MASTER THESIS

The needs and wishes of healthcare professionals regarding the use of an eHealth technology

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15/04/2019

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Abstract

Introduction: In 2017, more than 1.6 million people suffered from cardiovascular diseases in The Netherlands. After suffering from a cardiac incident, patients are offered a cardiac rehabilitation program. The use of technology in the form of an electronic patient portal (EPP) can help optimize the efficiency of rehabilitation and improve disease maintenance of patients. When developing a technology, it is important to involve different stakeholders. Most studies focus on the views of the patient, however, the views of healthcare professionals (HCPs) are just as important, but often underexposed. Therefore, this study focusses on the views of the healthcare professional regarding the development of an EPP. The aim of this study is to elicit system requirements by uncovering the needs and values of healthcare professionals.

Methods: This study performs secondary analysis on a data set collected within the Benefit project. This data set contained 16 interviews with healthcare professionals. Interviews were transcribed and inductively coded in Atlas.ti 8. Quotes were then exported to Excel to elicit requirements. First, attributes were determined by studying each quote. Second, the underlying values of that quote were determined. Third, based on the quote, attribute and corresponding value(s), requirements were formulated.

Results: six (out of 16) HCPs have a need for good reliable information to provide to patients. Eight HCPs are concerned on losing sight of patients after cardiac rehabilitation. Nine HCPs stated that they want to see a trend in the health data of their patients. HCPs value efficiency (16 HCPs), providing good quality of care (14 HCPs), giving personalized care (12 HCPs), and overview and being informed (11 HCPs). Requirements that were reflected by the most healthcare professionals are: the system must provide a visual image of the patient's health values to the healthcare professional (8 HCPs); the system should be linked to external databases with scientific, reliable information to support the healthcare professional (7HCPs); the system must have a low-threshold for healthcare professionals (7 HCPs); and the system must be used in a multidisciplinary manner (4 HCPs).

Conclusions: The results of this study show the needs and wants of HCPs concerning the functionalities, content, and use of technology. Since HCPs are part of the intended end-users, it is important to incorporate the context and values of HCPs when developing a technology, to ensure a match between user and technology. An EPP supported and endorsed by HCPs is potentially the key to increase adoption by patients.

Contents

1. Introduction

In 2017, more than 1.6 million people suffered from cardiovascular diseases in The Netherlands. During that year, there were more than 272.000 hospital admissions due to cardiovascular disease and 38.613 disease related-deaths [1]. After suffering from a cardiac incident, patients are offered a cardiac rehabilitation program. Cardiac rehabilitation is aimed at improving functional capacity, physical recovery, and improving psychological well-being and social functioning, which leads to a reduction of cardiovascular incidents and an increase of the quality of life of the patient [2].

There are three different phases in cardiac rehabilitation. Phase one, or the clinical phase, starts directly after an acute cardiac event. In this phase, the patient receives medical treatment at the hospital. Phase one ends when a patient is ready to go home and is referred to cardiac rehabilitation by their treating cardiologist. Phase two, or the rehabilitation phase, connects to phase one and starts after being discharged from the hospital, where the patient is offered a rehabilitation program. This program can be arranged either from within the hospital or from within a rehabilitation center. Phase two consists of an indication statement to determine the goals of the rehabilitation. Goals of the rehabilitation include physical goals, such as being able to swim or walk again; mental goals, such as overcoming fear or depression due to the cardiac event; social goals, such as receiving social support, reintegration at work; and goals focused on influencing at-risk behavior, such as smoking, alcohol consumption, and therapy compliance [2]. The patient can be offered of one or more interventions, which can be group interventions or individual interventions. Phase two is concluded with an evaluation by the cardiologist. In phase three, or the post-rehabilitation phase, attention is being focused on the transfer to the general practitioner, the preservation of lifestyle changes of phase two, a modest follow-up of psychological symptoms, and if necessary, treatment of psychological symptoms [2]. Cardiac rehabilitation is a pre-eminently multidisciplinary process. Many different healthcare professionals are involved in cardiac rehabilitation, such as cardiologists, rehabilitation physicians, rehabilitation coordinators, general practitioners, company doctors, nurses, dietitians, psychologists, social workers, physiotherapists, occupational therapists, psychiatrists, insurance physicians, and labor experts. Each professional focusses on a different part of the rehabilitation, but all to support patients in their rehabilitation [2].

Cardiac rehabilitation brings multiple benefits, such as reduced overall mortality, reduced hospital admissions, and improvement in psychological wellbeing and quality of life [3]. Although there are many benefits of joining a cardiac rehabilitation program, a study of the Dutch Heart Foundation found that of the 87% of patients with an indication to join an exercise module, only 80% of the patients decided to actually join. Additionally, of the 90% of the patients with an indication to join a lifestyle module, less than 25% of the patients joined the module [1].

Studies show it is more effective to personalize information and support to the individual needs and situation of the patient [2]. The multidisciplinary guideline cardiac rehabilitation recommends using a decision tree to identify the individual goals of the patient and compose a personalized care plan [2]. However, while healthcare professionals are motivated to give the best possible care, they already experience a lack of time during consultations. Therefore, it is important to optimize the efficiency of rehabilitation to ensure that the best possible care can be provided. After cardiac rehabilitation, patients are expected to be able to manage their own disease and maintain a healthy lifestyle with no or minimal supervision [4]. Unfortunately, it is known that a large proportion of patients do not follow up on medication and lifestyle recommendations from cardiac rehabilitation after termination of phase two [2]. Possible explanations for this are miscommunication between patient and healthcare

professional or non-adherence to therapy due to inadequate treatment of factors such as depression, fear, and lack of social support [2].

The use of technology can offer a solution in optimizing the efficiency of rehabilitation, phase two, and improving disease maintenance, phase three of cardiac rehabilitation. Using technology to support health, well-being, and healthcare is called eHealth [5]. The use of eHealth can be of added value on several levels and is multifunctional to improve efficiency [5]. eHealth could be used through record sharing, remote care, assisted self-care, computerized care assistance, remote monitoring, administration and public health assistance, and aligning the care system with needs of the patient [6]. An example of an eHealth technology suited for phase two and three of rehabilitation is an electronic patient portal (EPP). Due to the many different applications of an electronic patient portal, it is often used in healthcare. Ammenwerth, Schnell-Inderst & Hoerbst [6] define electronic patient portals as "the class of applications provided and maintained by healthcare institutions that primarily allow access to clinical electronic health record data and secondarily may offer functions and services that are targeted towards enhancing medical treatment". Additional functions and services to patients can include appointment scheduling, secure messaging between patient and healthcare professional, medication refills, and access to general medical information such as guidelines and information about diseases [6]. 'MijnHartfalencoach' is an example of an electronic patient portal used in cardiac rehabilitation. It is a secure and personal page on the internet that helps the treatment of patients with heart failure in six different ways: through educational modules, reminders, weekly checks, periodic checks, an individual care plan, and being able to contact healthcare professionals [7].

There have been multiple studies on the perception of electronic patient portals and according to the systematic literature review of Kruse, Argueta, Lopez, and Nair [8], patients are concerned about the safety of secure messaging, the complexity of the portal design, the lack of guidance, and the inability to understand the information of the educational modules. Healthcare professionals expressed time management as their main frustration, as they would not have sufficient time to perform activities that are reimbursable [8]. Positive attributes of patient portals are patient-provider communication, secure messaging, educational resources, and user-friendliness. Negative attributes of patient portals include insufficient security, secure messaging, time management, and costs [8]. The identification of positive and negative attributes of a patient portal can serve as input for developing a new patient portal or improving an already existing portal. It is helpful to distinguish between attributes mentioned by patients and attributes mentioned by healthcare professionals when developing a patient portal, because it ensures a better fit between technology and user. Unfortunately, whether attributes are mentioned by patients, healthcare professionals, or both, is not always reported [8].

Healthcare professionals are one of the important stakeholders to involve in the development process of an EPP, as they may hold the key to increasing adoption by patients [9-11]. The study of Nazi showed the importance of healthcare professionals, as they can routinely endorse patient use [11]. Therefore, it is essential that healthcare professionals support the technology and use it themselves, for they have an exemplary function in using the

> ## CASE EXAMPLE
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> In this study, the electronic patient portal "mijn HEP" is used as an example of an EPP. "mijn HEP" is part of the Benefit program, supported by the Dutch heart foundation. The purpose of this portal is to give patients access to their own health data and motivate them to maintain a healthy lifestyle. Simultaneously, it allows the healthcare professional to give more personalized and better quality of care.

technology. To be able to get the healthcare professionals' support, they have to be involved during the development process [5]. Therefore, this study focusses on the views of the healthcare professional regarding the development of an EPP. The aim of this study is to elicit system requirements by uncovering the needs and values of healthcare professionals. For this, the following research questions will be answered with the use of a case example:

1. What are the needs and problems of healthcare professionals in supporting patients in cardiac rehabilitation?
2. What are the values of healthcare professionals in supporting patients in cardiac rehabilitation?
3. How can an eHealth technology fit the needs and problems of healthcare professionals in cardiac rehabilitation?

