listed above did not include patients in the development process of the interventions. The educational content of these interventions were evidence-centered rather than user-centered (Kazdin, 2008). Patients' needs and preferences were not addressed sufficiently, whereby fulfilling the patients' needs has the biggest impact on recovery (Lapum et al., 2016). Other studies that looked at educational interventions for cancer and asthma patients, for example, found higher patient contentment and greater health outcomes when a patient/ user-centered approach was utilized (Mitchell, 2014; Mullaney, Pettersson, Nyholm & Stolterman, 2012). Concluding, higher effects on outcome are expected when involving cardiac patients as stakeholders in the development process of an intervention.

Human-Centered Design as a Basis of Interventions for Cardiac Patients

Therefore, it is inevitable to include cardiac patients as stakeholders when developing an intervention that aims to fulfill their needs and preferences. When creating an intervention that aims to meet the needs and preferences of cardiac patients, a human centered design (HCD) should be central. HCD is an approach to problem solving that involves the human perspective, thus the perspective of future users of an intervention to ensure a good user experience, better efficiency and effectivity and a higher degree of satisfaction (Farinango, Benavides, Cerón, López, & Álvarez, 2018; Walji et al., 2014). It includes systematic and continuous consultation of users during the design process (Gould & Lewis, 1985). HCD aims to bundle different constructs like learnability, memorability, efficiency, error frequency and satisfaction that intend to make interventions more accessible and appealing to the user (Lyon & Koerner, 2016).

Lyon and Koerner (2016) reported that principles and methods of HCD exacerbate common difficulties, such as low level of use, inflexibility and complexity, when implementing evidence-based interventions. The authors support favoring HCD over evidence-based interventions based on greater success regarding usability, learnability, efficiency, memorability and user satisfaction and lower cognitive load and errors. In addition, Kujala (2003) reported positive effects on user satisfaction and fitting to the needs of the users. Thus, HCD achieves specific goals in an effective and efficient manner and satisfaction in the specified context of use. Additionally, the user reports a high usefulness of the HCD-based application (Davis, 1989; Kujala, 2003). Moreover, in her review, Kujala (2003) found that user involvement in the development process led to more accurate user requirements, the avoidance of unwanted or unneeded costly system features, improved levels of acceptance and greater understanding of the system by the user. Therefore, the HCD is a beneficial approach for users and developers regarding financial savings, the lower burden of usage for users, increased usability and lower drop-off rates.

eHealth Interventions for Cardiac Patients

To ensure a great amount of accessibility of HCD-based interventions electronic Health (eHealth) is of considerable value. The Ministry of health (“E-Health - Bundesgesundheitsministerium,” 2020) defined: “ehealth covers applications that use the possibilities offered by modern information and communication technologies (ICT) for the treatment and care of patients.” eHealth applications have several advantages for the target

group. Firstly, the large and growing group of cardiac patients who cannot be adequately cared for by the system would have additional access to health care. This would lead to enhanced quality of care and more equity of healthcare among cardiac patients (Eysenbach, 2001). Secondly, nowadays nearly everyone owns a mobile phone which provides an inexpensive and effective way to deliver much needed interventions to the target group of cardiac patients (Park, Beatty, Stafford, & Whooley, 2016). Thirdly, attitudes of potential users towards eHealth are positive. This was shown by a Dutch study that investigated the expectations of middle-aged and elderly people towards telecare and eHealth applications (Huygens, Vermeulen, & De Witte, 2014). Participants perceived timesaving, comfort and safety as the main advantages of eHealth. Lastly, eHealth is versatile and can be adapted to the patients needs'. The expanding scope of eHealth ranging from simple educative value or advice up to more complex online interventions is beneficial in an ongoing HCD development process of interventions for cardiac patients (Eysenbach, 2001). Nevertheless, these advantages would only come into effect if cardiac patients used existing or soon existing applications. This is a matter of adherence which of course should be as high as possible and no problem with the use of a HCD ("Health care delivery and clinical science: Concepts, methodologies, tools, and applications," 2017). Eventually, taking into account the advantages of eHealth applications with their effective and innovative way to prevent and manage cardiovascular diseases, shows the great value and potential.

The Present Study

This study intends to determine the needs and preferences of cardiac patients who have undergone CVS or CABG to make a first attempt of creating an HCD-based eHealth intervention for them. The findings should make an important contribution to the field of cardiac patients, the perioperative phase care and eHealth, in a way which would lead to greater rehabilitation and better health outcomes for cardiac patients. Therefore, the following research question "What are the needs and preferences of cardiac patients regarding an eHealth intervention during the perioperative phase?" and the following sub-questions: (1) "Is there a need for an eHealth intervention?" and (2) "How should this intervention look like concerning content (e.g. information, exercises, professional support) and preconditions (e.g. time investments and design elements)?" are formulated.

Methods

Study Design and Ethical Approval

A qualitative research design was chosen to gain insights into the needs and preferences of cardiac patients regarding an eHealth intervention during the perioperative phase. Since the research subjects were cardiac patients, this study was approved by the Ethics Committee of the University of Twente prior to the data collection (no. BCE 15309).

Participants and Procedure

Within the present study convenience sampling was used. In 2016 patients were recruited in Ziekenhuis Groep Twente (ZGT), a hospital in the eastern part of the Netherlands, after they had undergone a cardiovascular surgery. A specialist nurse informed the patients about the study and provided the interviewer with the data of those who agreed to take part in the study. When selecting the participants attention was paid to a balance between gender and type of surgery (CABG or CVS). Another inclusion criterion was the diagnosis with a cardiovascular disease that needed surgery which had to be performed beforehand. Furthermore, participants had to follow treatment at the participating hospital. Exclusion criteria were insufficient knowledge of the Dutch language and impaired cognitive abilities since the participants had to describe their experiences during the perioperative phase from their own perspective. A total of six patients were selected for interviewing. All six patients agreed and took part in semi-structured face-to-face interviews. The interviews took place after three to six months after the participants' surgery. Three male and three female participants between 62 and 78 years old (M = 69.7, SD = 6.8) were interviewed. Detailed characteristics of the participants can be found in Table 1.

