Master Thesis

Adherence and engagement in eHealth technologies that support CVD patients in improving lifestyle after a cardiac event

Case study on the Benefit personal health platform to improve and maintain a healthy lifestyle

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Abstract

INTRODUCTION: Cardiovascular disease will remain to be one of the most common chronic illnesses in the near future. This is despite the fact that many events can be prevented by improving lifestyle. eHealth could support patients with the challenge to improve their lifestyle. Patients often quit early with a technology which causes that the technology is unable to support these patients in the long term. It remains hard for any technology to get patients engaged in the long term. Therefore, the main question from this study is: *"How can the long-term usage of eHealth technologies to improve lifestyle changes in CVD patients be enhanced?"*

METHODS: A mixed-method study was performed. First, a log data analysis of 639 long-term users of the Benefit personal health platform, which is used as a case in this study, was performed. The log data provided information on general use, platform components and lifestyle components. A Cox prediction model was created to test if dropping out can be predicted. Second, usability tests & interviews were held with twelve users of the Benefit personal health platform. An inductive coding scheme was used to discover the wishes and needs of the participants.

RESULTS: The results from the log data analysis showed that although non-adherent users used the platform longer on average, adherent users used it more intensely. Especially goal setting, self-monitoring and medical records were more used by adherent users. On average, adherent users looked at two more lifestyle components than non-adherent users. A Cox prediction model can predict drop-out based on the user's activity. Participants of the usability tests & interviews would value extended professional support and reminders to improve long-term engagement. Self-monitoring was the most appreciated features post cardiac rehabilitation. The platform components: chat, appointments and goal setting were appreciated by most participants. The usability tests & interviews also revealed the need to speed up use, to be able to look back at previously entered data and the ability to adjust data. Participants were often intrinsically motivated and said that suitable information would motivate them.

CONCLUSION: There is much to gain to improve long-term engagement to be able to support CVD patients during behaviour change. This study provided several preconditions and factors that influence engagement. The technological features goal setting, self-monitoring and reminders are effective in improving engagement. Participants from this and other studies expressed a need for suitable, credible and inspiring information. Participants would like to have had extended professional support after cardiac rehabilitation was completed. Motivation seems to be a key factor as it is both an independent factor and will influence other factors. Persuasive features' effectiveness might depend on the users' motivation level, demographics and stages of change. Future research needs to be done to find the most effective way to motivate users based on their characteristics and to research how technology can be more supportive in long-term behaviour change.

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1 Introduction

1.1 Cardiovascular disease and lifestyle

In the next twenty years, cardiovascular disease (CVD) is likely to remain one of the most common chronic diseases [1]. This will be despite the fact that around 80% of CVD are preventable by adopting a healthy lifestyle [2]. Previously experienced cardiac event is an important risk factor, as half of the cardiovascular events occur in patients who already have the disease [3]. Improved diagnostics and treatment for CVD have resulted in more patients surviving [4]. Therefore, the demand for secondary and tertiary care that aims to regain health and prevent recurrence will further increase. Cardiac rehabilitation (CR) is often the first step of care after hospital treatment. CR is given in hospitals or (cardiac) rehabilitation centers and starts several weeks after the event [5]. CR is a holistic approach that focuses on both physical and mental health [6]. The risk of developing an event is largely influenced by unhealthy living. Therefore, making lifestyle changes is an important goal of CR [7]. Although CR is successful in decreasing the chance of patients experiencing a CVD in the short term, the long-term results are less promising [6]. It can take a long time to transform established habits into long-term behavioural change [8]. According to the stages of change model transitioning newly learned behaviour from the action to the maintenance phase takes around six months. However, even then there is a risk of relapse [9]. Since CR is on average only six to twelve weeks, this period is too short to maintain behavioural change [10]. Consequently, in the first six months after completing CR, about 60% of the patients will relapse [11].

1.2 Advantages of eHealth

eHealth is defined as “health services and information delivered or enhanced through the internet and related technologies” [12]. eHealth has several advantages for the sharing of data between the health care professional and the patient. eHealth enables the health care professional to receive more data and at different times during the day from their patients, compared to what is possible during a regular check-up [8]. Health care professionals get notified when data is divergent. Quick action might prevent further deterioration and hopefully gets the patient on the right track again [4]. eHealth also got advantages for the knowledge of the patient. eHealth is often accessible 24/7 the patient can access it whenever they feel that they need it [13]. eHealth can not only help to share data from the patient to the health care professional, but also the other way around. If medical data is entered into the system, the patient is able to see his clinical results. Giving the patient more information about their health provides an opportunity to increase their self-management ability [13]. Often the technology itself is trying to motivate or demotivate behaviour. The technology can provide the patient with different messages to either encourage or discourage behaviour at the moment that the patient is at risk, providing timely support [14]. eHealth can be used during CR and to continue and extend support after CR is completed. eHealth technologies can support CVD patients in transforming their new learned short-term behaviour into maintained long-term behaviour [15].

1.3 Adherence and engagement

Although eHealth can support patients with long-term behaviour change, it is often hard for users to use the technology the way it was supposed to. This is where the terms adherence and engagement are introduced. Figure 1 provides a schematic overview of the relation between these terms. Adherence is defined by the WHO as “*the extent to which individuals should experience the content to derive maximum benefit from the technology, as defined or implied by its creators*” [16]. Adherence refers to the objective use of an eHealth technology. The term “intended use” can be used to describe the minimum use that is necessary to be adherent [16]. By measuring the usage of an eHealth

combined with a definition of intended use there is a distinction between adherent and non-adherent users. [17]. Several studies agree that more frequent use of a technology does not necessarily mean that the user is more adherent [16–18]. It might even be that instead certain experiences the user has while using the technology might increase effectiveness [19]. The user experiences are a combination of engagement and usability. Engagement is defined by Perski et al. as "*the extent of usage and a subjective experience characterized by attention, interest and affect*" [20]. Engagement is a multidimensional construct that consists of three components [19]:

- The behavioural component refers to the use of the technology. This is more extensive as it also includes making eHealth part of daily life. For example, a CVD patient would fill in his blood pressure every morning around the same time.
- The cognitive component explains how much users think that the technology will help them to reach their goals. A lack of knowledge to change behaviour is likely to result in the non-usage of technology to improve behaviour. Low health knowledge causes more adverse behaviour and influences the subjective experience of health [21]. A patient will first have to be informed and convinced that it is possible to reduce the risk of another event. CR is important to achieve this. If a user does not feel confident in using technology or does not see the added value in using technology the result will be non-usage of technology to reach behavioural change [22]. Since most CVD patients are older adults and therefore likely have a lower technology skill level, the technology has to be simple.
- The affective component is about the emotions involved when using the technology. If the technology fits with the identity of the user it is more likely that the affective component is positive [18]. The first period after a CVD event can be very emotional, the technology can encourage the user that change is possible. High engagement will increase the chance of an effective technology [23, 24].

Since engagement is important for long-term use, it is crucial to design a technology in such a way that the chance of engagement is high [19]. One way to improve engagement is by incorporating a combination of persuasive design and behavioural change techniques [24]. The combined term for this is persuasive features. The definition for persuasive features is "characteristics of a technology that influence the user's motivation and/or ability to make desired behaviour changes, or provide the trigger(s) for such change, without using coercion or deception"[25]. Another factor that influences engagement is usability. Usability relates to the quality of the technology in terms of easiness to learn and use it [12]. Usability and engagement together form the user experience. Usability and persuasive features will have a small direct influence on the adherence but will mainly affect engagement. High engagement is likely to improve adherence.