2. Theoretical framework

Over the years, different frameworks have been introduced for the development of eHealth technologies. Well-known theories are the Information Systems Success Model of DeLone and McLean [12, 13], the Technology Acceptance Model [14, 15], diffusion models and theories [16-18], and Human-Centered Design models [19, 20]. Each framework contributes to the development of an eHealth technology. However, none of these frameworks are addressing both the problems with diffusion, acceptance and adherence [19]. Therefore, the CeHRes roadmap has been introduced by the Center for eHealth Research and Disease Management. The purpose of this roadmap is to help plan, coordinate and execute the participatory development process of an eHealth technology [21]. The roadmap hints towards a holistic approach, meaning that each phase is connected to the previous phase and to the next [19]. If the content of one phase changes, other phases are affected. A holistic approach to developing eHealth is needed to ensure accessibility, applicability, manageability, enjoyability, and feasibility. Addressing the need for a fit between people, technology, and the context of usage during the development process is important. Without it, eHealth technologies risk being ineffective to support healthy living [19].
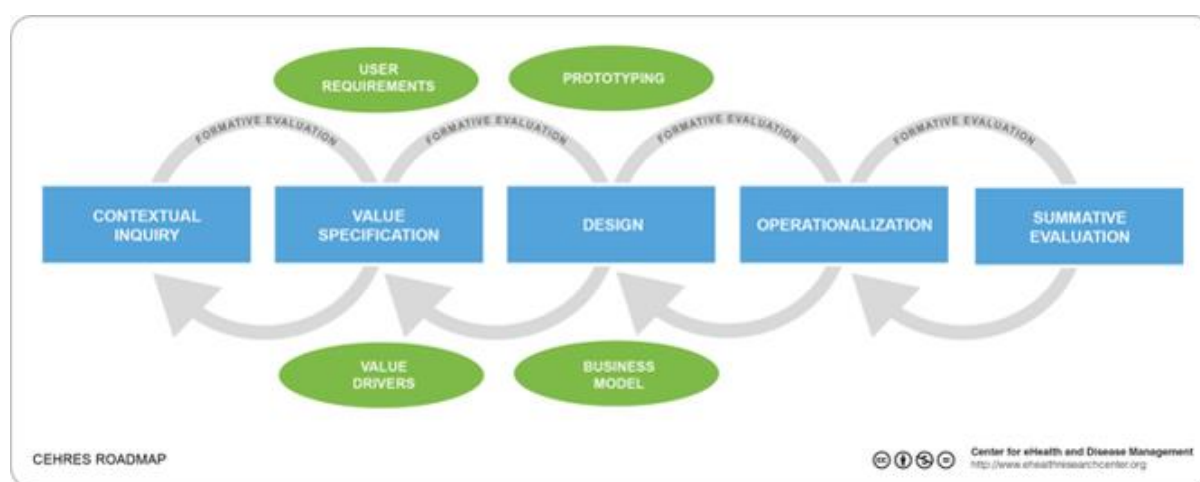

Figure 1: CeHRes roadmap [19].

Developing an eHealth technology starts with a contextual inquiry where the needs and problems of stakeholders are identified [19]. These results lead to the value specification to determine the added value of an eHealth technology. The previous outcomes will be translated into functional requirements and persuasive features for a prototype. Prototypes need to be evaluated by the stakeholders before the final design is made. After this, a business model is used to operationalize and implement the technology. After the technology is implemented, a summative evaluation is carried out to determine the effects on behavior, healthcare, and usage of the technology. Developing an eHealth technology is an iterative process. During this process, it is normal to take a step back and evaluate if what has been done matches the expectations of that phase [19].

Combining the first two phases of the roadmap leads to the drafting of requirements. The development of requirements is recommended before a technology can be designed, as requirements represent the design objectives [5]. Moreover, requirements are a way to evaluate the previous phases because requirements represent the wants, needs, and values of the user [5]. In addition, considering the case example this study uses, requirements can serve as a way to evaluate the current electronic patient portal called 'mijnHEP', to check if the current technology matches the wants and needs of the users. Note, evaluation is not a part of this study, but the results of this study can be used to evaluate a readily developed platform.

The roadmap has been used in other studies. For example, the study of Wentzel [22] used a large part of the roadmap to develop an eHealth technology to support clinical practice. Looking at the first two phases of the roadmap, Wentzel used two focus groups to do the contextual inquiry and value specification. The results of the second focus group enabled the development of requirements. In addition, these requirements were validated via on-site observations. This ensured that the requirements were compatible with the actual behavior of the end-users [22]. Another example of a study that used the CeHRes roadmap to develop technology is the study of Reblin and colleagues [23]. During their contextual inquiry phase, they performed a literature review, interviews, and focus groups with different stakeholders. Their value specification consisted of detailed and purpose-driven interviews with stakeholders, which led to user needs, tool requirements, and feature specifications [23]. These examples show that the phases of the roadmap can be operationalized in various ways since the roadmap is merely a guide to developing technology with no mandatory methods. This study focusses on the first two phases (RQ 1 and 2) of the roadmap and follows through to the drafting of user requirements (RQ 3), as described in the next section.

3. Methods

Data were collected within the Benefit project by two researchers (JG & DB). In total 16 healthcare professionals from 11 different disciplines were interviewed. Of which, a neurologist, a cardiologist, a research-physician, a lifestyle coach, five nurse practitioners from different hospitals, a neurovascular nurse practitioner, a nurse practitioner from the general practitioner, a physician assistant, a psychologist, a coordinator from physiotherapy, a general practitioner (GP), and a physiotherapist. Semi-structured interviews were held, lasting approximately 60 minutes. These interviews were audio-recorded and verbatim transcribed. However, to promote feasibility of analyzing the transcripts by third-party members, the midsentence "ehm's" were omitted.

3.1. Data analysis

This study performs secondary data analysis through inductive coding of interviews according to the approach of Ritchie and Lewis [24] in the program Atlas.ti 8. First, an initial code scheme was made based upon recurring themes and ideas of the transcripts. With this code scheme, 3 transcripts were coded. Hereafter, negotiation and revision of the code scheme took place with an independent researcher (FS) until consensus was reached. This formed the final code scheme consisting of 4 main codes and 14 sub-codes, which was applied to all transcripts, including the first three. Additionally, 10% of the quotes were checked by an independent researcher (RG) on inter-rater reliability, meaning the extent to which two independent coders agree on the coding while using the same code scheme [25]. This resulted in a clearer description of the codes. The initial and final code scheme are included in Appendix 1. Second, quotes were exported to Microsoft Excel to further analyze the data. All quotes were checked by the researcher if they could be understood without further context. If not, the size of the quote was adjusted in Atlas.ti and exported to Excel.

3.2. Requirement development

Based on the multidisciplinary requirements development approach of Van Velsen and colleagues [26], the following steps were taken. First, attributes were determined by studying each quote. An attribute is formulated as a very short summary of the need or problem of the healthcare professional [26]. Healthcare professionals primarily express themselves through needs with attributes representing underlying values. Thus, attributes state the needs and problems of healthcare professionals. Quotes were grouped on attribute level and checked if attributes represented the quote by reading both quote and attribute once more. If necessary, attributes were revised.

Second, from reading the quote and attribute, the underlying values of that quote were determined. A quote could have more than one value. Values are ideals or interests the respondent has, the underlying reason why someone wants or needs what they want or need [26]. Quotes were grouped on value level and checked if values were formulated consistently. If necessary, values were revised. Third, based on the quote, attribute and corresponding value(s), requirements were formulated. Requirements specify the values of the end users into terms with which a system designer can work. Requirements should be formulated as specific as possible [26]. An independent researcher (RG) checked the formulated attributes and requirements and noted disagreements and suggestions. These findings were discussed and, where needed, requirements were adjusted. In the end, all requirements were classified into one of the following types: functional, content, usability & user experience, service, and organizational [26]. Each requirement was documented based on the Volere template [26], assigned a priority based on the MoSCoW method [27], and included in Appendix 2. The Volere template was slightly adjusted as the fit criterion is omitted. The reason for this is that fit criterion is the basis for evaluation and since evaluation is not part of this study, the fit criterion is not relevant.

4. Results

The results of this study are based on the secondary analysis of a data set collected in the Benefit project. In total, 16 healthcare professionals were interviewed. Of the 16 healthcare professionals, 5 had experience with using eHealth at work. Other characteristics such as age, gender, and work experience were not discussed during the interview. However, the physiotherapist and two nurse practitioners did mention their work experience. This is respectively 40 years, 12 years, and 5 years in their current function.

First, the needs and problems of healthcare professionals will be discussed to answer the first research question. Second, the values of healthcare professionals will be discussed to answer the second research question. Last, the requirements based on the attributes and values will be explained, to answer the third research question. All discussed attributes and values are used in the requirements elicitation. Attributes and values related to healthcare in general will not be discussed as they do not fit within the scope of this study. All explanatory quotes were originally in Dutch and translated to English to promote comprehensibility. The source of the quote is characterized by the respondent's number and profession.

4.1. Attributes

To identify the needs and problems of healthcare professionals (RQ 1), attributes were grouped into three categories: therapy, logistics, technology. These categories were based on the subcodes of the code scheme and the result of a discussion with an independent researcher (RG).

4.1.1. Therapy

This category includes the needs and problems healthcare professionals encounter while supporting their patients. All attributes in this category were mentioned by more than two different healthcare professionals. Six respondents expressed a need for good reliable information to provide to patients. As one respondent put it: *"Ehm, well, it's just a matter of knowing where people can go best and then knowing that that is not an industry, no pharmacists behind it, just reliable information"* (16, GP).

In addition, six respondents stated that they want to be able to provide patients with more information and support. For example, one respondent said: *"I think it would be good if especially in the beginning with the diagnosis you should provide very good guidance. Explaining what CVD means, what the consequences are, and then in a simple way. I think people need that; information, support, information from us, support from other healthcare professionals"* (14, nurse practitioner).