All interviews were conducted by a PhD candidate (AH) of the department of Psychology, Health and Technology of the University of Twente. The interviewer collected the data with regards to her PhD-study and was trained to conduct interviews. Interviewer and participants did not meet prior to the interviews. Participants had insights into the overall research goal when taking part in the study. Before starting the interview, participants had to fill in an informed consent. Interviews were conducted at the patients' homes, sometimes in the presence of a family member. All interviews were audio recorded with a mobile phone and transcribed verbatim with the Express Scribe Transcription Software.

Interview Scheme and Draft Design

In this study, coded interviews of Dutch cardiac patients were used to find an answer to the research question. This study only focuses on the need of cardiac patients for such an intervention and on the needs and preferences in terms of content and preconditions. Not all parts of the interview were equally important for answering the research questions since all interviews followed a predesigned interview scheme which can be found in the appendix (Appendix B). Firstly, the interviewer introduced herself, thanked the participant for his or her participation and explained the procedure of the interview and the privacy regulations of the study. Secondly, participants were asked how they experienced the time before surgery. Topics like pain, daily functioning and previous treatment attempts were talked about. Thirdly, participants were interviewed about experiences regarding the surgery and the time afterwards. Hereby, questions about the hospital stay and rehabilitation were asked. Fourthly, participants were asked about content preferences for a new intervention. Besides, questions about preconditions like time investment, possible exercises and form of support (if or if not participants wanted to be guided by a professional) were included. Fifthly, the interviewer introduced the first draft design of an eHealth intervention and the participants were encouraged to comment on it. Participants were asked about their need for an app at a certain point in the interview, mostly when switching to the subject of apps or when introducing the draft design. The description of the draft design can be found in Textbox 1.

Textbox 1

Description of the Draft Design

> "Then we have a first draft design which we are thinking of based on our research. I would like to read it to you and then see what you think about it. We do assume that people already know how to use a table. If that is not the case, then we will adjust that. The idea is that after an introduction in the hospital, as the patient knows that he will have surgery, an introductory interview with a professional will take place. The professional will explain the program to the patient. The patient then gets a tablet to take home with. Once every week, there is an email exchange between the patient and the professional. So the professional sends a message like 'is everything okay?' to check in on the patient. During hospitalization, when the patient is admitted to the hospital, the professional encourages the participant to apply exercises, for example relaxation exercises for pain or breathing exercises if someone has a throat problem. The professional is able to do the exercises together with the patient, if necessary. After surgery the patient goes home after about a week. Then there is email contact again between the patient and the professional. By that, the patient could email if there are any questions and vice versa the professional can check whether everything is still okay. What do you think of this setup?"

Finally, all interviews closed with questions about the demographics sex, age, religion, education, employment and access and use of technology. An average interview lasted 60 minutes [range between 44-80 minutes].

Data analysis

All transcripts were coded by the author of this study. The data analysis was based on the conventional content analysis described by Hsieh & Shannon (2005) which is a common approach in interview studies and topics that lack wide theories. Using this approach, the author retrieves categories and names from the data rather than from existing theories. The author read and reread all transcripts in order to familiarize with the data. Striking or repetitive statements were marked and first ideas about the data were written down by the

author. Next, all fragments that appeared important with regards to the research questions were selected. Only these fragments were used for further analysis. Within these fragments, it was chosen to use sentences as coding units. It was possible to code one sentence with multiple codes since it was necessary to capture all aspects of a response. Within the selected fragments, inductive category development was utilized, meaning all codes and categories derived from the data (Hsieh & Shannon, 2005). Firstly, the author coded one transcript. Secondly, with the initial codes, the author coded a second transcript and created additional codes. Thirdly, initial codes of both transcripts were put on cards to get a visual overview. The author revised the used coding process, organized codes into subcategories and merged several codes. Fourthly, two more interviews were coded with the revised codes. Several codes were merged again, resulting in final codes and categories. Fifthly, during the coding process of the last two interviews no new codes were created. All categories were discussed multiple times with the supervisors of the author. For all coding purposes Atlas.ti 8 was used. Since the interviews were held in Dutch, all quotes used in this result section were translated. In case that interviewer and interviewee were cited at the same time, the interviewer is marked with an 'I' and the interviewee with a 'P'.

Results

In the following data of the participants and categories emerging from the interviews will be presented. First, the descriptive statistics are described and then the further results concerning the research questions will be presented.

Participant Characteristics

The participants from which data were retrieved were a heterogeneous group from different educational backgrounds. The majority of the participants were already retired at the moment of interviewing, 16.67% would describe their employment rather as 'housewife'. Two-thirds of the participants said that they had access to technology and Internet, the remaining participants had neither. Regarding the received surgery, participants were evenly divided into CVS and CABG. The detailed characteristics of each participant and their answers regarding sub-question (1) can be seen in Table 1 below. Turning now to the participants view on the need for an eHealth intervention.