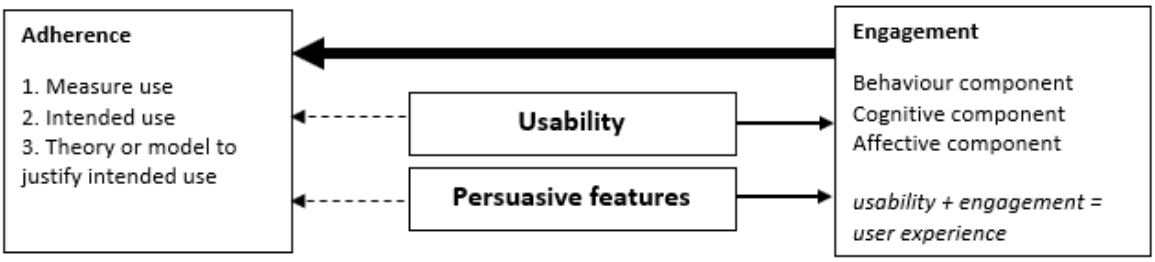

Figure 1: relationship between adherence, engagement, usability and persuasive features

1.4 Aim of this study

Engagement proves to be challenging for many eHealth technologies [4, 22, 24]. To achieve effective long-term usage of eHealth technologies for CVD patients it is important to gain insight into facilitators that motivate patients into adherent behaviour. The Benefit personal health platform is used as a case to find such facilitators. The Benefit personal health platform is a digital technology for CVD patients to improve and maintain a healthier lifestyle. By improving the engagement of an eHealth technology for CVD patients the likelihood that these patients will successfully continue to improve or maintain their health will increase. To achieve this the following main question needs to be answered:

"How can the long-term usage of eHealth technologies to improve lifestyle changes in CVD patients be enhanced?"

To be able to answer the main question four sub-questions need to be answered.

1. *How is eHealth currently used by CVD patients?*
2. *Which elements are associated with higher levels of adherence of CVD patients?*
3. *What are the long-term needs of CVD patients to improve and maintain a healthy lifestyle?*
4. *How can eHealth fulfill the needs of CVD patients?*

To be able to answer the research questions a mixed-method study consisting of log data analysis and usability tests & interviews was performed.

2 Methods

2.1 Mixed-methods approach

Quantitative and qualitative methods both have some advantages and disadvantages and can complement each other [23, 26]. Therefore, the choice was made to combine them. The log data analysis is the quantitative study. Log data analysis can provide information about the use of the technology for a large number of users without interfering with normal behaviour [27]. Although log data analysis can show interesting differences, it often remains unclear why these differences in use exist. Qualitative studies can only reach a small number of the total users, but it gives more insight in barriers and facilitators [4]. The qualitative method is the usability tests & interviews. In this study, the log data analysis provided insight into general use and difference in use from Benefit personal health platform users for a certain period of time. The usability tests & interviews were held after the log data analysis was completed and provides insights into the user experiences, barriers and facilitators.

2.1.1 Benefit personal health platform

The Benefit personal health platform is a technology for patients after a cardiovascular event, with the aim to prevent another event by improving lifestyle. It consists of a website and more recently a mobile application has been added. The platform is created by members of the Benefit consortium and is currently hosted by Vital10. Vital10 is a provider of eHealth that has been established by health care professionals. The Benefit personal health platform combines information from the patient's personal health record with their data. It is a multi-component technology aiming at many lifestyle factors [28].

Figure 2 shows a screenshot of the Benefit personal health platform dashboard. The Benefit personal health platform consists of twelve components. These components are:

- *Dashboard*: a quick overview of the patient's overall health, advice and activities.
- *Goals (doelen)*: the ability for goal setting and review progress. Challenge refers to the creation of new goals. Mission refers to looking at the progress of the current goals.
- *V-CHEQ*: this stands for challenges, homework, education and questionnaires.
- *Appointments (afspraken)*: an overview of appointments with the patient's health care professionals.
- *Health (gezondheid)*: an overview of different lifestyle factors, fill in information about them, add lifestyle factors and choose which can be viewed from the dashboard.
- *Advice (adviezen):* here patients get advice based on their data to improve their health. It is also possible to look at previous advice.
- *Medical records (dossier)*: the data shared by the patient's health care professionals are shown here. There were three types of medical records: health record (dossier), history (history) and care doc (zorgdoc)
- *Resources (hulpbronnen)*: links to apps or websites that focus on a specific lifestyle factor.
- *Information (informatie)*: links to brochures and websites can be found that relate to a lifestyle factor. There are also demo's about how to use the platform. Indicator refers to which lifestyle component was used.
- *Webshop*: patients earn points (v-points) for activity. These can be used to get discounts on health-related products or gift cards.
- *Chat*: the ability for the patient to chat with their health care professionals.
- *Help*: the ability to find instructions, manuals and the possibility to ask questions about the use of the platform.

The words between brackets are the Dutch words for these platform components.

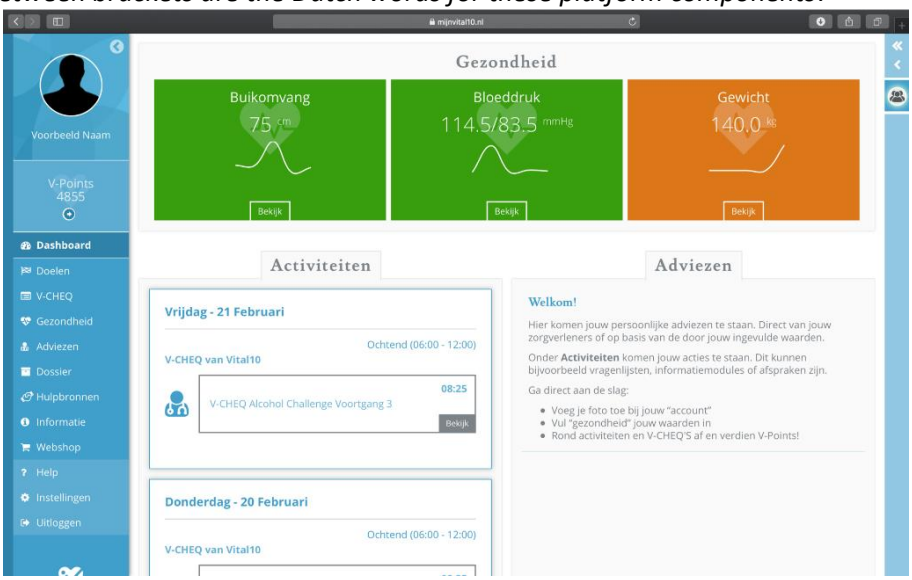

Figure 2: a screenshot of the Benefit personal health platform's dashboard

2.2 Study 1: log data analysis

2.2.1 Design

For this study, a log data analysis was performed for the Benefit personal health platform. Log data analysis is defined as "*anonymous records of real-time actions performed by each user*" [29]. The Benefit personal health platform is currently actively used by patients and health care professionals. Therefore, the log data analysis is used during the operationalization phase. The goal of the log data analysis was to get, insight into the current levels of use of the Benefit personal health platform, differences in use between adherent and non-adherent users and if non-adherence is predictable. The results from this study provide a starting point for the usability test & interview study. The log data analysis study will provide the answer for the first and second sub-question: "*How is eHealth currently used by CVD patients?" and "Which elements are associated with higher levels of adherence of CVD patients?".*

2.2.2 Dataset

The data used for this study had already been collected prior to the start of this study. The data is from users of the Benefit personal health platform in the period from 03-01-2020 till 15-03-2021 (437 days). All users have been invited by their health care professional after experiencing a cardiovascular event. Before first access to the platform, the user had to agree to the terms of use, which include the collection of anonymous data. No data on the characteristics of the users had been collected.