Five respondents expressed the importance of having no standard program for each patient. One respondent said: *"What I find most important is that there is no standard program. An individual program is determined during the conversation, both in terms of content and duration"* (1, physiotherapist). Although respondents do not want to provide patients with a standard program, four respondents stated that they do want to standardize the intake to find out what motivates patients. Table 1 presents an overview of all attributes within this category, accompanied by the number of individual sources (respondents) that stated the attribute and the frequency of how often it was mentioned in total between brackets. Lastly, an explanatory quote is provided.

4.1.2. Logistics

This category includes logistical needs and problems that healthcare professionals encounter during their daily work. Of the eight attributes in this category, four attributes were mentioned by more than two different healthcare professionals. Half of the respondents expressed losing sight of patients after cardiac rehabilitation as an obstacle in supporting lifestyle change. A quarter of the respondents hopes that the care chain continues. One respondent stated that: "*The time of the consultation is too short to go deeper into it. Then I hope that the chain that comes after me will pick it up. That you can give an impetus and put in your reference to the physio or dietitian: we have discussed this and that they are taking it up. The fact that that chain continues is very important*" (4, nurse practitioner).

Table 1. Therapy attributes

Attribute	# Respondents (frequency)	Explanatory quote
Need for good reliable information to provide to patients	6 (11)	"Ehm, well, it's just a matter of knowing where people can go best and then knowing that that is not an industry, no pharmacists behind it, just reliable information." (16, GP)
Provide patients with more information and support	6 (7)	"I think it would be good if especially in the beginning with the diagnosis you should provide very good guidance. Explaining what CVD means, what the consequences are, and then in a simple way. I think people need that; information, support, information from us, support from other healthcare professionals." (14, nurse practitioner)
No standard program for each patient	5 (8)	"What I find most important is that there is no standard program. An individual program is determined during the conversation, both in terms of content and duration." (1, physiotherapist)
Standardize the intake to find out what motivates the patient	4 (4)	"Actually, you should start the first consult with; this is the goal of this conversation and with a short test or questionnaire we will find out what kind of advice suits you and what motivates you." (3, research-physician)

Four respondents reported that their referral options were limited. Three respondents expressed the need for clear and transparent agreements about electronic contact. As one respondent put it: "*Also things you promise the patient you have to make true because otherwise it will work against you. So if you promise to call back within 24 hours, that must also happen*" (7, nurse practitioner). Table 2 presents an overview of all attributes within this category, accompanied by the number of individual sources (respondents) that stated the attribute and the frequency of how often it was mentioned in total between brackets. Lastly, an explanatory quote is provided.

4.1.3. Technology

This category includes the needs and problems healthcare professionals encounter when working with technology. Of the twelve attributes in this category, six attributes were mentioned by more than two different healthcare professionals. The majority of the respondents (9 out of 16) stated that while creating an overview of health values is time-consuming, they do want to see a trend in the data. For example, one respondent said: "*The hesitation is that we now have all the data and have to look at it per patient; both the heart film and the blood pressure, as the weight. That is just very time-consuming, and it does not give a good trend of the data because you have to see all data separately and therefore have to put all the data in succession yourself*" (12, nurse practitioner).

Table 2. Logistical attributes

Attribute	# Respondents (frequency)	Explanatory quote
Lose sight of patients after cardiac rehabilitation	8 (16)	*"What hinders your support in lifestyle change?* In particular that I have no insight into what happens after the HR. I have absolutely no idea if they continue, some people take a subscription here [at the gym], but I have no idea what percentage." (5, cardiologist)
Care chain must continue	4 (5)	"The time of the consultation is too short to go deeper into it. Then I hope that the chain that comes after me will pick it up. That you can give an impetus and put in your reference to the physio or dietitian: we have discussed this and that they are taking it up. The fact that that chain continues is very important." (4, nurse practitioner)
Referral options are limited	4 (4)	"Apart from quitting smoking, we do not have many things to refer people to." (10, physician assistant)
Clear and transparent agreements about electronic contact	3 (5)	"Also things you promise the patient you have to make true because otherwise it will work against you. So if you promise to call back within 24 hours, that must also happen." (7, nurse practitioner)
Clear agreements about who does what / when	2 (2)	"Well, what I wonder is who's keeping track? From a very practical point of view, I already receive many questions by email, but then you would make time for that and also who will do it. Is it something that the GP does or does it belong to a hospital procedure? You have to make agreements about that." (10, physician assistant)
Include more follow-up possibilities	2 (2)	"It would be good to also include follow-up moments in a rehabilitation program, to explicitly test the lifestyle changes. At the moment, this is difficult and hard to implement in the DBC structure." (1, physiotherapist)
More consultations	1 (1)	"If it would be possible to see the patient more often, you can understand better why some things just do not change." (16, GP)
The use of technology cannot take up more time	1 (1)	"In any case, I do not hope that it will take a lot of time [using the technology]." (14, nurse practitioner)

Moreover, the majority of the respondents (9 out of 16) indicated that giving patients insight into their own health values, stimulates them to maintain lifestyle change. As one respondent put it: "*If patients move and they measure blood pressure before, after and in between sessions, the blood pressure may be lower. Objective measurement values. When they see that, it works stimulating*" (5, cardiologist).

Half of the respondents (8 out of 16) stated that uploading health values automatically ensures a higher reliability of those values. By connecting measuring devices to the system, the data is more reliable compared to the manual entry of data. Thus, they have a need for reliable data.

Six respondents suggested that they would like to have an algorithm that gives some kind of notification when patients enter abnormal health values. As one respondent put it: "*It would make it much easier and more insightful if you get a kind of algorithm that gives you a warning when someone has a rhythm disorder, or a warning when someone has hypotension or hypertension, or if someone gained a few kilograms in a couple of days' time. So that you spend less time there plus you are warned earlier and less likely to overlook something*" (12, nurse practitioner).

In addition, four respondents want to see in one glance how the patient is doing, value-wise, and three respondents stated that they will not do the administration more than once. Table 3 presents an overview of all attributes within this category, accompanied by the number of individual sources (respondents) that stated the attribute and the frequency of how often it was mentioned in total between brackets. Lastly, an explanatory quote is provided.

Table 3. Technical attributes

Attribute	# Respondents (frequency)	Explanatory quote
Creating an overview is time-consuming, but I do want to see a trend in the data	9 (20)	"The hesitation is that we now have all the data and have to look at it per patient; both the heart film and the blood pressure, as the weight. That is just very time-consuming, and it does not give a good trend of the data because you have to see all data separately and therefore have to put all the data in succession yourself." (12, nurse practitioner)
Insight into health values can be stimulating	9 (20)	"If patients move and they measure blood pressure before, after and in between sessions, the blood pressure may be lower. Objective measurement values. When they see that, it works stimulating." (5, cardiologist)
We want reliable data	8 (14)	"Preferably connecting measuring devices to the system. People now enter data themselves. If you connect it, it is even more reliable." (5, cardiologist)
An algorithm that gives a notification when abnormal values are entered	6 (7)	"It would make it much easier and more insightful if you get a kind of algorithm that gives you a warning when someone has a rhythm disorder, or a warning when someone has hypotension or hypertension, or if someone gained a few kilograms in a couple of days' time. So that you spend less time there plus you are warned earlier and less likely to overlook something." (12, nurse practitioner)
See in one glance how the patient is doing (value-wise)	4 (7)	"You need to be able to see in one glance on which factors someone requires additional help, or not." (15, nurse practitioner)
I won't do administration more than once	3 (4)	"Every hospital location and rehabilitation works with its own IT systems. Of course we will not do administration in two systems." (13, coordinator physiotherapist)
Simple, user-friendly, clear, and transparent technology for both patient and healthcare professional	2 (2)	"It is very nice if you just have an easily organized system, otherwise it makes the threshold higher for people to use it." (10, physician assistant)
Using technology can be difficult for some users	2 (2)	"What I said: in terms of population, I wonder if all our patients are suitable for this. Also because people can be severely affected after a stroke, so that not everyone can actually operate a computer or have the insight to use a computer." (10, physician assistant)
Being able to see the patient and make a link	1 (1)	"That you see a picture of who the patient is in the portal. I really can not remember names and then I really do not know who it is anymore. It is always nice to see in the portal who the patient is, then I can immediately make a link." (15, nurse practitioner)
Wanting to support patients via technology	1 (1)	"I would like to take the step to supervising at a distance. Then it would be easy for me that I can guide patients with use of my phone." (13, coordinator physiotherapist)
Create a customized portal for the patient	1 (1)	"But I do think that when creating the portal, and I really like that, it is tailor-made." (1, physiotherapist)
Dependence on the internet	1 (1)	"Another technical problem, if the internet fails, everything is in the portal. We are totally depending on the internet." (5, cardiologist)

4.1.3.1. 'MijnHEP' patient portal

This subcategory includes the needs and problems of healthcare professionals with regards to the patients' side of the technology. Of the two attributes in this subcategory, one attribute was mentioned by more than two different healthcare professionals. A quarter of the respondents is concerned that patients feel overloaded and thus misinterpret information when they have access to test results. For example, when one asked about the risk of an overload of information, one respondent said: "*People can also interpret data incorrectly, so that they can lead a life of their own.*

Thus, we should not do that" (15, nurse practitioner). Table 4 presents an overview of all attributes within this category, accompanied by the number of individual sources (respondents) that stated the attribute and the frequency of how often it was mentioned in total between brackets. Lastly, an explanatory quote is provided.