Table 1

Characteristics and Attitude Towards an eHealth Intervention per Participant

Participant	Gender	Age	Children	Religious	Education	Employment	Access to technology	Access to internet	Surgery	Tendency of need for an eHealth intervention
1	Female	64	Yes	Unknown	Low	Retired	Yes	Yes	CVS	Declining
2	Female	73	Yes	Yes	Medium	Retired	Yes	Yes	CABG	Declining
3	Female	65	Yes	Yes	Low	Housewife	No	No	CABG	Indistinct
4	Male	76	Yes	Yes	High	Retired	Yes	Yes	CABG	Declining
5	Male	78	Yes	No	Low	Retired	No	No	CVS	Indistinct
6	Male	62	No	Yes	High	Retired	Yes	Yes	CVS	Indistinct

Table 2

Coding Scheme Regarding Sub-Question (1) "Is There a Need for an eHealth Intervention?"

Theme	Category	Codes/ Arguments	Number of Participants Naming One Argument	Example Quote
Is there a need for an eHealth intervention?	Need	Need for distraction	1	*I: Other things that you say 'take that into account' or 'put that in'? P: Yes, I read to […]. But reading is also distracting. I mean reading a biography I also find a very pleasant event. I: Yes, yes. So reading as a sort of distraction tactic? P: Yes, and there your attention is also tied to something for a longer period of time.*[Participant 4]
		Need for supplement to existing care	2	*You know, I would like to be the best informed I could be about all things that I need.* [Participant 2]
		Need for emotional stability	1	*I: So you think that because of your 'physical' surgery, something physically changed within you [...] through hormones you have become a bit more emotional?* *P: Yes, yes, yes, yes! Particularly more vulnerable.* [Participant 4]
	No Need	Need for personal contact	1	[*...] I am not the kind of person for that, I am really not that type of person. I would rather go to the doctor and talk to her [...] I would be more able to tell it (complains) to her than I would be in such an intervention. [The doctor] would understand me much better and she knows me just the way I am.* [Participant 1]
		Suitability	3	*I thought I was prepared in every possible way.* [Participant 2]
		Lack of technical knowledge	1	*I would rather have it on paper than. I could just read it. I would find it easier. I think those things (technology) are so complicated.* [Participant 3]
		Impaired memory	1	*P:Well, I could suffer from my impaired memory ... fine. I can live with that. It doesn't bother me. So I forget [...]. I: Ok. So you actually indicate 'that online program I really wouldn't use', mainly because of your forgetfulness.* [Participant 3]

Need for an eHealth Intervention

As shown in Table 1, the attitude towards an eHealth intervention varied under the participants. Table 2 presents an overview of the used coding scheme regarding sub-question (1) and provides the arguments (codes) participants gave for need/ no need regarding an eHealth intervention. Of the six participants who were asked whether they would have needed to use an intervention during their perioperative phase, three were not interested and three had ambivalent feelings. Regardless of their first personal tendency for the need of an eHealth intervention, the participants named different reasons for need and no need. The reasons for 'no need' were missing personal contact, the unsuitability of an intervention because they had an overall positive experience regarding the perioperative phase, lack of technical knowledge, no access to technology and impaired memory. The reasons for 'need' were need for distraction in the stressful times of the perioperative phase, need for emotional stability since participants experienced stress and anxiety and a needed supplement to the existing care like regular contact with professionals and more aftercare. Interestingly, participants 1, 2 and 5 regardless of their initial tendency would want to use the eHealth intervention anyway because they were convinced, for example, through possible exercises presented by the interviewer during the interview or on the advice of a doctor. This will be further illustrated per participant in the following.

Participant 1 said to be in no need for an eHealth intervention since she could benefit more from personal contact with her practitioner.

> I am not the kind of person for that, I am really not that type of person. I would rather go to the doctor and talk to her [...] I would be more able to tell it [complains] to her than I would be in such an intervention. [The doctor] would understand me much better and she knows me just the way I am. [Patient 1, female, 64]

Interestingly, participant 1 reconsidered her attitude towards an eHealth intervention when the interviewer introduced possible exercises that could be part of it. The interviewer explained the possibility of breathing exercises and from then on the participant was interested in using the eHealth intervention:

> I: [...] When we would insert an option in the intervention that when you choose it, an audio recorded voice tells you: 'Lie down for a while, try to see how your body feels…'[...] Then you would have used the intervention? P: Then yes. (Patient 1, female, 64 years old)

Participant 2 retrospectively sees no need to use an eHealth intervention since her cardiovascular surgery experience was very uncomplicated and easy. Nevertheless, she would use the eHealth intervention if her doctors advised her to do so.

> I: Imagine going back in time and the intervention was already designed before you had surgery and it would be offered to you by doctors [...] Would you use it? P: Yes, I would consume everything [...] I: So you would use it. Could you explain to me why? P: Yes. You know, I would like to be the best informed I could be about all things that I need. (Patient 2, female, 73 years old)

Participant 3 was indistinct about her need for an eHealth intervention and had various concerns using an eHealth intervention. Firstly, the participant suspected that she could not use the intervention since she did not have any technical device. Secondly, it would be easier for her to read materials on paper than on screen because those are too complicated for her to use. Thirdly, the participant was afraid that she would be too forgetful to learn how to use a tablet if one was allocated to her. About her actual need for an intervention the participant did not speak out. When the draft design was introduced to her, the participant was positive about it. Commenting on the presented draft design, the interviewee said “Oh I think that is nice. Yeah well, you have no additional aftercare.” (Participant 3, female, 65 years old). The participant further explained that during the time of aftercare she only had her children and homecare and an eHealth intervention could have been of added value.

Participant 4 was declining an eHealth intervention and described his surgery experience as uncomplicated like participant 2 did and saw no need in his own case. When talking about other cardiac patients going through the same process, he was positive about how an eHealth intervention could be a supplement in this process stating: “Well I think that is a very good statement that you say 'it is a supplement' that you can add on and that is of course wonderful.” (Participant 4, male, 76 years old). One reason that spoke in favor of an app in his case, however, was the lack of distraction during the perioperative phase.