2.2.3 Data analysis

Data was anonymously collected from users during the above-described period. The raw data first had to be prepared by adjusting variables, creating new variables and categorizing users based on their activities. Data was prepared and analyzed with R version 1.3.1056. The original variables were Timestamp (date and time), UserID (unique user ID), HttpMethod (GET for receiving information from the platform, POST for posting information on the platform), ApiCall (the activity performed), V-cheq (assignments send to the user). Sessions were created. A session lasted at least sixty seconds and after thirty minutes of inactivity a new session began. New variables were created: session number (count

of sessions for a user), total sessions (maximum number of sessions for a user), total time used (total days of use), days between sessions (number of days between two sessions) and lapse ("days between sessions" > 7 days). The most important variables are summarized in table 1.

Table 1: variables necessary to categorize users for the log data analysis

Variable	Explanation
Timestamp	Date and time
UserID	Unique user ID
HttpMethod	GET for receiving information from the platform, POST for posting information on the platform
ApiCall	The activity performed, often the platform component
V-cheq	Assignments send to the user
Session number	Count of sessions for a user
Total sessions	Maximum number of sessions for a user
Total time used	Total days of use
days between sessions	Number of days between two sessions
Lapse	"Days between sessions" > 7 days

** Variables one to five are original variables (sometimes adjusted), variables six to nine are newly created variables.*

For the descriptive analysis users were categorized in starter, adopter-only, adherent and non-adherent. The starters are the users who started to use the platform less than three weeks ago. The adopters-only were the users who only used the platform for a short period. Research shows that many users stop using any eHealth within three weeks [3]. Since this study is about long-term use both adopter-only and starters were excluded. Any user who used the platform for longer than three weeks was either adherent or non-adherent. To be able to get a definition for adherence, the intended use had to be described. Members of the Benefit consortium have defined this as: *logging in at least weekly and filling in the vitality score weekly*. Every user can have some lapse in adherence as this is pretty common [30]. Therefore, not every user who has one lapse is labelled non-adherent. The vitality score is a scoring based on different self-monitored data, the healthier the lifestyle the higher the vitality score will be. Unfortunately, it was not possible to add the vitality score to the intended use because this was not collected separately in the log data. In table 2 the conditions for being labelled as non-adherent are explained. Only one of the variables has to apply to be labelled as non-adherent. Every user on who none of the variables from table 2 apply is labelled as adherent.

Table 2: conditions for being non-adherent

Variable	Explanation
4 weeks of non-usage	"Days between sessions" > 28 days
Too many lapses	The total number of lapses is higher than allowed for the "total time used" by the formula: "total time used" * 0.034 < "lapse". 0.034 means that one lapse is allowed every 30 days (one month).
Stopped using	The last "timestamp" is earlier than 2021-02-15 (four weeks before the end of the log data) or "total time used" < 364 (one year)

Only one of the variables has to be true to be labelled as non-adherent.

To be able to say more about the difference in use between adherent and non-adherent users more variables were created: session length (describes how long a session took in minutes) and mean total days used (the sum of "days between sessions" divided by "session number"). Mean total days used explains the average time in days between using the platform. For each platform component two variables were made. The first explains if this platform component was used (yes or no) and the other

is called “sum variable name” and is for the Cox prediction model. Each platform component could be used once per session and the sum of how often this is used explains this variable. The same two variables were created for each of the lifestyle components. Table 3 shows the variables that were created to explain the differences between the categories.

Table 3: variables created to explain differences between categories

Variable	explanation
Session length	The length of a session in minutes
Mean total days used	The sum of “days between sessions” divided by “session number”, explains the average time in days between using the platform.
“Platform or lifestyle component”	Explains if the platform or lifestyle component was used by a user. For example, “advice” = yes, explains that the user did use advice.
Sum”platform or lifestyle component”	Explains how often a platform or lifestyle component was used by a user during the first twenty sessions. One component could only be used once per session. For example, “sumadvice” = 6, means that the user used advice 6 times in twenty sessions.

The Cox prediction model was created based on the performed descriptive analysis [31]. The cox prediction model predicts an event, the session in which a user will go from adherent to non-adherent. Although some non-adherent users did continue using the platform after an event, all sessions after an event were deleted. The model was allowed to predict an event up to four sessions before the event. Because use changed over time and most users became non-adherent in the first fifteen sessions the model was created to predict an event in the first twenty sessions. Session one to three were used to create a baseline for the user. Users were censored after session twenty. The data was divided into training data (80%) and test data (20%). The model was created with the training data. A two-step feature selection was applied consisting of the individual Kaplan-Meijer significance and the combined Cox prediction relative risk and significance score [32]. The model calculates for each variable: (x – mean(x))*coefficient(x). The test data is used to test the accuracy of the model. This is shown in the confusion matrix.

2.3 Study 2: usability tests & interviews

2.3.1 Design

In usability testing you provide the participant with a version of the technology to test its functionality, navigation and interaction. Usability tests are used to find usability issues, barriers and facilitators [4, 33]. In this study, version 1.78 of the Benefit personal health platform is used. This was the current operationalized version of the platform. Approval for this study was given by the Behavioural, Management and Social Sciences (BMS) ethics committee of the University of Twente. The informed consent form can be found in Appendix 1 (in Dutch). In the usability tests, the participants were asked to perform certain scenarios, share their personal experiences with the feature and were asked about their valuation of the feature. For example, participants were asked to perform the task of entering a weight of 80 kg, if they filled in self-monitored data on their account and how they value the self-monitoring component. All requested scenarios can be found in the protocol in Appendix 2 (in Dutch). The usability tests were held with the "thinking aloud method" to receive more information about the thoughts of the participants [20]. The more overarching questions about the adoption, duration of use and social support were requested in the supplementary interviews, which were held directly after the usability tests. The usability tests & interviews were conducted between 31-03-2021 and 24-05-2021. This study had some overlap with the previous usability test & interview study that was held between July and October 2020 and focused on new users. Many interview questions were (almost) equal to the ones from the previous usability test and interview study, providing more data. The goal of this qualitative study is to get insight into the usability, discover which features CVD patients value and ways to implement a technology for CVD patients. The usability tests & interviews answered the third and fourth sub-question: "*What are the long-term needs of CVD patients to improve and maintain a healthy lifestyle?*" and "*How can eHealth fulfill the needs of CVD patients?*".

2.3.2 Participants & procedure

The participants were users of the Benefit personal health platform. Participants were recruited by mail and phone call from the interviewer. When permission was given by mail the interviewer called the participant to give additional information and answer potential questions. Before the appointment participants received two emails. The first one was the confirmation of the appointment with attached the participant information form, including the conditions of informed consent. The second email was sent several days before the appointment and contained the link to the Microsoft Teams appointment. At the start of the appointment, the interviewer and study were introduced. The informed consent was explained step by step. Approval of the informed consent was asked at the start of each recording. The usability tests & interviews were held with a predefined protocol, which can be found in appendix 2 (in Dutch). The usability tests & interviews took between 32 and 97 minutes. Because of the COVID-19 virus, all usability tests & interviews were held online through Microsoft Teams. The inclusion criteria were that the participant was using the platform for at least three months and that the participant is able to open the appointment in Microsoft Teams. The exclusion criterion was not being able to speak or understand Dutch.