Table 1. MijnHEP attributes

Attribute	# Respondents (frequency)	Explanatory quote
Overload of information and a possibility of misinterpretation of information when everything is given at once	4 (8)	"*I: What is the risk with that overload of information?* People can also interpret data incorrectly, so that they can lead a life of their own. Thus, we should not do that." (15, nurse practitioner)
Rewards should be transparent	1 (2)	"*I: What is your opinion about the use of a reward system to promote lifestyle change in cardiovascular disease patients?* I think it will help a lot, especially if you have a good reward system with a certain algorithm underneath, where people really get the feeling that I've done this now, coupled with this reward" (5, cardiologist)

4.2 Values

To identify the values of healthcare professionals (RQ 2), quotes and attributes were analyzed as described in section 3.2. This resulted in the following eight values:

1. Efficiency
2. Providing good quality of care
3. Personalized care
4. Having overview, being informed
5. Being in contact with the patient
6. Reliable data
7. Involve the patient
8. Integrated care

Values are the underlying reason why someone wants or needs what they want or need. It is possible that one attribute has more than one value. For example, the attribute "Standardize the intake to find out what motivates the patient" is partly because healthcare professionals want to provide good quality of care. By finding out what works for what patient, healthcare professionals can provide good quality of care. Moreover, by standardizing the intake, finding out the preferences of their patient is more efficient. Therefore, the underlying value of this attribute is also efficiency.

Of the eight values, only the first four will be discussed because these are mentioned by more than 10 respondents. The value 'efficiency' is deducted from 9 out of 27 attributes. Combined, these attributes were mentioned 55 times by 14 respondents. The value 'providing good quality of care' is deducted from 10 out of 27 attributes. Combined, these attributes were mentioned 44 times by 14 respondents. The value 'personalized care' is deducted from 6 different attributes. Combined, these attributes were mentioned 32 times by 12 respondents. The value 'having overview and being informed' is deducted from 3 different attributes. Combined, these attributes were mentioned 29 times by 11 respondents. Table 5 presents an overview of all values with corresponding attributes, accompanied by the number of individual sources (respondents) that stated the attribute, and the frequency of how often it was mentioned in total between brackets.

Table 2. Values and attributes

Attribute	# Respondents (frequency)	Value
Creating an overview is time-consuming, but I do want to see a trend in the data	9 (20)	Efficiency
An algorithm that gives a notification with abnormal values	6 (7)	
No standard program for each patient	5 (8)	
See in one glance how the patient is doing (value-wise).	4 (7)	
Standardize the intake to find out what motivates the patient	4 (4)	
I won't do administration more than once	3 (4)	
Simple, user-friendly, clear, and transparent technology for both patient and healthcare provider	2 (2)	
Using technology can be difficult for some users	2 (2)	
The use of technology cannot take up more time	1 (1)	
Total	**14 (54)**	
Need for good reliable information to provide to patients.	6 (11)	Providing good quality of care
Provide patients with more information and support	6 (7)	
Overload of information and a possibility of misinterpretation of information when everything is given at once	4 (8)	
Clear and transparent agreements about electronic contact	3 (5)	

Attribute (continues)	Frequency (# respondents)	Value
Referral options are limited	4 (4)	Providing good quality of care
Standardize the intake to find out what motivates the patient	4 (4)	
Limited follow-up possibilities	2 (2)	
More consultations	1 (1)	
Create a customized portal for the patient	1 (1)	
Dependence on the internet	1 (1)	
Total	**14 (44)**	
The information is personalized; in order to support and inform the patient better	7 (7)	Personalized care
Provide patients with more information and support	6 (7)	
No standard program for each patient	5 (8)	
Overload of information and a possibility of misinterpretation of information when everything is given at once	4 (8)	
Being able to see the patient and make a link	1 (1)	
Create a customized portal for the patient	1 (1)	
Total	**12 (32)**	
Creating an overview is time-consuming, but I do want to see a trend in the data	9 (20)	Having overview, being informed
An algorithm that gives a notification with abnormal values	6 (7)	
Clear agreements about who does what / when	2 (2)	
Total	**11 (29)**	

Attribute (cont.)	# Respondents (frequency)	Value (cont.)
Lose sight of patients after cardiac rehabilitation	8 (16)	Being in contact with the patient
Wanting to support patients via technology	1 (1)	
Total	**9 (17)**	
We want reliable data	8 (14)	Reliable data
Rewards should be transparent	1 (2)	
Total	**8 (16)**	
No standard program for each patient	5 (8)	Involve the patient
Include more follow-up possibilities	2 (2)	
Total	**6 (10)**	
Care chain must continue	4 (5)	Integrated care
I won't do administration more than once	3 (4)	
Total	**6 (9)**	

4.3 Requirements

To analyze the fit between technology and the needs and values of healthcare professionals (RQ 3), requirements were elicited from quotes, attributes, and values. These are documented based on the adjusted Volere template, as can be seen in Appendix 2. The template consists of the following aspects: requirement number; requirement type; value, attribute, and description of the requirement; rationale, a short statement justifying the need for this requirement; source, where source 2:5 is interpreted as interview 2, quote 5; priority, based on the MoSCoW method; conflicts with other requirements; and history, the date of creation. The requirements are classified into 5 different types as stated in section 3.2. Per type, the requirement based on the most individual sources will be elaborated, because it applies to the most situations. When requirements are based on the same number of individual sources, the requirement with the most sources in total will be elaborated. Requirements are ranked from most to least sources. This does not mean that requirement 1 is more important than requirement 2 or 10. In addition, analyzing the data showed that healthcare professionals tend to have ideas and suggestions of how and what patients would like or need in an EPP. These ideas and suggestions are translated to requirements and are given at the end of this chapter.

4.3.1. Functional

Functional requirements specify technical features of the technology. Table 6 presents an overview of all functional requirements. Respondents expressed a need for good and reliable information not only to provide to patients but also for themselves. This resulted in the development of requirement 1: "The system should be linked to external databases with scientific, reliable information to support the healthcare professional. This link must remain up to date." (Template 1). The rationale behind this requirement is that by providing healthcare professionals with reliable sources of information, supporting patients becomes easier. Since there is a lot of information available on the internet, healthcare professionals get questions of patients who do not know what information to trust and thus ask their healthcare professional for information. In addition, providing HCPs with easy access to reliable up-to-date information contributes to their possibility to provide good quality of care according to the latest standards.

Table 3. Functional requirements

#	Functional requirement	# Sources
1	The system should be linked to external databases with scientific, reliable information to support the healthcare professional. This link must remain up to date.	6
2	The system must give a signal to the healthcare professional when patients enter abnormal health values, such as a highly elevated blood pressure.	6
3	The system must enable the healthcare provider to provide information / data in parts (bite-sized chunks) to the patient.	4
4	The system should include an expert system where the healthcare professional can enter the patients' situation in order to automatically generate an advice schedule.	4
5	The system must be able to integrate information from other systems, such as an EPR.	3
6	The system should include an expert system where the healthcare professional can enter the patients' situation in order to automatically generate a training schedule.	2
7	The system should have a calendar function where the healthcare professional can set the time period for the patient to return.	2
8	The system could contain the possibility to link a photograph of the patient to the patient profile.	1
9	The system must contain a chat function to facilitate patient-professional communication.	1
10	It should be possible to supplement the anamnesis in follow-up consultations.	1
11	The system could be accessible to healthcare professionals both online and offline.	1

Template 1. Requirement 1

Requirement #: 1	Requirement type: Functional
Value: Providing good quality of care	Attribute: Need for good reliable information to give or refer to patients.
Description: The system should be linked to external databases with scientific, reliable information to support the healthcare professional. This link must remain up to date.	
Rationale: Healthcare providers have a need for reliable and up-to-date information for themselves to be able to give good quality care and to refer patients to reliable information when asked.	
Source: 18:12, 16:15, 2:1, 19:6, 16:8, 9:7, 10:4, 9:2, 18:13, 16:14, 9:6	
Priority: Should	Conflicts:
History: created January 14	

4.3.2. Content

Content requirements specify the content that needs to be communicated via the technology. A list of all content requirements can be seen in Table 7. Respondents appreciate having overview and being informed on their patients' health. Healthcare professionals have access to a patient's health values and stated that creating an overview of this data is time-consuming. Nonetheless, they do want to see a trend in the data regardless of the time it takes to analyze the data. This need and problem resulted in the requirement: "The system must provide a visual image of the patient's health values to the healthcare professional" (Template 2). Transforming the health data automatically into graphs is less time-consuming and thus more efficient compared to do this by hand. In addition, a visual image of the patient's health values enables the healthcare professional to spot changes in health values more easily and act on these changes if necessary.

Table 7. Content requirements

#	Content	# Sources
12	The system must provide a visual image of the patient's health values to the healthcare professional.	9
13	The system should contain recommendations and advice that the healthcare professional can give to the patient (either orally or digitally).	7
14	The system should include the possibility that healthcare professionals can upload and send / visualize their own content to the patient.	7
15	The system must display the relevant patient data quickly and clearly.	4
16	The system could provide an overview of all referral options to support the healthcare professional.	4
17	The system must contain a comprehensive anamnesis of the patient.	4
18	The system could be able to give an overview of the local sport possibilities for the patient.	1

Template 2. Requirement 12

Requirement #: 13	Requirement type: Content
Value: Efficiency Having overview, being informed	**Attribute:** Creating an overview is time-consuming, but I do want to see a trend in the data
Description: The system must provide a visual image of the patient's health values to the healthcare professional.	
Rationale: Healthcare providers want to be able to see immediately how health values develop over time. With the use of graphics, healthcare providers gain insight in these values and thus can give appropriate care. Showing these graphics to the patients can work stimulating, since graphics are usually easier to understand compared to numbers.	
Source: 5:11, 12:9, 18:8, 16:16, 13:1, 19:13, 5:17, 19:12, 14:2, 5:26, 5:27, 5:35, 9:16, 9:17, 18:3, 5:19, 9:18, 15:12, 12:14, 5:5	
Priority: Must	**Conflicts:**
History: created January 17	

4.3.3. Usability & user experience

Usability and user experience requirements specify how user experience factors should be integrated into the technology and the interaction design of the technology. A list of all usability and user experience requirements are shown in Table 8.