Participant 5 (78 years old), the oldest interviewee, was indistinct about his need for an eHealth intervention. He stated that he felt well prepared by the hospital. The participant never clearly stated whether he was in actual need or favor of an intervention or not. When analyzing his interview it seemed questionable how much he understood from the questions since often he didn't answer at all or his wife helped him. The participant for example gave no comment on the draft design that was presented to him. Nevertheless, when asked about his attitude trying an eHealth intervention, he was merely positive about it. The interviewer asked “You just said that if there had been such an intervention before and it would have been really

easy to use, you might have wanted to try it. Just to see how it works?" and the participant enthusiastically said "Of course!".

Participant 6, when asked about his opinion on an eHealth intervention, was indistinct. On one hand he had an unpleasable experience with his doctors, dealt with pain and anxiety during his perioperative phase but on the other hand he questioned his emotional and physical ability to use an intervention.

> I do not know. I really don't know. That had to do with how much rest I would still have in my head, I think. I think that at that moment [...] I already had the feeling 'I have nothing under control anymore' and reading or using that app would not have increased that control. I already said 'it soon will be over' [...] Then I thought of myself 'oh psychologically it affects me very much'. And then I was completely unexpectedly thrown off the blow, I had become afraid of the hospital and I did not want to go there and that surprised me. (Patient 6, male, 62 years old)

Desired Preconditions and Content

Four broad categories emerged from the analysis of the desired content and preconditions: preferences regarding the given information, preferences regarding the offered exercises, preferences regarding the professional support provided through the app and preferences regarding the conceivable expenditure of time and design. Participants' needs and preferences regarding those categories can be found in Table 3.

Table 3

Overview of Patients' Needs and Preferences Regarding Content and Preconditions of an eHealth Intervention

Theme	Category	Codes	Example Quote
Content and Preconditions of the eHealth intervention	Needs regarding information	Treatment and procedure	*I: And more information about the procedure? Or was that information sufficient? – P: No, I don't think so either. A little more is allowed.* [Participant 3]
		Risks and effects of treatment	*I: No, did you have other expectations? – P: Yes. That you can cycle again and that you can do everything. You could cycle again the next day. That's what they said.* [Participant 1]
		Prognosis	*The only thing I missed, yes not literally missed because they did tell, is the quality of my condition, of my heart, of ... how it actually turned out.* [Participant 6]
		Deal with friends and family	*And then, in the beginning I didn't dare just to do everything because everyone said "you need to stay calm," you know. They think I'm doing too much.* [Participant 2]
		Need for surgery	*I had to. Otherwise I would not have had 2 more years to live. Within 2 years it could have been over. The heart valve was calcified. And it had to go.* [Participant 1, had difficulties to accept the surgery because she had no complaints]
		Medication	*Well, good ... I would (put in the app) everything that has to do with medication. I still have that extreme itch on a regular basis for example and that is most likely due to one of those medicines.* [Participant 6]
		Testimonials	*Well, I have to say at that meeting in (city name), where we are in a large circle, and you hear all kinds of stories, I think 'well, I'm actually doing pretty well". I think in that sense it is nice to be able to compare.* [Participant 4]
	Needs regarding exercises	Relaxation / Breathing exercise/ Mindfulness exercise	*I: If there had been mindfulness exercises in such an app, would you have used them? P: Yes, sure [...] I: And why? I: Well because I've had some experiences with mindfulness exercises. That works well. I: And what do you think would it work for? P: Well for harmony [...] emotions I think, yes (handling) feelings, achieving more harmony.* [Participant 4]

Category	Codes	Example Quote
	Physical exercises	*Well, I did yoga-like techniques during the cardio workouts. After a few times - at first I thought ... I didn't understand, shut my ears, just watched what the others were doing, of course I wouldn't catch up at first - at one point I noticed 'wow that's good for me, good for my back.* [Participant 6]
	Self-evaluation techniques	*Because it is so confusing. I found it very difficult to indicate to what extent I felt better. You have to be able to measure that in some way 'which things do I feel like doing?', 'which things am I doing again?'.* [Participant 6]
	Diary writing	*I: So would you be willing to do that kind of exercise? To look at what you are doing? P: Yes, for sure! I think if you can do something about it yourself then you shouldn't hesitate.[...]I: And exercises which give you insight into yourself, in which you look critically at yourself, how you cope with certain things, how you see yourself in life? P: Yes, I would add that for sure. I: That is also part of your lifestyle or not? P: Yes, I mean I kept my diary [...]* [Participant 4]
Needs regarding professional support	Personal contact	*I: Would you like to do this independently or would you like to be guided by someone? P: I would make it part of the physiotherapy. (since there he would have a contact person)* [Participant 6]
	Virtual contact	*Yes, you would already have the feedback, once you have the weekly contact with the professional. Well, that seems very nice to me. That's great that it is supervised this way.* [Participant 2]
	Independent use	*If I couldn't do it on my own I would ask for help.* [Participant 2]
	Other	*And the drugs I was given ... I had no idea, but maybe that's something I missed when my brain wasn't active yet. Or that it just wasn't ... Very briefly, I was given medication and I did not understand them at all.* [Participant 6]
Needs regarding time investment and design	Period of time	*Yes, I would take half a year for that. That depends on to what extent the complaints in patients proceed normally ... side effects may occur.* [Participant 6]
	Frequency of usage	*I think that will be very different, if you spend a couple of times a week on it. But some may say 'I want that every day', so I don't know. I cannot estimate that properly.* [Participant 2]
	Form	*I: And if we made a video of it? That it is not on paper that someone should read it but if it was explained in a video […] would that be a possibility? P: Maybe that would work. I: Because some people are a bit more visual? Could be an option? P: Could be an option*. [Participant 2]