2.3.3 Data analysis

All usability tests & interviews were recorded through Microsoft Teams. The recordings were transcribed and coded by CS. Due to technical issues with the sound of one of the recordings it was not possible to transcribe this usability test & interview. Instead, the notes that were written during and directly after the interview were used for analysis. inductive coding schemes based on technology and implementation were created by CS. The coding schemes were checked by JW and BB and multiple times adjusted by CS until the final coding schemes were created.

3 Results from the log data analysis

3.1 General use

A total of 953 users were invited to use the platform. Of the 930 users that actually used the platform, 639 users (68.7%) were long-term users. After the first three months, the number of sessions per month at least doubled. On average the long-term user has had 27 sessions. A session took 14 minutes on average. The average length of a session decreases from 35.9 minutes for the first session to 11.1 minutes for session eight and beyond. On average the platform was used 110 days (range: 21 – 392 days). Half of the users who quit using the platform did this in the first twelve sessions. The chance of quitting to use the platform is higher during the first fifteen sessions with an average risk of 4.2% per session of stopping (range 2.3 – 6.8%) compared to a risk of 1.8% in the next 10 sessions (range 1.1 – 2.6%). Over 36% of the users have a total number of sessions that represent at least one session per week. Users were most active between 9 AM and 1 PM. Table 4 provides an overview of the general usage statistics.

Table 4: general usage statistics

Number of sessions	27 sessions*
Session length	14 minutes*
First session length	35.9 minutes*
Length of session eight and beyond	11.1 minutes*
Total time used	110 days*
50% has quit using the platform	Session 12
Time that the platform is most used	9 AM till 1 PM

** Variables are averages.*

Difference between adherent and non-adherent users

Of the long-term users, 31 users (5%) were adherent and 608 users (95%) were non-adherent. Two-third of the non-adherent users did not use the platform for a consecutive period that was longer than four weeks and one-third of the non-adherent users had too many lapses. Interestingly, non-adherent users have on average 112 days of use while adherent users' average is 75.9 days. On the other hand, adherent users use the platform more intensively. The differences between the two categories can be seen in table 5.

Table 5: difference in general use averages between adherent and non-adherent users.

Variable	**Adherent**	**Non-adherent**
Users (%)	31 users (5%)	608 users (95%)
Total time used	75.9 days	112 days
Days between sessions	2 days	6.8 days
Total number of sessions	39.3 sessions	17.5 sessions

3.2 Platform components

The system was able to receive log data from seven components of the platform. In addition to the original platform components, information was collected on reminders. Some platform components are divided into multiple components. This is explained in the caption of Table 6. Table 6 shows the differences in platform component usage per category. Log data did not provide the insight if users actually used a specific component of the platform. Therefore, the assumption was made that if the user viewed it, the platform component was actually used. Dashboard is not included because this

was a combination of advice, health and v-cheq. Since the chat, appointments, help-function and webshop were linked to other parts of the website it was unfortunately not possible to get log data from these platform components.

Table 6: difference between usage of platform components by category

	Adherent		Non-adherent		Total	
	Yes (%)	No (%)	yes (%)	No (%)	Yes (%)	No (%)
Advice	31 (100)	0 (0)	608 (100)	0 (0)	639 (100)	0 (0)
Challenge[1]	30 (97)	1 (3)	483 (79)	125 (21)	513 (80)	126 (20)
Mission[1]	31 (100)	0 (0)	486 (80)	122 (20)	517 (81)	122 (19)
Health[2]	28 (90)	3 (10)	376 (62)	232 (38)	404 (63)	235 (37)
Record[3]	28 (90)	3 (10)	384 (63)	224 (37)	412 (64)	227 (36)
History[3]	29 (94)	2 (6)	515 (85)	93 (15)	544 (85)	95 (15)
Care doc[3]	25 (78)	7 (22)	267 (43)	350 (57)	292 (45)	357 (55)
Indicator[4]	31 (100)	0 (0)	608 (100)	0 (0)	639 (100)	0 (0)
Information[4]	20 (65)	11 (35)	320 (53)	288 (47)	340 (53)	299 (47)
Resources	17 (55)	14 (45)	348 (57)	260 (43)	365 (57)	274 (43)
Reminders	20 (63)	12 (37)	207 (34)	410 (66)	227 (35)	422 (65)
V-cheq	31 (100)	0 (0)	593 (98)	15 (2)	624 (98)	15 (2)

The rows represent the eleven platform components from the log data. The columns represent both user categories and the calculation of both categories combined. [1]challenge and mission refer to goal setting, [2]health refers to self-monitoring, [3]Record, history and care doc refer to medical record, [4]indicator and information refer to information.

Advice

Advice is a central feature of the Benefit personal health platform. It is located on the dashboard and in the platform component “advice”. Since all users used advice, it is interesting to see that there is a difference in the number of times that it is used. The average use of advice is 38.6 times for adherent and 17.1 times for non-adherent users. Since the average number of total sessions is almost equal, for both adherent and non-adherent, it seems to be that all users used it during each session.

Goal setting

Challenge, the creation of new goals, is more often used by adherent users (97%) than non-adherent users (79%). Mission refers to looking at the progress of challenges. Mission was used by all adherent users and by 80% of the non-adherent users. Both challenge and mission are higher in adherent users. Adherent users seem to be more concerned with setting goals to improving their lifestyle.

Self-monitoring

Either at the dashboard or in the platform component "health" a user could enter their measurements for self-monitoring. Measurements could either be entered manually or automatically. 90% of the adherent users and 62% of the non-adherent user entered data into the platform. Automatically entering data was used by 70% of the adherent users and 34% of the non-adherent users (automatic measurements are not shown in the table). Adding measurements either manually or automatically seems to increase adherence.

Medical records

In the features: record, history and care doc, the user could view their medical data. History was viewed most often and care doc the least by all users. Although care doc is the feature for personal data it was only used by 78% of the adherent users. 85% of the non-adherent users watched their medical history, but only 63% checked their record. For care doc, this percentage drops to 43%. All features that refer to personal data are higher in the adherent category, especially the differences for record and care doc are large.

Information

All information on the website is checked for trustfulness. There are links to brochures and websites that have credible information. Information is shared in advice, indicator and information. Since advice was previously explained it will not be mentioned again. Indicator refers to the different lifestyle factors and will be explained in the next paragraph. Platform component information was only used by 53% of the users. The difference between the categories is small, with 65% for adherent users and 53% for non-adherent users. Although adherent users did use information more it does not seem that information is increasing adherence.

Resources

Resources refers to external apps or websites that focus on a particular lifestyle component. The difference in the use of resources is only 2% in favor of the adherent users. In total, 57% of the users did look at the resources. There is a limited difference in use for both categories, making it unlikely that the use of resources will either increase or decrease adherence.

Reminders

There were two types of reminders that a user could receive. One was receiving reminders at the moment they logged in to the platform. These reminders mostly referred to how the user is progressing with a certain goal or lifestyle factor. The other type was a reminder that there were activities, often v-cheqs, for the user on the platform. This type of reminder was sent by email or text and is not logged in the data. Because the first type of reminders was sent to users working on their goals it is already more likely that adherent users received these more often as these users more often set goals and use the platform more often in general. 63% of the adherent users received reminders versus 34% of the non-adherent users.

V-cheq

Nearly all users (98%) filled in at least one v-cheq. All adherent users and 98% of the non-adherent users. Questionnaires from the user's healthcare worker, often related to CR, were one of the most commonly used v-cheqs. Two third of these v-cheqs were sent in the first 20 sessions.