Table 8. Usability and user experience requirements

#	Usabilty & user experience	# Sources
19	The system must have a low-threshold for healthcare professionals.	7
20	Logging in must not consist of many actions.	2
21	The system must save time.	1
22	The system must be easy to operate for healthcare professionals.	1

Healthcare professionals stated that when it takes too much time or too many actions to do something in the system, they were less likely to use the system. Being efficient is important to HCPs, as it enables them to do more in the same amount of time and not waste time that is already precious. A system that has a low-threshold is all the more important for it can contribute to the efficiency of performing work-related tasks. Therefore, the requirement: "The system must have a low-threshold" was developed (Template 3). This requirement can be operationalized in different ways, some of which are expressed as individual requirements such as requirements 20 and 22 (Table 8). Other operationalizations of this requirement were not clear from the data provided and thus discussion with HCPs is needed to specify the requirement.

Template 3. Requirement 19

Requirement #: 19	Requirement type: Usability and user experience
Value: Efficiency	Attribute: Simple, user-friendly, clear, and transparent technology for both patient and healthcare provider
Description: The system must have a low-threshold.	
Rationale: Healthcare professionals stated that when it takes too much time or too many actions to do something in the system, they were less likely to use the system. Therefore, the system must have a low-threshold to use.	
Source: 6:7, 6:36, 2:9, 18:10, 5:23, 9:13, 15:11, 7:15, 5:30, 18:17	
Priority: Must	Conflicts:
History: created January 21	

4.3.4. Service

Service requirements specify how services like user support need to be organized. This category contains one requirement: "The system must provide technical support to the healthcare professional", which enables users to receive technical support when necessary (Template 4). For example, when the system is not working, or users are not able to log in, they need to be able to contact a helpdesk to receive technical support. Especially when first using the system, support needs to be available. Otherwise, there is a chance that users stop using the technology.

Requirement #: 23	**Requirement type:** Service
Value: Efficiency	**Attribute:** Using technology can be difficult for some users
Description: The system must provide technical support to the healthcare professional.	
Rationale: Both patients and healthcare providers need to be able to receive support when using the portal. Support can be given in the form of a manual, instruction video's or calling a hotline.	
Source: 10:11, 5:23	
Priority: Must	**Conflicts:**
History: created January 14	

4.3.5. Organizational

Organizational requirements specify how the technology should be integrated in working routines and in the organizational structure. A list of all organizational requirements can be seen in Table 9.

Table 9. Organizational requirements

#	Organizational requirement	# Sources
24	The system must be used in a multidisciplinary manner	4
25	Concrete agreements must be made about which healthcare provider is responsible for what within the system	2

Respondents expressed the importance of a continued care chain. The problem of not knowing if the next healthcare professional continues with your recommendations is solved if multiple disciplinaries use the same system, for it enables communication and collaboration. The requirement "The system must be used in a multidisciplinary manner" specifies that all healthcare professionals in cardiac rehabilitation should work with the same system (Template 5). If only a small part of the healthcare disciplines will use the system, collaboration and communication between healthcare professionals to give patient-centered and integrated care is not possible. Moreover, working with the same system provides the patient with one portal for all their personal healthcare information, instead of multiple portals each meant for a different part of their rehabilitation. This requirement is beneficial for both healthcare professionals and patients.

Requirement #: 24	Requirement type: Organizational
Value: Integrated care	**Attribute:** Care chain must continue
Description: The system must be used in a multidisciplinary manner	
Rationale: To be able to give patient centered care. It enables the healthcare provider to get an overall view of the patients and their context. For example, the cardiologist knows that the patient is seeing a dietician or a physical therapist. Moreover, it provides the patient with one portal for their personal healthcare information.	
Source: 8:1, 8:4, 2:4, 11:7, 19:2	
Priority: Must	**Conflicts:** Privacy. Not every healthcare provider should have access to all information (need to know basis).
History: created January 14	

4.3.6. Patient portal

Healthcare professionals have expressed ideas concerning the patient portal. The formulated requirements are not targeting the portal for healthcare professionals, but the portal for patients. These requirements are based on attributes and values of healthcare professionals, expressing what they would want for their patients. An overview of these requirements can be seen in Table 10.

Table 10. Patient portal requirements

#	Patient portal requirements	# Sources
26	The system must be capable to connect to the patient's measuring equipment (wearables)	8
27	The system must contain a disclaimer with the timeframe within which the healthcare professional answers a question posed by the patient	3
28	The system must contain an algorithm that awards the reward points	1
29	The system could contain different visualizations for the health overview to be displayed to the patient. The healthcare professional is be able to opt for an X number of options of visualizations related to the needs of the patient	1
30	The system could provide an overview of all lifestyle changes and their effects	1

Respondents expressed their need for a high reliability of data. Reliable data enables the healthcare professional to make careful adjustments to the patient's care plan or medication. The requirement: "The system must be capable to connect to the patient's measuring equipment" contributes to the reliability of data collected by the patient (Template 6). In addition, connecting wearables to the system to automatically upload health data is less burdensome to the patient compared to manually entering health data.

Requirement #: 26	Requirement type: Functional
Value: Reliable data	Attribute: Uploading health values automatically for a higher reliability
Description: The system must be capable to connect to the patient's measuring equipment (wearables).	
Rationale: By connecting wearables to the system in order to automatically upload data, healthcare providers believe it will produce more reliable data. Moreover, if data is uploaded automatically, it is less burdensome on the patient who does not have to do this by hand and there is a smaller chance of error.	
Source: 5:5, 19:10, 12:15, 10:10, 15:9, 18:8, 19:12, 5:26, 5:31, 5:29, 10:12, 16:7, 18:3, 13:12,	
Priority: Must	Conflicts: Privacy
History: created January 17	

5. Discussion

First, the research questions will be answered by discussing the main findings. Next, interesting results and its relation to literature will be discussed. Implications for this study, future research, and the theoretical framework will be considered. Last, limitations and recommendations will be given.

5.1. Main findings

Findings revealed the needs and problems of healthcare professionals with regards to performing work activities. An example of this is that HCPs have a need for good reliable information to provide to patients. Needs and problems concerning logistical aspects of their work entails losing sight of patients after cardiac rehabilitation and limited referral options. With the use of technology, healthcare professionals want to have insight into a patient's health values and need to be able to see a trend in this data. Healthcare professionals value efficiency, providing good quality of care, providing personalized care, and having overview and being informed. This contributes to the explanation of why healthcare professionals experience certain needs and problems. An eHealth technology can provide a solution to these needs and problems while meeting the values of healthcare professionals by linking to external databases with reliable information, provide a visual image of the patient's health values to the healthcare professional, give a signal to the healthcare professional when patients enter abnormal health values such as a highly elevated blood pressure, and provide technical support to users.

These results are partly in line with that of Haan [28], confirming that healthcare professionals are concerned that patients get overwhelmed and worried if test results are given without explanation. In addition, Haan suggested that healthcare professionals need to be able to receive technical support in order to successfully implement a patient portal, which is in line with the result of this study. Since the study of Haan [28] evaluated an already developed and implemented patient portal, there is no match between all findings. Haan did list specific suggestions with regards to the functionalities of the technology as a result of evaluating their patient portal. However, these suggestions concern additional functions next to the main patient portal [28], while this thesis focuses on functionalities concerning the main portal. Therefore, the results of both studies correspond for a small part. To illustrate, both studies mention the integration of information between systems, connecting the system to wearables, and being able to provide the patient with more information. Other suggestions of Haan [28] were to print data with the hospital logo to serve as evidence, authorizations to log in for another and to see who is authorized, and adding patient instructions to the portal.

5.2. Losing sight of patients

An interesting result of this study is that at least half of the respondents are concerned about losing sight of their patients after cardiac rehabilitation. It is interesting because similar results have not been found in literature. Possible explanations for this concern could be that healthcare professionals want to keep an eye on their patients because they care; healthcare professionals want to receive feedback on if what they were doing during rehabilitation actually results in lifestyle change; healthcare professionals want to know how many patients succeed in maintaining lifestyle change and why, to be able to provide better care to future patients; and healthcare professionals want to be able to prevent relapse, which is possible when healthcare professionals are able to keep an eye on their patients.

One respondent suggested that technology could provide a solution to this concern by monitoring patients at home with sensors and a portal where patients enter their health values. However, the respondent in question was somewhat reserved as to the specifics of this intervention: "*You also have to ask yourself how many professionals have to deal with this and how affordable does healthcare*

remain if you want to keep in touch with all people" (4, nurse practitioner). Another possibility is to let patients keep access to the EPP after their rehabilitation. This way, patients can still upload their health values and have low-threshold contact with a healthcare professional if needed. Moreover, there is still a check as healthcare professionals get a notification when there are big changes in the patient's health values, hopefully resulting in prevention of relapse. Unfortunately, the same questions posed by respondent 4 are applicable to this scenario. In addition, it is questionable if a solution should even be provided since there is also a personal responsibility of the patients themselves to maintain a healthy lifestyle. Therefore, this option should be further investigated on its necessity, and if so, applicability.