Needs regarding information

All six participants indicated that they would have needed more information in their perioperative phase that should or could be incorporated in an eHealth intervention. Some needs for more information arose from the participants' descriptions of their inadequate education during the perioperative phase, while others were specifically commented on as content for an eHealth intervention. Especially information about the procedure and risks of cardiovascular surgery seemed to be needed. Preferences regarding information given in an app according to the participants can be seen in Table 4. Referring to the informational content of an eHealth intervention, participants could imagine a variety of aspects when considering themselves or other cardiac patients as potential users. These aspects were information about treatment and procedure, about risks and effects, about prognosis, how to cope with social problems with friends and family, the general need for surgery, medication and testimonials.

Table 4

Preferences Regarding Information Given in an eHealth Intervention According to the Participants (n=6)

Content	Number of Participants Naming One Content Wish
Information about treatment and procedure	6
Information about risks and effects of surgery	6
Information about prognosis after surgery	5
Information about how to deal with worries of friends and family	4
Information about the need for surgery	3
Information about medication and side effects of medication	3
Information of other cardiac patients (testimonials)	3

One third of the participants felt not well informed enough and/ or were scared to look up information on the Internet. According to one participant, the information should be not too overwhelming but tailored to its users. By doing that, no user/ cardiac patient would experience needless anxiety. Participant 6 (male, 62 years old) saw the positive aspect of a "closed environment like in an app" and stated: "The chance that you will search for wrong information is a lot smaller." Despite the high demand for information among the participants, there were also concerns that too much information might be worrying. The 76 year old

participant 2 (female) said: “And I think the more I know that things can go wrong, the more I might worry.“

Needs regarding exercises

Participants indicated a need for exercises related to relaxation, breathing and mindfulness, physical exercises, self-evaluation techniques and diary writing options. It is noteworthy that during the interviews no clear distinction was made between breathing-, mindfulness- or relaxation exercises on the part of the interviewer. The interviewer generally asked about exercises aimed at calming the body and mind and mixed terms. That is why no clear distinction can be made between the different kinds of exercises. An overview of the different exercise preferences and the participants’ distribution can be found in Table 5.

Table 5

Preferences Regarding Exercises in an eHealth Intervention According to the Participants (n=6)

Kind of exercises	Number of Participants Naming One Exercise Wish
Relaxation/ Breathing/ Mindfulness/	3
Physical Exercises	3
Self-evaluation techniques	3
Diary writing	1

Half of the participants could imagine using exercises aiming to focus on their mind/ to relax. Reasons for that was prior positive experience with that kind of exercise, like in the case of Participant 4 (male, 76 years old): “Well, because I have had experiences with mindfulness exercises. That works well!”. Furthermore the willingness to be positive towards oneself and the positive effect it could have in order to deal with problematic emotions.

> I: If there had been mindfulness exercises in such an app, would you have used them? P: Yes, sure [...] I: And why? I: Well because I've had some experiences with mindfulness exercises. That works well. I: And what do you think would it work for? P: Well for harmony [...] emotions I think, yes (handling) feelings, achieving more harmony. (Participant 4, male, 76 years old)

The other half did either not comment on the subject, found it interesting still not suitable, were unexperienced or questioned the effects of those kinds of exercises and were critical about it. When the interviewer introduced relaxation exercises, for instance, to participant 5, he was open about it but in his personal case he never used those kinds of exercises and felt no need to do so:

> I: And if, for example, we would incorporate relaxation exercises that allow you to calmly watch your breathing if, for example, you are short of breath or if you have pain somewhere. Would that be an option to put in there? P: I have never experienced that. I can say 'that's interesting', but I mean ... I: You didn't feel the need for that? P: No. (Participant 5, male, 78 years old)

Regarding physical exercises, 50% would advise some kind of them in an intervention, since it helped their physical recovery, managing pain, regaining strength and flexibility. One participant stated when asked by the interviewer “Other things that you say 'well that could be in it?' or 'you should take that into account'?” that “the physical exercises for sure” since he had “done a lot of sports” which helped him with his recovery (Patient 4, male, 76 years old). The remaining participants were not rejecting physical exercise but did not comment on it regarding an intervention. However, all participants have been physically active in their recovery phase, either prescribed physiotherapy, swimming, walking or home exercises.

Furthermore, there were three participants that wanted some sort of evaluation method in order to monitor their own progress after surgery. One of those three commented this: “I found it very difficult to indicate to what extent I felt better. You have to be able to measure that in some way 'which things do I feel like doing?', 'which things am I doing again?'” (Patient 6, male, 62 years old). Other participants did not comment on the subject. One participant could also imagine diary writing as a technique to find inner peace.

Needs regarding support

The needs regarding any kind of support were heterogeneous among the participants. Needs about the support given through an eHealth intervention were either personal contact with a professional supplementing the app, virtual contact with a professional, independent use of the app and ‘other’ (support preferences that were not related to the support of a professional). The distribution of needs regarding support can be seen in Table 6.