3.3 Lifestyle components

The component indicator from the previous table represents if users did look at the possibility to get more information on lifestyle components. All users looked at least at one lifestyle component. The platform had a large list of lifestyle components. The ten lifestyle components that were included in this study have been chosen because at least 10% of the users have looked at them. In table 7 a list of the use of lifestyle components for adherent, non-adherent and total users is shown in descending order.

Table 7: difference between usage of lifestyle components by category

	Adherent		**Non-adherent**		**Total**	
	yes (%)	**No (%)**	**Yes (%)**	**No (%)**	**Yes (%)**	**No (%)**
Exercise	31 (100)	0 (0)	511 (84)	97 (16)	542 (85)	97 (15)
Alcohol	25 (81)	6 (19)	390 (64)	218 (36)	415 (65)	224 (35)
Blood pressure	29 (94)	2 (6)	340 (56)	268 (44)	369 (58)	270 (42)
Nutrition	19 (59)	13 (41)	337 (55)	280 (45)	356 (55)	293 (45)
Steps	18 (58)	13 (42)	216 (36)	392 (64)	234 (37)	405 (63)
Weight	14 (45)	17 (55)	206 (34)	402 (66)	220 (34)	419 (66)
Pulse	17 (55)	14 (45)	165 (27)	443 (73)	182 (28)	457 (72)
Stress	14 (45)	17 (55)	150 (25)	458 (75)	164 (26)	475 (74)
Sleep	15 (48)	16 (52)	131 (22)	477 (78)	146 (23)	493 (77)
Smoking	10 (32)	21 (68)	117 (19)	491 (81)	127 (20)	512 (80)

The rows represent the ten lifestyle components in descending order for total use. The columns represent user categories and the calculation of both categories combined.

All components were watched more often by adherent users. By far, the most used lifestyle component was exercise, this was viewed by 85% of all the users. All adherent users and 84% of the non-adherent users looked at this component. The second most used lifestyle component is alcohol which was used by 65% of all users. Blood pressure and nutrition are viewed by 58 and 54% of all users. The other components were viewed by less than half of the users: steps (37%), weight (34%), pulse (28%), sleep (23%), stress (26%) and smoking (20%). The biggest difference in use between adherent (94%) and non-adherent (56%) users is for blood pressure. Users who used this component were more likely to measure it regularly, making it more likely to stay adherent. Pulse and sleep were viewed twice as much by adherent users than non-adherent users. Adherent users used on average 6.2 components compared to 4.2 components for the non-adherent group.

3.4 Cox prediction model

A model was created that predicts the risk of dropping out. Data was separated into 80% training data and 20% test data. Training data was used to make the model. The accuracy of the model was tested with the test data.

Feature selection

The training data was used to create the model, starting with the feature selection. There were two steps in the feature selection starting with the individual Kaplan-Meijer. All possible independent variables were independently placed on a Kaplan-Meijer curve. Variables were labeled as significant with a p-value ≤ 0.05. The Kaplan-Meijer significance test excluded: length per session (0.08), mean session length (0.39), platform component challenge (0.48), platform component record (0.28) and lifestyle component weight (0.21). In the second step, the remaining variables were added together in a Cox prediction model. Variables with the lowest significance value were stepwise removed until all variables were significant with a p-value ≤ 0.05. The platform components history (0.71), measurements (0.51), mission (0.61), information (0.15) and reminders (0.76) were removed. The lifestyle components steps (0.73), stress (0.94), nutrition (0.27), sleep (0.11), pulse (0.06) and smoking (0.22) were removed. If any variables crossed the relative risk value of one these were removed as well. This was the case with variables sum session length (RR 1.00 – 1.00) and alcohol (RR 0.98 – 1.23).

The Cox prediction model

The remaining variables are used to make the Cox prediction model, these are: mean total days used, platform components advice, care doc, resources and vcheq and lifestyle components blood pressure, exercise and pulse. Figure 3 shows the hazard ratio for each variable. It shows how the variables influence the risk of an event. Advice, resources, vcheq, blood pressure and pulse are protective factors. A larger "mean total days used", more use of platform component care doc and lifestyle component exercise does increase the chance that a user becomes non-adherent.

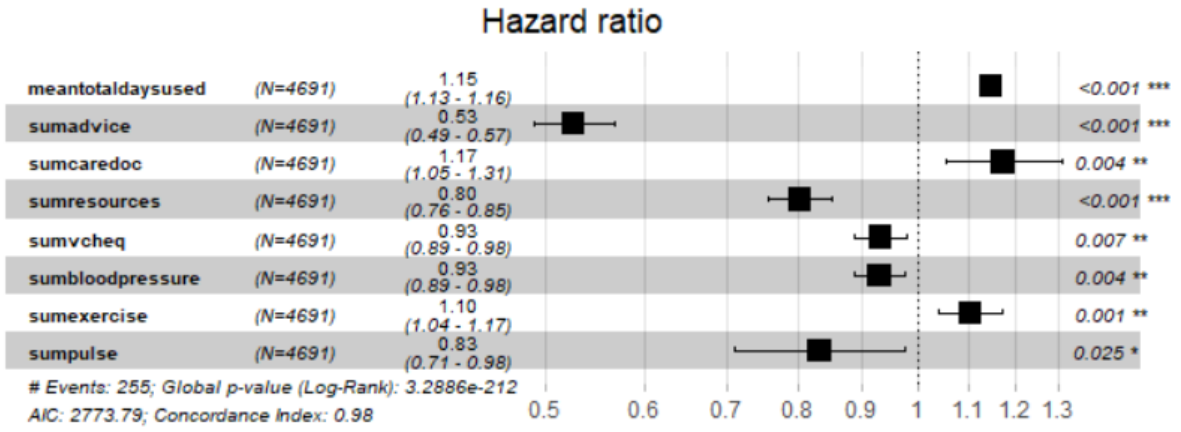

Figure 3: forest plot of the hazard ratio / relative risk ratio for the remaining variables

With the coefficient and the mean for each variable the model can be created:

$((x_{meantotaldaysused} - 2.9123463) * 0.13597) + ((x_{sumadvice} - 8.0449797) * -0.64160) + ((x_{sumcaredoc} - 0.6732040) * 0.15998) + ((x_{sumresources} - 1.2246856) * -0.21874) + ((x_{sumvcheq} - 3.5898529) * -0.06829) + ((x_{sumbloodpressure} - 2.3500320) * -0.07086) + ((x_{sumexercise} - 2.5109785) * 0.09821) + ((x_{sumpulse} - 0.5376252) * -0.184644)$

The goal of the model is to predict if a user will experience an event and so become non-adherent. Ideally, this will be predicted in advance so that action could be taken to prevent this. The model was allowed to predict the event up to four sessions before the event happened until that the current session was the actual session with the event. For example, a user had an event in session eight, so the model was predicting this right in sessions four, five, six, seven, or eight. The difference in the Cox linear predictor value for a session is compared to that of the previous session. The difference that is allowed differs between each session. The allowed difference has been calculated manually from the training data.

The accuracy of the model

The test data was used to test the accuracy of the model. The test data includes 86 unique users. 63 of the users experienced an event in the first twenty sessions. The model was able to predict this at the right moment for 50 users (79.4%). The model most often predicted an event at the session of the event, this happened 37 times (74%). In 13 cases (26%) the model was able to predict non-adherence in advance. There were 13 non-adherent users for whom the model did not predict an event, falsely classifying these users as adherent. Only one user out of the 23 adherent users (4.3%) was falsely predicted as experiencing an event. Table 8 shows the confusion matrix for the number of right predictions with the right timing. The accuracy of the model is (50+22)/86 = 83.7%.