5.3. Patient portal

Another interesting result is that healthcare professionals, when asked, often had elaborate ideas of what their patients should want or do to change their lifestyle. It is interesting because healthcare professionals apparently know what patients need and want. Two respondents are currently researching the use of an EPP themselves and thus have firsthand knowledge on how the EPP is perceived by patients through receiving feedback. Consequently, expressing ideas of what patients should want or do, is somewhat justifiable. Other respondents base ideas on their experience with patients in their daily work. Another reason why healthcare professionals who express ideas of what their patients should want or do to change their lifestyle is interesting is because of the content of these ideas, as discussed in section 4.3.6. These ideas match almost entirely with the results of a fellow researcher (RG) who focused on the views of patients in cardiac rehabilitation regarding the use of an EPP [29]. Of the 5 requirements developed, 4 requirements matched with the results of Groeneveld. This shows that healthcare professionals can be seen as experts in the field of the needs and wishes of patients because of their hands-on experience.

The study of Groeneveld [29] focused on the views of patients regarding the usability of the current patient portal and how technology can support patients better. This resulted in similar findings regarding the use of technology as both research populations expressed concerns about the availability of technical support when working with the system and the level of user-friendliness.

5.4. Reimbursement and costs

An unexpected finding is the absence of concerns regarding reimbursement and costs, which is in contrast to earlier findings [8, 30]. This could partly be explained because of the structure of the Dutch healthcare system. Most healthcare professionals are getting paid per hour and not per patient by the hospital. Arguably, there is less stress on how many patients they see and how many actions they perform that are reimbursable. Another possible explanation is that, because this subject was not addressed by the interviewers for it was not part of the interview scheme, healthcare professionals simply did not think of reimbursement and costs. It could be argued whether this subject should have been included in the interview scheme since previous studies did find concerns regarding reimbursement and costs [8, 30]. An added value of discussing this subject with respondents would be to compare with previous findings and thus being able to confirm or contradict previous finding. On the other hand, the study of Haan and colleagues [28] did not find concerns regarding reimbursement and costs. This was performed in The Netherlands, whereas previous findings were found in studies performed outside of The Netherlands. Thus, all the more interesting to discuss this topic with respondents.

5.5. Theoretical framework implications

Using the CeHRes roadmap turned out to work pleasantly for the following reasons: it provides support to the researcher; it ensures that the goal is kept in mind; and it ensures linking back to a

previous phase when needed, to prevent skipping important components. Reflecting on the roadmap, it is believed as the right choice to guide this study compared to other frameworks or theories. The Technology Acceptance Model, for example, focusses more on users' acceptance and usage of technology and less on the development of technology [14]. Since this study performs the first steps to develop an eHealth technology, the CeHRes roadmap is more suitable.

The CeHRes roadmap advocates to use a holistic approach when developing an eHealth technology, involving multiple stakeholders. At the moment, this study only involved the healthcare professional, as that stakeholder is often overlooked [11]. Other stakeholders to involve are patients, as the study of Groeneveld [29] does, hospitals and rehabilitation centers, to start laying the foundation for implementation, and health insurance companies, to check for reimbursement possibilities.

Requirements were elicited using the approach of Van Velsen and colleagues [26]. This approach advocates for a step-by-step elicitation of attributes, values, and eventually requirements. During the phase of eliciting values, it appeared that while making the link from quotes to values, requirements often followed easily. Therefore, instead of separating the elicitation of values and requirements, it can be advocated to combine these steps into one step. Meaning that, instead of analyzing all quotes to determine the underlying values and then analyzing all quotes again to develop requirements, the researcher analyses all quotes once and determines values and requirements together. Nonetheless, it is important to document both values and requirements separately to safeguard transparency and replicability of the results.

5.6. Study implications
A positive characteristic of this study is that it follows a step-by-step plan to elicit requirements. During each step, the link was made to the original quote. This ensured that the attributes, values, and requirements represent the data. Another positive of this study is the diversity of healthcare professions. In total, 11 different professions were interviewed and according to the Dutch Rehabilitation Guidelines, there are 15 professions involved in cardiac rehabilitation [2]. However, despite the diversity in the study sample, the sample was small, leaving not enough room for generalizability of results and affecting the external validity.

While analyzing the data it became clear that eliciting requirements from quotes, attributes, and values is difficult without the opportunity to discuss all the data with another person. Even though there were moments where discussion with another person was possible, more moments were preferred. The reason for this encountered difficulty may be due to a researcher who is inexperienced with requirements elicitation. Another explanation is that a quarreling partner is simply needed to limit interpretation bias and to decrease subjective results. Reflecting on the methodology, it can thus be advocated that eliciting requirements in teamwork enables intense discussion to decrease subjective results, contributing to the external validity of this study.

This study could have benefitted from observing healthcare professionals during their workday. This way, the researcher gets a more complete image of the needs and problems of healthcare professionals, obstacles obvious to healthcare professionals and therefore not mentioned during interviews can be identified, and how technology could provide a possible solution. In addition, observations would enable the possibility to validate the developed requirements, as these can be checked on their applicability in the work environment [5].

5.7. Limitations and recommendations

Due to the use of data collected by other researchers, there was no influence on how many healthcare professionals from which profession were interviewed. From the 15 disciplines involved in cardiac rehabilitation, HCPs from 11 disciplines were interviewed. Cardiac rehabilitation focusses for a large part on lifestyle change and since a persons' diet is part of that, interviewing a dietician should have provided a valuable addition to the study sample. By not including a dietician, there is a possibility that certain insights are overlooked. Other disciplines who were not involved in this study are related to health insurance and a patient's work environment, such as company doctors, labor experts, and insurance doctors. With regards to the focus of the Benefit project, not including these disciplines in the study population makes sense. Benefit focusses on promoting and maintaining lifestyle change during and after cardiac rehabilitation and not on rehabilitation back to the work field [31].

In addition, only one healthcare professional per discipline was interviewed with the exception of the discipline nurse practitioner. Therefore, the answers of one healthcare professional are not generalizable as the opinion of all healthcare professionals in that discipline. Consequently, the external validity of this study is low. It can be argued that the external validity of this study would be higher if more healthcare professionals from each discipline were interviewed. Furthermore, this would enable the possibility to study the connection between discipline and needs and problems. At the moment, whether certain needs and problems are specific to a discipline or simply specific to that respondent, is not clear. Thus, further research with a larger study population is needed to study this connection.

The internal validity of this study can be considered as moderate since the code scheme was discussed with an independent researcher (FS) and inter-rater reliability of the quotes was performed by a different independent researcher (RG). The internal validity can be improved by evaluating if the identified values and requirements comply with the views of the respondents. Values can be evaluated through focus groups and requirements can be evaluated through focus groups and observing HCPs in their work environment. The latter enables the possibility to check if requirements are compatible with HCPs' work environment.

This study uses data collected within the Benefit project. The original aim of these interviews differs from the aim of this study as the original aim is broader than that of this study. Therefore, some interview questions were not relevant to this study, missing, or were formulated differently than desired. This led to omitting data not relevant to the use of technology. For example, this study could have benefitted more from questions such as: "Could you describe a typical workday?", instead of asking what the healthcare professional's function is and entails. The former could uncover more bottlenecks in the healthcare professional's daily work and provide more information on if and how the healthcare professional works with eHealth, compared to the latter. In addition, the use of this data limits the possibility to follow through on the answers from healthcare professionals. As a result of which additional information or clarification on certain subjects could not be requested.

This study showed that healthcare professionals have elaborate ideas of what they want in an eHealth technology. To develop a complete eHealth technology, additional studies will be needed that check if these requirements comply with the wants, needs, and values of healthcare professionals, as advocated by the CeHRes roadmap during a formative evaluation. In the ideal situation not restricted by time or recourses, this can be done by performing focus groups. Moreover, during these focus groups, the priority of the requirements can be determined. After the formative evaluation, the requirements can be converted to a design and implementation strategies can be made. However, in a more realistic situation, the next step in line with the roadmap is converting the developed

requirements into mock-ups and start usability testing with healthcare professionals. A simple design is often more reflective of requirements than words alone. During the usability tests, the requirements and mock-ups can be evaluated together and thus saving time and resources otherwise spend on evaluating results separately. In addition, evaluating results with healthcare professionals contributes to their sense of involvement and according to Van Gemert-Pijnen and colleagues, users who are involved in the development of an eHealth technology, are more likely to start and keep using it [19]. Thus, laying the foundation for the implementation of the technology.

6. Conclusion

The results of this study form the base of developing an EPP that will be supported and endorsed by healthcare professionals, possibly the key to further adoption by patients. In general, healthcare professionals have concerns about the use of technology, encounter difficulties in their daily work, and would like to see logistical changes. They value efficiency, providing good quality of care, and providing personalized care. When developing an eHealth technology, it is important that it contains at least the following functions: integrate information from other systems; give a signal to the healthcare professional when patients enter abnormal health values; connect to the patient's measuring equipment; and provide technical support to healthcare professionals. In addition, the system must display health values visually, as well as the relevant patient data to the healthcare professional. A system with a minimum of these functions should be well received by the target group healthcare professionals. Despite the previously mentioned limitations, the results of this study show great potential of using technology to tackle the needs and problems of healthcare professionals working in cardiac rehabilitation.

Further research in general should focus on whether and how losing sight of patients after cardiac rehabilitation should be resolved. In addition, why Dutch healthcare professionals are not concerned about costs and reimbursement regarding the use of technology might be interesting to study, since literature from other countries does find these concerns [8, 30].

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Appendix 1. Code scheme

Initial code scheme is based on four main themes. Namely, barriers (belemmeringen), promotions (bevorderingen), solutions (oplossingen), and wishes (wensen).