Table 6

Preferences Regarding Support (From A Professional) in an eHealth Intervention According to the Participants (n=6)

Kind of support	Number of Participants Naming One Support Wish
Personal contact	1
Virtual contact	5
Independent use	3
Other	5

The majority of participants (n= 5) expressed the need for virtual interaction with a professional. One third of those participants would have had the urge to have this contact with a professional on a regular basis, for example once a week. This contact could be either via mail or call. Participant 3 (female, 65 years old) was positive about regular virtual contact since after her discharge she felt quite alone and commented: "Oh, I like that. Yeah well, there is not much aftercare ... I think that's good because that is, look, you come home and you lose everything.*"* Participant 2 shared this opinion (female, 73 years old): "Yes, you would already have the feedback, once you have the weekly contact with the professional. Well, that seems very nice to me. That's great that it is supervised this way." Another reason for participant 2 that spoke in favor of virtual contact was her not bothering her real doctor with questions since she felt uncomfortable doing so ("That could be something. Then you can ask someone neutral. Yes, not directly, how should I say that a doctor has to be bothered. A nurse who is especially there for that."). Additional to the weekly contact, participant 2 would like to have feedback on her performance within the app, whereas participants 1 and 4 would prefer mainly independent use of the app next to possible virtual contact with a professional. They only wanted some sort of feedback when problems would occur. It should be noted that the 76 year old participant 4 stated very clearly and directly that he prefers face-to-face contact. He emphasized that an app could only be a support and no substitute in any way. Participant 6 preferred personal contact with a professional and suggested incorporating the intervention as part of the physiotherapy. Participant 3 did not comment on this topic.

Support preferences that were not coded under personal contact, virtual contact or independent use, were referred to as 'other'. Two participants wished e.g. for support regarding their medication intake, 66.67% of the participants would have liked support when getting external help like home care or physiotherapy and 83.33% were interested in support to keep track of regular health check-ups.

Needs regarding time investment and design

Expenditure of time. Needs regarding the expenditure of time varied among the participants. Participants had preferences regarding the frequency of usage and the period in which the eHealth intervention should be accessible. Concerning the period of time the intervention should be available, answers ranged from one up to three weeks before surgery and from 10 weeks up to one year after surgery. Detailed information about the preferences regarding the expenditure of time per participant can be seen in Table 7.

Table 7

Preferences Regarding the Expenditure of Time (Frequency of Usage and Period of Time) Per Participant

Participant	Frequency of usage	Period of time
1	No comment	1 week before surgery - 3 months after
2	10 minutes everyday	? - 10 weeks after
3	No comment	No comment
4	Every day (No comment on how long)	Before, during and after surgery, co comment on exact period of time
5	No comment	3 weeks before surgery - ?
6	No comment	? - one year after

Note. Question marks show that participants did not comment on either the period of time before or after surgery.

Form. No detailed questions were asked about the form the content should be delivered as in the interviews. Nevertheless, some impressions have been recorded. There were three participants that thought videos were a good alternative to present materials in an understandable way.

> I: And if we made a video of it, for example? That it is not on paper that someone should read it but if it was explained in a video, in such a program, would that be a possibility? P: Maybe that would work. I: Because some people are a bit more visual? Could be an option? P: Could be an option. (Participant 2, female, 73 years old)

Additionally, one participant could imagine audio recordings for e.g. relaxation exercises in an app based intervention. Another participant who struggled with her memory would rather have something on paper, as that would be the easiest option for her.

Discussion

This study was one of the first to investigate the needs and preferences of cardiac patients regarding an eHealth intervention using six semi-structured interviews. The participants had varying needs for an eHealth intervention, still mentioned several needs regarding information, exercises, support and preconditions like time investment and design.

No clear statement can be made whether participants were in need of an eHealth intervention since half of the participants were not interested because they lacked personal contact, were satisfied with the existing support in health care or had no affiliation with technology and the other half of the participants had ambivalent feelings towards an intervention due to lack of technical knowledge and skepticism about the added value of eHealth. Contrary to the expectations, this study did not show a clear present need for an eHealth intervention. Considering the high burdens of the perioperative phase with all its stressors, anxiety and changes, it was expected that participants indeed have a need (Contrada et al., 2008; Lapum et al., 2016; Salzmann et al., 2017).

The need for an eHealth intervention is possibly not present in the target group of cardiac patients. The high age of the participants and their partly limited access and ability of technology might be the reason for the lack of need for eHealth. In our sample the mean age was 69.7 years old. In comparison, in the Netherlands 2017 men were on average 67 years old and women 70 years old at a CABG/ CVR (*Hart- en Vartziekten in Nederland*, 2018), showing that the sample was representative. Since some participants do not interfere with technology on a daily basis or do not even have access to technology and internet, the imagination of an intervention that is based on technology might be impaired. Jimison et al. (2008) found that the usage of technological health interventions was more successful if the intervention is delivered on technologies consumers use every day for other purposes. Thus, the experiences and usual interaction with the technology seem to be a crucial aspect for technological health interventions, such as proposed in the present study. Nevertheless, it is expected that the following generations will have high usage of technology, also in an elderly state. Therefore, the adoption and acceptance of technology/eHealth might increase. To examine the usefulness of an eHealth intervention without the reluctance of cardiac patients who are not technologically adept, the study should be repeated in 5-10 years.