Table 8: the confusion matrix for the Cox prediction model (including right timing).

	Predicted		
	Non-adherent **N** **(%)**	**Adherent** **N** **(%)**	
Actual: non-adherent	50 (79.4)	13 (20.6)	63 (73.3)
Actual: adherent	1 (4.3)	22 (95.7)	23 (26.7)
	51 (59.3)	35 (40.7)	86 users (100%)

4 Results from the usability tests & interviews

4.1 Participants

Twelve participants participated in the usability tests & interviews. Of the twelve participants, 11 (91.7%) are male and one is female (8.3%). In table 9, a list of the gender, age and condition for each participant is shown. The average age is 55 years (range: 49 – 74 years).

Table 9: overview of gender, age and condition for each participant.

Respondent #	Gender	Age	condition
1	Female	DNS*	Congenital heart disease
2	Male	63	Heart surgery
3	Male	64	Second heart attack
4	Male	66	3 heart attacks + pacemaker
5	Male	63	Heart surgery
6	Male	49	Heart surgery
7	Male	58	Heart attack
8	Male	74	Preventive vascular surgery + Stent
9	Male	48	Cardiac arrest after a heart attack
10	Male	48	Poor heart muscle + ICD
11	Male	64	Poor left ventricle + multiple heart attacks
12	Male	56	Genetic heart condition + preventive stent + angina pectoris

*DNS = did not state.

Participants were asked about the changes in lifestyle from before and after the event. Most participants already did some form of exercise, like walking or cycling, before the event. For some participants, the event triggered them to become either active or more active. For nutrition it was the other way around: some participants already paid attention to what they ate, but for most, the event triggered a healthier diet. Participants try to eat less salt, less unhealthy fats, less red meat and consume more fruit and vegetables. Attention to other lifestyle components like stress, sleep, alcohol and weight was mostly triggered by the event. Six out of the twelve participants had the need for professional support after CR was completed. Professional support was given by the physical therapist for exercise or by the dietician for nutrition and weight. Two participants are currently following a general lifestyle technology that focuses on multiple lifestyle components.

4.2 Technology

The first results relate to technology. Technology refers to the usability, looks and purpose of the technology. Since this technology is meant to support behaviour change, it is important that the technology is informative, motivational and contains features to improve behaviour change. The results are shown in table 10. In total 198 comments were made about the technology.

Table 10: code scheme for technology

Code & definition	*Subcode & variables*	$N_{interviews}$	N_{total}
Ease of use	**Learning to use the technology**		
Anything said about how easy or hard it was to learn and use the technology	The technology is easy to learn on your own	4	4
	Instructional videos helped to learn what the possibilities of the technology are	4	4
	No personal support for early use	2	3
	Using the technology		
	Navigational issues	11	37
	Simplify or speed up use	9	19
	Ability to save or look back at entered data and information	5	9
	Ability to adjust previously entered data	4	6
		12	**76**
Layout	The technology should have a calm and consistent appearance	3	8
Comments on looks and style	Features should be easy to find and have a prominent place	2	2
	Adjusting the menu, with submenus, would make it easier to know what can be found in each menu	2	2
	Colors and signs ensure that it is quickly visible when it deviates	1	1
		6	**13**
Information	Graphs provide a quick, visual overview	10	10
Remarks about the language, text and graphs.	Information should be complete and correct	6	14
	Information should be interesting and suitable	6	12
		12	**36**
Motivation	Intrinsically motivated to improve my health	4	4
If the technology did inspire and encourage to improve lifestyle.	The reward is not worth it	4	4
	Suitable and credible health information motivates me to use a technology	3	5
	A financial incentive motivates me	2	2
	An increase in points motivates me	2	2
	Providing information in an inspiring way would motivate me	1	2
	Consequences about unhealthy behaviour would motivate me to improve my lifestyle	1	1
		12	**20**
Valuation of features	**Chat**		
Experiences with regard to the values and functions of the technology	Chat is a useful way to communicate with health care professionals	7	7
	Would have preferred a more personal way to contact the health care professional	4	4
	Chat helps to lower the access threshold to contact the healthcare provider	2	2
	Goal setting		
	No desire to create short-term goals	4	6
	Setting goals makes you more aware to work on your lifestyle	3	3
	Setting goals helps to improve your lifestyle step by step	3	3
	Would prefer to be able to set multiple goals at the same time	3	3
	Would like to see an example of a correct goal	2	2

Self-monitoring		
Easy to keep track of values	6	6
Would like to receive feedback on self-monitored data	3	3
Would like to self-monitor other health-related components	2	2
Challenge to get all lifestyle components to healthy	1	1
Personalization		
Personalizing my technology helps to focus on the most important things	6	6
Do not mind having to make the extra effort to find personally relevant information	3	3
Nonpersonal information gives me a bad feeling	1	1
No desire to personalize the technology	1	1
	12	**53**

Results for technology are shown in descending order. $N_{interviews}$ relates to in how many interviews the subcode was mentioned, N_{total} explains how often a comment about a variable was made.

4.2.1 Ease of use

Two participants made a remark about not having any human support in learning the technology. Other participants mentioned that this technology was relatively simple to learn on their own or found the instructional videos helpful in learning the possibilities that the technology has to offer.

"The very first time that I logged in I received my account details, but no one was there to go through it in the first place, so I had to search a bit." (Participant 10)

Although most participants did not directly address the need for support in learning the technology, none of the participants were able to complete all tasks from the usability test without help. For all participants at least one and at most three features that were asked during the usability test were unknown. Navigational issues and technical issues (technical issues not included in the table) caused problems in the usability of the technology. The most common navigational issue was that the participants expected to find the answer in another menu. It was not clear to the participants what could be found in each menu. One feature of the technology had a link to an external webpage. Several participants had some remarks about returning to the website from the technology. One participant was unable to return without help.

"Then it goes to the website and then it loads the webshop again… But you say that if you click twice on the arrow? I did not know that. Yes, now we are back. I've never experienced double-clicking. (Participant 8)

Other navigational issues had to do with buttons that were either not standing out or "hidden" at the bottom of the page. The usability tests also revealed multiple technical issues. Since these are platform-specific, they will not be mentioned here. Participants expressed the need to simplify or speed up the technology. Participants that had a smartwatch or another connectable device would have liked to connect it to the technology so data could be transferred automatically. This would both simplify and speed up the self-monitoring feature. Other functions that could be simplified are the question if you would like to save changes and to replace the drag and drop function, as several participants were unable to perform this without help. Some participants mentioned that logging in is complicated because of the security code that is sent by mail. Two participants mentioned that they would like to receive an email when new information is added to avoid the need to log in to see if there is something new. The corresponding app was named as a way to be able to quickly enter self-monitored data or look if there is anything new. Participants also expressed the need to be able to

look back at previously entered data. Data includes questionnaires, measurements, information and advice.

"I miss that you fill out these questionnaires and never see them again. That you cannot print it in the right way without having to make screenshots. I have not been able to find a print function anywhere so far. It's a questionnaire and you can do something with that, but beyond that, you do not see much of it after that. I think that's a disadvantage." (Participant 4)

A last-mentioned necessity is the ability to adjust data. Participants would like to be able to adjust their data that is either incorrect or has changed. Adjusting goals was mentioned several times as goals changed over time. Participants also mentioned the ability that the health care professional, who is able to send questionnaires, is able to adjust these.