Table 4. Initial code scheme

Code	Betekenis
Belemmering	De handelingen, toepassingen, situaties of logistieke zaken die de zorgverlener belemmeren in het ondersteunen van de patiënt. Alles wat een negatieve invloed heeft.
Bevordering	De handelingen, toepassingen of technologieën die de zorgverlener bevorderen in het ondersteunen van de patiënt. Alles wat een positieve invloed heeft.
Oplossing	Zelfbedachte oplossingen voor bestaande problemen in de werksituatie
Wensen	Wat zorgverleners graag willen zien in hun werksituatie, wat ze zouden willen veranderen

Final code scheme

Table 5. Final code scheme

Code	Betekenis
Belemmering	Factoren die het revalideren belemmeren
Bel - logistiek	Logistieke factoren die het revalideren belemmeren
Bel - omgeving	Omgevingsfactoren die het revalideren belemmeren
Bel - patiënt	Patiënt-gerelateerde factoren die het revalideren belemmeren
Bel - technisch	Technische factoren die het revalideren belemmeren
Bel - zorgverlener	Zorgverlener-gerelateerde factoren die het revalideren belemmeren
Bevordering	Factoren die het revalideren bevorderen
Bev - feedback	Feedback geven aan de patiënt
Bev - logistiek	Logistieke factoren die het revalideren bevorderen
Bev - omgeving	Omgevingsfactoren die het revalideren bevorderen
Bev - patiënt	Patiënt-gerelateerde factoren die het revalideren bevorderen
Bev - technisch	Technische factoren die het revalideren bevorderen
Bev - zorgverlener	Zorgverlener-gerelateerde factoren die het revalideren bevorderen
Oplossing	Zelfbedachte oplossingen voor bestaande problemen in de werksituatie. Dit kan vanuit de zorgverlener bedacht zijn, maar ook vanuit de patiënt. Oplossingen zijn al geïmplementeerd
Opl - technisch	Een technische oplossing voor een bestaand probleem
Wensen	Wat zorgverleners zouden willen zien veranderen/gebeuren, maar wat nog niet zo is. Mogelijke ideeën over hoe een situatie er uit zou moeten zien.
Wen - logistiek	Wat zorgverleners zouden willen zien veranderen/gebeuren op logistiek gebied
Wen - technisch	Wat zorgverleners zouden willen zien veranderen/gebeuren op technisch gebied
Overig	Wel relevante informatie, maar past niet onder bovengenoemde codes. Vaak een voorbeeld van hoe het in de praktijk is

Appendix 2. Requirements documented in adjusted Volere templates

Requirement #: 1	Requirement type: Functional
Value: Providing good quality of care	**Attribute:** Need for good reliable information to give or refer to patients.
Description: The system should be linked to external databases with scientific, reliable information to support the healthcare professional. This link must remain up to date.	
Rationale: Healthcare providers have a need for reliable and up-to-date information for themselves to be able to give good quality care and to refer patients to reliable information when asked.	
Source: 18:12, 16:15, 2:1, 19:6, 16:8, 9:7, 10:4, 9:2, 18:13, 16:14, 9:6	
Priority: Should	**Conflicts:**
History: created January 14	

Requirement #: 2	Requirement type: Functional
Value: Efficiency Having overview, being informed	**Attribute:** An algorithm that gives a notification with abnormal values
Description: The system must give a signal to the healthcare provider when patients enter abnormal health values, such as a highly elevated blood pressure.	
Rationale: Healthcare providers want to know immediately when there is a change is the health values of their patients. This can prevent a relapse of the patient and the provider is able to give good quality care.	
Source: 12:10, 15:8, 17:3, 19:9, 19:10, 9:10, 18:6	
Priority: Must	**Conflicts:** Patients may not always enter their values in a correct way, thus this should be as easy as possible.
History: created January 14	

Requirement #: 3	Requirement type: Functional
Value: Providing good quality of care Personalized care	**Attribute:** Overload of information and a possibility of misinterpretation of information when everything is given at once
Description: The system must enable the healthcare provider to provide information / data in parts (bite-sized chunks) to the patient.	
Rationale: Healthcare providers want to be able to fulfill the need of information of their patients in a personalized way. For example, some patients want all available information, others are better served when information is provided in portions.	
Source: 18:14, 18:12, 19:6, 15:10, 18:2, 19:8, 5:6, 18:3	
Priority: Must	**Conflicts:** deciding on the content of the parts
History: created January 14	

Requirement #: 4	Requirement type: Functional
Value: Personalized care Involve the patient	**Attribute:** No standard program for each patient
Description: The system should include an expert system where the healthcare professional can enter the patients' situation in order to automatically generate an advice schedule.	
Rationale: For the healthcare provider; it is easier, faster, and evidence-based to set up a personalized lifestyle changing program for the patient to better support the patient. A knowledge-based system, also known as an expert system, is a computer system that represents specific knowledge of human experts and used to solve a problem within a certain area [32].	
Source: 17:8, 2:2, 7:11, 18:11	
Priority: Should	**Conflicts:** Expert system must be made and updated regularly
History: created January 17	

Requirement #: 5	Requirement type: Functional
Value: Efficiency Integrated care	Attribute: I won't do administration more than once
Description: The system must be able to integrate information from other systems, such as an EPR	
Rationale: The system must be compatible with already available systems in order to avoid extra work load of the healthcare provider. This way, systems do not operate parallel to each other, but interchangeable.	
Source: 2:10, 9:19, 9:20, 13:4	
Priority: Must	Conflicts: At the moment, healthcare organizations work each with their own system. Rights on these systems prohibit cooperation between systems.
History: created January 14	

Requirement #: 6	Requirement type: Functional
Value: Personalized care Involve the patient Efficiency	Attribute: No standard program for each patient
Description: The system should include an expert system where the healthcare professional can enter the patients' situation in order to automatically generate a training schedule.	
Rationale: For the healthcare provider; it is easier, faster, and evidence-based to set up a personalized training program for the patient. A knowledge-based system, also known as an expert system, is a computer system that represents specific knowledge of human experts and used to solve a problem within a certain area [32].	
Source: 17:2, 13:5, 13:2	
Priority: Should	Conflicts: Expert system must be made and updated regularly
History: created January 17	

Requirement #: 7	Requirement type: Functional
Value: Providing good quality of care	Attribute: Include more follow-up possibilities

Involve the patient	
Description: The system should have a calendar function where the healthcare provider can set the time period for the patient to return.	
Rationale: Healthcare providers want to know how their patients are doing. Instead of waiting until patients make an appointment, it should be possible that healthcare providers initiate making the appointment.	
Source: 17:7, 16:4	
Priority: Should	**Conflicts:**
History: created January 17	

Requirement #: 8	**Requirement type:** Functional
Value: Personalized care	**Attribute:** Being able to see the patient and make a link
Description: The system could contain the possibility to link a photograph of the patient to the patient profile.	
Rationale: Not all healthcare providers can remember the names of their patients. Therefore, it is useful to attach a picture of the patient to their profile.	
Source: 15:13	
Priority: Could	**Conflicts:** Privacy
History: created January 17	

Requirement #: 9	Requirement type: Functional
Value: Being in contact with the patient	Attribute: Wanting to support patients via technology
Description: The system must contain a chat function to facilitate patient-professional communication.	
Rationale: Healthcare providers want to be able to support their patients with the use of technology. This is possible via a chat function. Being able to chat with patients, questions can be answered more quickly, appointments are not always necessary, and thus it is more efficient in term of time and money.	
Source: 13:3	
Priority: Must	Conflicts: Privacy
History: created January 17	

Requirement #: 10	Requirement type: Functional
Value: Providing good quality of care	Attribute: More consultations
Description: It should be possible to supplement the anamnesis in follow-up consultations.	
Rationale: If there is information missing, or changing, the healthcare provider should be able to add or change the anamnesis.	
Source: 16:5	
Priority: Should	Conflicts:
History: created January 14	

Requirement #: 11	Requirement type: Functional
Value: Providing good quality of care	Attribute: Dependence on the internet
Description: The system could be accessible both online and offline.	
Rationale: If the portal is only accessible via internet and the internet malfunctions, healthcare providers cannot do their job properly. Therefore, it is necessary that the portal functions without the internet	
Source: 5:22	
Priority: Could	Conflicts: It is no longer a website when it should be able to function without the internet. It will become a program which needs to be installed on every computer. It is uncertain if this is achievable and if it is the purpose of the portal.
History: created January 14	

Requirement #: 12	Requirement type: Content
Value: Efficiency Having overview, being informed	Attribute: Creating an overview is time-consuming, but I do want to see a trend in the data
Description: The system must provide a visual image of the patient's health values to the healthcare professional.	
Rationale: Healthcare providers want to be able to see immediately how health values develop over time. With the use of graphics, healthcare providers gain insight in these values and thus can give appropriate care/therapy. Showing these graphics to the patients can work stimulating. Patients get a better overview of the effect of lifestyle changes on their health which promotes patient consciousness.	
Source: 5:11, 12:9, 18:8, 16:16, 13:1, 19:13, 5:17, 19:12, 14:2, 5:26, 5:27, 5:35, 9:16, 9:17, 18:3, 5:19, 9:18, 15:12, 12:14, 5:5	
Priority: Must	Conflicts:
History: created January 17	

Requirement #: 13	Requirement type: Content
Value: Personalized care	Attribute: The information is personalized; in order to support and inform the patient better
Description: The system should contain recommendations and advice that the healthcare provider can give to the patient (either orally or digitally).	
Rationale: Pre-made personalized and evidence-based recommendations can support the healthcare provider to give quality therapy and information to the patient. By enclosing these recommendations into the dossier/portal of the patient, the patient is able to check them (again) in their own time.	
Source: 6:15, 14:3, 8:2, 18:2, 16:14, 2:2, 17:5	
Priority: Should	Conflicts: Healthcare providers need to continue to check if recommendations are suitable to that specific patient.
History: created January 18	