It is possible that the participants also lacked the idea of what an eHealth intervention could look like and how they could benefit from it, given the fact that half of the participants did not even have or used technology yet. How should they know what it can look like? A

study by Dogruel, Joeckel, & Bowman (2015) was able to point out that the main reason for elderly to use and accept technology was the perceived usefulness and ease of use. This would be supported by the fact that some participants thought much more positively about an eHealth intervention after hearing the draft design. Participants might have decided differently about their needs if they previously had a better picture of an eHealth app. That is also in line with what Clark & Mcgee-Lennon (2011) found in their stakeholder exploration of the current barriers to the uptake of technology in elderly with acquired or inborn disability. The authors stated that "acceptance levels may vary depending on the social context and the amount of knowledge a stakeholder has regarding what the *technology can and cannot do*" (p.20). That is why future research should investigate which cardiac patients' needs would be described when a better presentation of a possible eHealth intervention is guaranteed. The use of mock-ups has proven very helpful. In a study about the needs and preferences of partners of cancer patients regarding a web-based intervention, participants benefitted from the use of mock-ups by getting a better visual picture and understanding of applications (Köhle et al., 2015). Furthermore, research could take another step back. The human-centered approach in this study was based on which content and preconditions cardiac patients wanted to see in an intervention. Would it not be even more human-centered to let those patients decide which medium they would prefer for *their* intervention? By taking a step back in the development process of an intervention user and researcher could benefit from it. Future research could ask and design an intervention medium together with the target group. Also, we think that it is necessary to rethink on the part of the health care system. If it is one of the biggest obstacles for cardiac patients to benefit from eHealth because they are not familiar with it and therefore declining, then doctors and nurses should introduce eHealth much earlier in the treatment process to the target group. By doing so, the fear of cardiac patients to use eHealth might tail off and they could eventually benefit from additional and more equal care in an inexpensive, timesaving and comfortable way (Eysenbach, 2001b; Huygens et al., 2017; Park et al., 2016).

Participants of this study had clear ideas regarding the preconditions and content of an eHealth intervention. The participants reported the need for more information (e.g., about treatment procedure or risks and effects), different kinds of exercises (such as physical, mental or self-monitoring) and support from professionals through the app. Regarding the time investment in an app-based intervention, the participants had varying ideas. One third of the participants imagined using the intervention on a daily basis and the participants' answers regarding the duration of usage ranged from 1 to 3 weeks before the cardiovascular surgery up to one year after the cardiovascular surgery.

First, the majority of participants indicated that they felt insufficiently informed about the surgery and the life afterwards by medical staff. Therefore, informational content should be a central topic within an eHealth intervention for cardiovascular patients. This finding is consistent with the results of Zanetti et al. (2014) who showed that patients want "clinicians [to] pay particular attention to processes of care that are related to personalization, active listening, and offering patients realistic expectations of their postoperative experiences". The implications for practice are the high demand of appropriate and understandable information. Although, all the information that the participants described as needed in the interviews should have been given to them in the course of the treatment, it does not seem to be done to a sufficient extent ("Alles over bypass- of omleidingsoperatie | Hartstichting," 2019). Since the content patients ask for should largely already be delivered to them by the healthcare system, maybe higher standards in quality assurance are needed. Until now, the Dutch Healthcare authority tries "monitoring care for vulnerable people like the elderly" ("Monitoring the quality of healthcare | Quality of healthcare | Government.nl," 2020) and offers people to submit a complaint. Perhaps it would be of additional value to collect random sample surveys of cardiac patients to get a better understanding of what information is missing in the course of the treatment or rather difficult to understand. However, a precise analysis of quality assurance in the Netherlands would be necessary and that is beyond the present study. Apparently, the health care system as it is, cannot inform, prepare and care for cardiac patients' in a way that leads to patients' satisfaction which would be of utmost importance to guarantee better health outcomes (Anderson, 1987; Lapum et al., 2016; Mumford, Schlesinger, & Glass, n.d.). This lack of information can lead to significant physical and psychological stress, including high levels of depression and anxiety (Fitzsimons, Parahoo, & Stringer, 2000; Gallagher & McKinley, 200). Higher levels of stress and symptoms of depression, again, can impair the wound healing, prolong the recovery or can cause sudden death (Andrew, Baker, Kneebone, & Knight, 2000; Borowicz et al., 2002; Duits, Boeke, Taams, Passchier, & Erdman, 1997; Pignay-Demaria, Lespérance, Demaria, Frasure-Smith, & Perrault, 2003; Salzmann et al., 2017).

Second, the participants reported a need for exercises. A lot of patients were interested in some sort of exercises like mindfulness, relaxation or diary writing. Besides, the participants indicated the wish for physical exercises like done in physiotherapy or yoga. In addition to that, participants expressed the urge to measure their mood and/ or recovery progress with the help of an intervention. A study by Kim, Wineinger, & Steinhubl (2016) could show the benefits of a self-monitoring program. In their study hypertensive patients

used a self-monitoring program which consisted of a blood pressure monitoring device connected with a mobile phone, reminders for self-monitoring, a web-based disease management program, and a mobile app for monitoring and education. After six months those patients did not only improve their blood pressure measurements but were also more motivated to improve their health management including less smoking and drinking.

Research has shown that exercises can be of added value during the perioperative phase of a vascular surgery. Schwarzer (1998), for instance, found that well-being, mental and physical activity can be indicators for recovery from cardiac surgery. Additionally, the author showed that coping with surgery mediates resources prior to the cardiovascular surgery and readjustment post to the surgery, indicating that suitable and adapted exercises could help create a positive surgery and recovery process. Fortunately, participants in this study seem to be willing to engage in psychological and physical exercise during their perioperative phase – by which they can positively influence their health outcomes. Different studies showed that psychological interventions as well as exercise training had positive effects in terms of psychosocial outcomes that have proven impact on cardiac rehabilitation and mortality rates (Fernandes, McIntyre, Coelho, Prata, & Maciel, 2017; Lavie, Menezes, De Schutter, Milani, & Blumenthal, 2016). One approach that combines the exercise wishes of the participants is yoga. Yoga includes physical exercise, breathing techniques and meditation principles, all aiming to connect body and mind ("Yoga for Everyone: A Beginner's Guide - Well Guides - The New York Times," 2020). Two separate randomized controlled trials could also show the physical and psychological health benefits of yoga for cardiac patients (Prabhakaran et al., 2020; Toise et al., 2014). Those yoga programs were able to improve quality of life and self-compassion and decrease anxiety in cardiac patients. A different study by Bharshankar, Bharshankar, Deshpande, Kaore, & Gosavi (2003) could also show the positive effects of cardiovascular functions of yoga in participants > 40 years old. It would be interesting to see more research on the attitudes of cardiac patients towards yoga as an additional treatment during their perioperative phase.