4.2.2 Layout

Although layout was not specifically asked during the usability tests & interviews half of the participants commented on it. The most common need was to have a calm and consistent appearance of the technology. This can be reached by improving the clarity of the technology, the use of more contrast in text, being consistent with styles and the possibility to use dark mode. A second comment was that features should be placed in such a way that these are easy to find and use. Participants mentioned that the menu could be changed in such a way that it provides more information about what can be found there. One participant mentioned that the use of different colors and signs was positive in quickly showing when something is deviant.

"No, I would really carefully think about the user interface. What I maybe would do is: left you have all those categories, but I would maybe expand them, for example, so that you can quickly see where you can find something." (Participant 2)

4.2.3 Information

Asking about the self-monitoring graphs was part of the usability tests. Most participants have a positive view about the use of graphs for providing quick, visual information. Several participants said that the graphs are limited. These participants would like to get more explanation about the results from the graph and would like to have incorporated goals and prognoses in the graph.

"It is not as nice as the graph on [health app] because there, if the app knows that you are trying to lose weight, it also has a target weight that you want to go to and what is a healthy weight loss pattern. This only gives a graph about a fact, it does not give a prognosis, it also does not indicate whether it is healthy what you are doing, it does not say anywhere that you are overweight, that your BMI is too high. It's just a snapshot of what is there." (Participant 12)

Participants would also like to see a list of the corresponding numbers from the graph. Besides the limitations in the graph, the need for complete and correct information was expressed. Several times the meaning of words was unclear. Information about health or a certain lifestyle component was sometimes too limited. There was one occasion where information was incorrect. Participants also expressed the need to know how algorithms were scored.

"There are a number of things that work with an algorithm that I do not want to see at all because they are not clear. Because someone is declared unhealthy if they drink a glass of alcohol a year. Then you are unhealthy right away. No, it is not stated, that it is unclear. For example: a lifestyle score of 7 out of 10 means that you have little stress, which is healthy. But how this score is reached, I do not know." (Participant 11)

Another need is that for interesting and suitable information. Several participants said the information did fit their personal level of knowledge. Comments on how interesting information was, were that information was repeated too many times, there was too much text to read and that the text was little inspirational.

4.2.4 Motivation

The current way the technology tries to motivate users is by providing a financial incentive. This seems to work for only two participants. Some participants say that the reward is not in proportion or that there are limited health-related products for sale. Four participants stated that they are intrinsically motivated to use the technology. Several of the intrinsically motivated participants even had a negative association with the financial incentive.

"There are things that I find very strange. Webshop and that scoring make me very grumpy. I do not think health is something to play with. I do not like that kind of stuff. I think that comes across as very commercial for something that is very serious to a lot of people and I actually find that really strange." (Participant 9)

Two participants said that an increase in points worked motivating. Participants were asked about how they could be motivated. The most named way to motivate is by providing suitable and credible health information. One of these participants would like the information in a more inspiring way by the use of multimedia. One participant said that being reminded about the consequences of not changing behaviour would be motivational.

4.2.5 Valuation of features

Four persuasive features were evaluated. Chat was named as a useful way to communicate with their health care professionals by most participants.

"I would not want Vital10 just to click on things. At a certain point, you also have the need or wish to talk to someone, whether that is through chat or on the phone. This makes it a bit more personal [chat] and this makes it more distant [left menu]." (Participant 3)

Other participants mentioned that they would like a more personal way to contact their health care professional. The main named advantage of a chat is that both users can answer when they have time. Participants said that chat lowered the threshold to contact their health care professional. Through chat, it is also possible to get into contact with different health care professionals. Since the chat was answered by their health care professional, all experiences varied.

"I do find it useful. You can ask a question and they will answer when they have the time. And then, you can see for yourself when you have time for it again so it's not that you really have to be available for a call." (Participant 1)

The valuation of goal setting varied. Four participants did not feel the need to set short-term goals. Reasons were that this short-term goal setting makes things unnecessary complicated, that goals could not be measured due to problems with self-monitoring and that they only desired long-term goals. Five participants did say that goal setting helps to improve lifestyle by making them more aware and providing step by step support.

"It will help you to make choices towards your goal. I see these as useful handles that you are guided a little. Because let's be honest, the things that were there all have to do with the situation you're in and then it's only useful if you get a little help with that." (Participant 3)

Participants also expressed the need to be able to set multiple goals at the same time and to get some support in creating a correct goal. Half of the participants said that self-monitoring made it easy to keep track of values. They explained that digital entry is preferred over paper, especially for the long term. Digital entry also makes it easier to share with their health care professionals. Participants would like to get feedback on their self-monitored data to know if they are on the right track or get support to improve.

"I enter things, but nothing happens. Right now, it says I have a blood pressure of 200/140 and no one has responded to that." (Participant 12)

Response on self-monitored data had to be given by the health care professionals so just like with the chat response would vary depending on the health care professionals involved. One participant said that he created the challenge to get all lifestyle tiles to green. As a final feature, the valuation of the personalization of the technology was asked. This response varied. Half of the participants explained that they would like personalized technology. One of the participants said that general information causes a bad feeling.

"Then I get the feeling that it is a general story and not specifically intended for you." (Participant 6)

Four participants explain that they do not mind it if they need to make an extra effort to find relevant information. One of these participants does not feel the need to personalize the technology.

4.3 Implementation

Table 11 shows the result for implementation. In addition to a well-functioning technology, implementation is also very important. Implementation refers to getting to know the technology and how use is promoted. For implementation all possible users are important. For example, in the Benefit case use was promoted by the rehabilitation coaches by adding questionnaires for the participants to fill in through the platform. In total 146 comments were made.

Table 11: code scheme for implementation

Code & definition	*Subcodes*	$N_{interviews}$	N_{total}
Adoption *Anything said about the introduction to the technology*	Would prefer to combine the use of technology with the start of cardiac rehabilitation	3	3
	Would prefer to be able to use the technology directly after hospital discharge	3	3
	Would prefer to be able to use the technology even before hospital admission	1	1
		7	**7**
Use over time *Comment that explains how the technology was used during cardiac rehabilitation and post-rehabilitation*	**During cardiac rehabilitation**		
	Being able to enter self-monitored data was a reason to use the technology during cardiac rehabilitation	4	4
	Having an overview of my appointments was a reason to use the technology during cardiac rehabilitation	4	4
	Being able to communicate with my health care professional was a reason to use the technology during cardiac rehabilitation	3	3
	Being able to read lifestyle information was a reason to use the technology during cardiac rehabilitation	2	2
	Post-rehabilitation		
	Use fades because there is no need to look	6	6
	Problems with connecting devices led to the use of an alternative	4	4
	No ability for professional advice/support	3	5
	Not able / allowed to join online sessions	2	2
	Continue to self-monitor	3	3
	Helps with behaviour change, but limited support in maintaining	1	1
		12	**46**
Social support *Remarks about contact with others or wishes for human assistance*	It would not be useful for family and friends to have their own account to support me through the technology	12	12
	Would not share data with friends	7	7
	Possibility to get professional feedback on the basis of measurements and activities	5	9
	Health care professionals can support and motivate me in moving in the right direction	5	8
	Would share data with relatives	5	5
	Technology as an addition to usual care	2	2
	Peer support		
	No need to have contact with peers through the technology	7	7
	Would appreciate the ability to have peer support through the technology	2	2
	Hard to find users in a similar situation because of the diversity	3	3
	No need for contact but it would be interesting to read about other´s experiences	1	1
		12	**56**
Integration of medical data *Experiences and values over the sharing of data either from the health care professional to*	Would appreciate one central place for their medical record	11	11
	Would agree to share medical data between involved health care professionals	10	11
	A health-related technology would not be an appropriate place for my medical data	7	9
	Looking at medical records through other channels	4	4
	Would only like medical records that relate to lifestyle	1	1
	Health care professionals should ask the user for consent to share data	1	1
		12	**37**

the participant or vice versa	

Results for implementation are shown in descending order. $N_{interviews}$ relates to in how many interviews the subcode was mentioned, N_{total} explains how often a comment about a variable was made.