Requirement #: 14	Requirement type: Functional/content
Value: Providing good quality of care	Attribute: Provide patients with more information and support
Description: The system should include the possibility that healthcare providers can upload and send / visualize their own content to the patient.	
Rationale: Healthcare providers often have more information to give to the patient than time allows. By being able to send the information via the portal to the patient, the information is still given, and the patient can check it in his/her own time at home. This way, no extra time is needed during the consult while patients receive extra information and support. For example, a physiotherapist who recorded her own fitness exercises for patients to do at home. If she is able to send those videos to her patients, they see a familiar face, receive more support on how to do the exercises, and know what exercises to do.	
Source: 2:5, 14:4, 6:8, 13:11, 8:10, 5:18, 6:17	
Priority: Should	Conflicts:
History: created January 17	

Requirement #: 15	Requirement type: Content
Value: Efficiency	Attribute: See in one glance how the patient is doing (value-wise).
Description: The system must display the relevant patient data quickly and clearly.	
Rationale: Time is limited during a consult. If the healthcare provider is able to see in one glance how the health values of the patient are doing, if the patient had any recent appointments with other departments, if there are new results of a test, etc., the mandatory actions take less time. And therefore, there is more time for answering questions the patient might have, or just paying attention to your patients. Something healthcare providers want to be able to do.	
Source: 17:8, 9:16, 9:17, 12:3, 9:5, 5:19, 9:18	
Priority: Must	Conflicts: It is complicated to specify the relevancy of patient data for each healthcare profession.
History: created January 14	

Requirement #: 16	Requirement type: Content
Value: Providing good quality of care	Attribute: Referral options are limited
Description: The system could provide an overview of all referral options to support the healthcare professional.	
Rationale: Healthcare providers are often unaware of all available referral options. By showing these options, healthcare providers can give better care to their patients.	
Source: 10:1, 15:3, 12:2, 7:6	
Priority: Could	Conflicts: The list of referral options can change, therefore it needs to be updated. Options are dependent on location.
History: created January 18	

Requirement #: 17	Requirement type: Content
Value: Efficiency Providing good quality of care	**Attribute:** Standardize the intake to find out what motivates the patient
Description: The system must contain a comprehensive anamnesis of the patient.	
Rationale: A standardized and comprehensive anamnesis of the patient ensures that the healthcare provider knows where to start with the therapy and what to expect from the patient. Identification of bottlenecks is easier. For example, knowing the diet of the patient can influence the given advice.	
Source: 18:4, 16:5, 6:23, 5:19	
Priority: Must	**Conflicts:** Time consuming
History: created January 14	

Requirement #: 18	Requirement type: Content
Value: Providing good quality of care Personalized care	**Attribute:** Provide patients with more information and support
Description: The system could be able to give an overview of the local sport possibilities for the patient.	
Rationale: A lot of patients are unaware of the sport possibilities in their environment. It is important that the patients exercise a sport to their liking, otherwise it is not sustainable. By showing a list of all sport possibilities, each patient can choose a sport they like. And thus, are more motivated to keep living healthy when cardiac rehabilitation ends.	
Source: 6:9	
Priority: Could	**Conflicts:** A list of all local sport possibilities should remain up-to-date
History: created January 14	

Requirement #: 19	Requirement type: Usability and user experience
Value: Efficiency	Attribute: Simple, user-friendly, clear, and transparent technology for both patient and healthcare provider
Description: The system must have a low-threshold.	
Rationale: Healthcare professionals stated that when it takes too much time or too many actions to do something in the system, they were less likely to use the system. Therefore, the system must have a low-threshold to use.	
Source: 6:7, 6:36, 2:9, 18:10, 5:23, 9:13, 15:11, 7:15, 5:30, 18:17	
Priority: Must	Conflicts:
History: created January 21	

Requirement #: 20	Requirement type: Usability and user experience
Value: Efficiency	Attribute: Simple, user-friendly, clear, and transparent technology for both patient and healthcare provider
Description: Logging in must not consist of many actions.	
Rationale: For both healthcare provider and patient, logging in to the portal should be as easy as possible. Otherwise, both users find it too difficult and will not use the portal.	
Source: 10:13, 6:36	
Priority: Must not	Conflicts: Privacy and security measures
History: created January 17	

Requirement #: 21	Requirement type: Usability and user experience
Value: Efficiency	Attribute: The use of technology cannot take up more time
Description: The system must save time.	
Rationale: Healthcare providers already have a limited time per patient. They want to be able to give attention to their patients. If the system/technology takes up more of their time, healthcare providers are less likely to continue using the portal. This can be achieved, for example, by the fact that the system takes over actions from the healthcare provider. Or that it is faster to do the administration compared to the current way.	
Source: 14:6	
Priority: Must	Conflicts: In the beginning, using the system will take up more time. This will decrease as the healthcare providers are more experienced in working with the system.
History: created January 21	

Requirement #: 22	Requirement type: Usability and user experience
Value: Efficiency	Attribute: Using technology can be difficult for some users
Description: The system must be easy to operate for healthcare professionals	
Rationale: More people can use the system if it is easy to operate. You can reach a larger target group by making the technology more accessible. For example, by working with icons and large buttons.	
Source: 10:11	
Priority: Must	Conflicts: The use of technology in healthcare is not suitable for every patient
History: created January 14	

Requirement #: 23	Requirement type: Service
Value: Efficiency	**Attribute:** Using technology can be difficult for some users
Description: The system must provide technical support to the healthcare professional.	
Rationale: Both patients and healthcare providers need to be able to receive support when using the portal. Support can be given in the form of a manual, instruction video's or calling a hotline.	
Source: 10:11, 5:23	
Priority: Must	**Conflicts:**
History: created January 14	

Requirement #: 24	Requirement type: Organizational
Value: Integrated care	**Attribute:** Care chain must continue
Description: The system must be used in a multidisciplinary manner.	
Rationale: To be able to give patient centered care. It enables the healthcare provider to get an overall view of the patients and their context. For example, the cardiologist knows that the patient is seeing a dietician or a physical therapist. Moreover, it provides the patient with one portal for their personal healthcare information.	
Source: 8:1, 8:4, 2:4, 11:7, 19:2	
Priority: Must	**Conflicts:** Privacy. Not every healthcare provider should have access to all information (need to know basis).
History: created January 14	

Requirement #: 25	Requirement type: Organizational
Value: Efficiency Having overview, being informed	Attribute: Clear agreements about who does what / when
Description: Concrete agreements must be made about which healthcare provider is responsible for what within the system.	
Rationale: Healthcare providers need to know where they stand concerning the use and responsibilities of the portal.	
Source: 10:9, 15:7	
Priority: Must	Conflicts:
History: created January 18	

Requirement #: 26	Requirement type: Functional
Value: Reliable data	Attribute: We want reliable data
Description: The system must be capable to connect to the patient's measuring equipment (wearables).	
Rationale: By connecting wearables to the system in order to automatically upload data, healthcare providers believe it will produce more reliable data. Moreover, if data is uploaded automatically, it is less burdensome on the patient who does not have to do this by hand and there is a smaller chance of error.	
Source: 5:5, 19:10, 12:15, 10:10, 15:9, 18:8, 19:12, 5:26, 5:31, 5:29, 10:12, 16:7, 18:3, 13:12,	
Priority: Must	Conflicts: Privacy
History: created January 17	

Requirement #: 27	Requirement type: Content
Value: Providing good quality of care	Attribute: Clear and transparent agreements about electronic contact
Description: The system must contain a disclaimer with the timeframe within which the healthcare provider answers a question posed by the patient.	
Rationale: It must be well communicated to the patient what he can expect from the chat in terms of reaction time and what it is meant for. To prevent miscommunication, unrealistic expectations and extra workload of the healthcare provider.	
Source: 15:7, 5:25, 5:24, 7:16, 7:13	
Priority: Must	Conflicts:
History: created January 14	

Requirement #: 28	Requirement type: Functional
Value: Reliable data	Attribute: Rewards should be transparent
Description: The system must contain an algorithm that awards the reward points.	
Rationale: Patients need to be able to relate the given rewards to their actions.	
Source: 5:28, 5:32	
Priority: Must	Conflicts:
History: created January 14	

Requirement #: 29	Requirement type: Content
Value: Providing good quality of care Personalized care	Attribute: Create a customized portal for the patient
Description: The system could contain different visualizations for the health overview to be displayed to the patient. The healthcare provider must be able to opt for an X number of options of visualizations related to the needs of the patient.	
Rationale: Some patients are really focused and motivated through numbers, other patients are more susceptible to colors. By responding to these preferences, the portal can be made customized to the patient and thus motivating the patient more to keep using the portal.	
Source: 18:5	
Priority: Could	Conflicts: It could be too much burden on the patient if he does not know what his preferences are. It could be too much burden on the healthcare provider because it leads to yet another task for him to do.
History: created January 14	

Requirement #: 30	Requirement type: Content
Value: Providing good quality of care	Attribute: No standard program for each patient
Description: The system could provide an overview of all lifestyle changes and their effects.	
Rationale: An overview of all lifestyle changes and their effects can support the healthcare professional when talking to their patients. Especially when the patient is not motivated to change his or her lifestyle, the overview ensures that all possibilities will be discussed.	
Source: 7:3	
Priority: Could	Conflicts: Not all lifestyle changes can be supported by scientific evidence.
History: created January 21	