Third, a need for professional support was described by several participants. The participants reported that they wish to interact with professionals for questions, feedback and monitoring purposes via mail or phone calls. This is based on the fact that the participants did not feel sufficiently attended before and after the cardiovascular surgeries and, moreover, did not want to be a burden to their doctors. Mohr, Cuijpers, & Lehman (2011) demonstrated in their study that professional support via telephone, mail or chat in eHealth enhanced the adherence of users in many treatments. This finding underlines the importance of support

provided by clinicians since it does not only help the cardiac patients to have additional contact with professionals but also increases the likelihood of cardiac patients to keep using eHealth interventions. The detailed Supportive Accountability Model by Mohr, Cuijpers & Lehmann (2011) on how to design and implement human support in interventions should be taken into account in the following steps of creating an eHealth intervention for elderly cardiac patients.

In summary, we saw that the participants in this study needed more information that would fit their individual needs, that they wanted exercises that would make them physically and mentally fitter and healthier and that they wanted to be accompanied on their sometimes difficult path. However, the majority of the participants were not impressed by an eHealth intervention on cell phones or tablets. So what could be an alternative for this group? Care robots could be an innovative solution. Care robots (socially assistive robots or artificial intelligence robots) are robots that aim to improve the health, functioning and quality of life of people with temporary or chronic health issues. Furthermore, they support healthcare personnel in providing care (Randall et al., 2019). Research on the benefits of robots could show promising health benefits, such as addressing loneliness, improving mood, increasing social interactions, providing medication and event reminders, monitoring and predicting users' health status with sensors accompanying the robot and relieving caregiver burden (Randall et al., 2019). In the perioperative care of cardiac patients care robots could exercise with patients or could talk to them and answer all their questions or uncertainties. Additional sensors connected to the robot could monitor the patients' vital signs and call for help in case of emergency. The robot could also replace the contact and support by a doctor to a large extent and, in more urgent cases, even call a doctor through video chats, for example. In the study just mentioned, socially assistive robots were able to positively influence depressive symptoms in older adults between 56 and 67. On top of that, participants of the study had positive attitudes towards the robot (Randall et al., 2019). The possibilities of robots are far from exhausted, which is why future research should also examine whether care robots can also have positive effects on the health of cardiac patients.

Image 1. Picture of Two Elderly Men Doing Physical Exercises with a Robot

Limitations and Strengths

There are four main limitations to this study. Firstly, the methodological approach is corrigible. Since the coding was done by one researcher only, resulting in lower reliability. However, the coding was discussed with supervisors. To ensure interrater reliability, working within a team during the coding phase is highly recommended. Additionally, this diminishes the bias due to the researchers.

Secondly, the aim of the data collection differs from the aim of the present study. The aim of the data collection was to discover the patients' experiences and coping strategies with cardiovascular surgeries. Consequently, a large part of the data could not be used within the present study. Still, there was crucial information included within the data in order to answer the research question. For follow up research, it is advised to rephrase and restructure the interview. The following order is recommended: Overview of the perioperative phase and positive and negative experiences of cardiac patients, introduction to the subject of an eHealth intervention, showing/ explaining mock-ups, pilot apps or draft designs, collecting needs and wishes regarding content and preconditions, elaborating the need or rejection for such an app.

Thirdly, another limitation is the number of participants and that all participants were recruited from the same area within the Netherlands. Therefore, the generalizability and thus external validity of the present study is rather low. Furthermore, with only six participants we cannot speak about data saturation since new information was retrieved in all six interviews.

It is highly recommended to replicate the present study with more participants recruited from different parts within the Netherlands.

Fourthly, the answers of the participants might be biased due to the recall bias. Since the participants' treatment was completed at the time of the interview, participants might have faced difficulties to fully take the perspective they had during the treatment. McPhail & Haines (2010) showed in a prospective cohort investigation that recall bias had a big effect on measuring change in health-related quality of life amongst older patients. Therefore, it cannot be ruled out that talking with participants in the beginning of the treatment or during the treatment in general would have led to different results. Thus, the timing of the interview might have been a crucial factor.

There are also important strengths to this study. The present study was an explorative research using inductive coding within a fairly new age of research that gave several new insights into the needs of cardiac patients in general and regarding eHealth. So far, studies have only looked at the effectiveness of evidence-based interventions for cardiac patients. The human centered approach, thus putting the patient and its needs in the focus, of this study is a crucial strength. When looking at similar studies, none ever included cardiac patients into the developing process and asked for their needs and preferences in extended face-to-face interviews.

Conclusion

The need for an eHealth intervention among cardiac patients remains inconclusive. The target group apparently does not fully believe in eHealth to manage the shortcomings they experienced during their perioperative phase. Nevertheless, this study provided a deeper insight into the needs and preferences of cardiac patients regarding an eHealth intervention’s content and preconditions. The existing preferences concerning the content indicate the potential value of an intervention for this target group including more understandable information, exercises that to foster physical and psychological recovery and optional support from professionals. It still has to be studied, how to deliver this content to the target group in order for them to benefit. A possible solution could be integrating care robots. Furthermore, it should be investigated how eHealth can become a more appealing medium for cardiac patients.

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