4.3.1 Adoption

Most participants were introduced to the technology at the start of CR. Answers about the best moment to start to use the technology were divided. Some participants liked to combine the use of the technology with the start of CR. This way they had the opportunity to partially recover and had support in what the technology can offer. Other participants would prefer to be able to use the technology soon after discharge to receive tips and tricks about how to behave even before CR starts.

"Nowadays you are no longer in the hospital for ten days, before you know it you are home again. And then? Then it is very useful if you get it from the hospital, go look for it, you are working on it, you can give it a place, you can describe it in your goal, so you can look back on what did I do wrong. Of course, it does not have to, it can also just be a physical thing. You will be helped a bit with that and triggered to think about it, but you can also do something with it. Otherwise, I'll come home and then there will be nothing, yes, continue to live happily, but at least that's what I experienced from cheerfully to live on, there are still some steps needed." (Participant 3)

One participant would, in the case of planned treatment, prefer to start with the technology before hospital admission. This would provide the opportunity to get familiar with the technology in advance and avoid the need to search for alternatives.

4.3.2 Use over time

All participants used the technology during cardiac rehabilitation. The technology was mostly valued because of the ability to self-monitor, an overview of appointments, ability to communicate with health care professionals and the lifestyle information available.

"It seemed useful to me to be able to communicate this way with care providers from the cardiac rehabilitation. You could also chat with them, enter a chat message here on the far right. The appointments were there, you had to fill in questionnaires and I think that in that first moment you also saw your goal of that rehabilitation program and what you would like to achieve. Well, that seemed very useful to me." (Participant 4)

Most participants did quit directly or shortly after CR was completed. Reasons for quitting were concerns about quality, finished the current goal, not being able to join online sessions, not being able to get professional support and use fades because there is no need to look.

"I did not see that many new things on the platform, at least not for me. I did not see any new things that I could hold on to." (Participant 8)

Several participants would continue to use the technology if there was long-term professional advice and support.

"But that you can regularly look back to then and assess how it stands now and what does still apply, do you still succeed, or do you tend to fall back to the past? And how you can apply that, with some evaluation moments here and there." (Participant 7)

The participants who did use the technology for longer especially valued the self-monitoring option. One participant said that the technology did help in taking action to improve lifestyle, but it has limited support in maintaining this healthy lifestyle.

"The trick is to keep it that way. Because you take a path with an adjusted way of nutrition, you pay more attention to that you are more aware, but it is also the trick that you continue to apply that and that you do not end up in an old pattern and go back to the way it was. There may still be some gain. A lot of people and I sometimes catch myself there, who tend to fall back into the old pattern. It could mean a trigger, the incentive to continue to stimulate someone to continue to follow a new path, that new lifestyle, that adjusted lifestyle. I'm looking for what makes someone touch, how can you motivate someone to stay on the right path." (Participant 7)

4.3.3 Social support

Professional support is the most valued type of social support. Especially the ability to receive feedback on self-monitored data and activities and to get help to move in the right direction are appreciated. Several participants said that the technology is a good addition to usual care.

"Well, it's good you can read stuff there, but I guess if you do… Well, let me speak for myself. In any case, I like it when I can also talk to a person about it, that you have that contact with someone. I think that you will do something faster. I think the incentive to do something happens by having contact with someone." (Participant 2)

None of the participants think that their friends or family should support them by having their own account for the technology. Participants said that their relatives are allowed to see all data, but that they would just share the log-in details. None of the participants feel the need to share their data with friends. The most common named reason is that this data is personal. Other reasons are that friends would not be stimulating in improving health and that if help is needed this will be requested outside of the technology. Most participants would not value peer support through the technology. They either have no desire for peer support, would like to find peers in a different way, or already have peer support outside of the technology. Two participants would like to have peer support through the technology. One participant would not want to be in contact but would be interested in reading about users' experiences with lifestyle change.

"I would not be into having contact with other heart patients because treatment and recovery greatly differ between conditions. It would be interesting though to read about how other patients deal with experiences of limitations or changes in lifestyle" (participant 5)

Some participants had some reservations about peer support. The most common reason for reservations is that it is hard to find users in a similar situation since heart diseases are very diverse in condition and demographics.

4.3.4 Integration of medical data

Although eleven of the participants would appreciate one central place where all medical records are kept not everyone thought that the technology would be the best location. Seven participants think that a health-related technology is not the appropriate place for medical data. Reasons why medical data integrated into the technology is not suitable are safety concerns, the use of the technology is temporary and that there are too many applications that copy medical data. One participant would only want medical data related to lifestyle.

"I would rather look it up on a national patient record. I do not need to see surgery results and such. That has no added value for my lifestyle." (Participant 4)

Some participants currently use other channels to look at their medical records. Most participants would agree to share their medical records between different involved health care professionals.

“I have no problem with that myself. My medical records are also shared mutually.” (Participant 6)

One participant would like to be asked for permission before data is shared between health care professionals. The ability to see medical records did not seem to be an important component for the participants and some did not even know that it was integrated into the technology.

5 Discussion

5.1 Main findings

A mixed-method study was performed to be able to answer the main question: *"How can the long-term usage of eHealth technologies to improve lifestyle changes in CVD patients be enhanced?".* This study has shown that this can be done by, features as goal setting & self-monitoring, suitable & inspiring information, triggering use, extended professional support and providing a technology that complies with the user his needs. Participants expressed the need for a technology that is easy to use and works fast, preferably automatically. The technology should offer the possibility to look back at data and adjust data when required. The way the Benefit personal health platform tried to motivate users, by providing a financial incentive, did rarely work. Most participants said that they were intrinsically motivated or that suitable and credible information would motivate them. Although participants would value a central place for their medical records and would agree to share medical data between involved health care professionals, there were concerns about safety and usefulness to provide the medical data on a health-related technology.

5.2 Maintaining long-term behavioural change

During the usability test & interview study it was mentioned that the Benefit personal health platform is less suitable as support in maintaining a healthy lifestyle. Maintaining a newly learned behaviour still requires effort [9]. Motivation in CVD patients is high during the first months after a cardiac event when the focus is on recovery. This motivation decreases around three months after the event [6]. Around three months is also the time when CR is completed. This means that patients have to keep themselves motivated at the most challenging moment when the focus shifts from recovery to normal life. One goal of the Benefit personal health platform is to extend care [28]. Unfortunately, the results show that this is currently not the case for most users: most users quit within the first fifteen sessions and nine of the participants quitted within several weeks after CR is completed. Although quitting to use the platform does not necessarily mean that patients do not work on improving their health, it can be more challenging to maintain healthy behaviour without any support.

5.2.1 Motivation

Motivation is one of the factors for maintaining a new behaviour [34]. Motivation can be explained by the self-determination theory [35]. There are three main types of motivation: amotivation, extrinsic motivation and intrinsic motivation. Amotivation means that there is no motivation. There are four levels of extrinsic motivation ranging from external to internal motivation. The more internal the motivation is, the more likely it is that a behaviour will be maintained. External motivation will be compromised once support ends. Integrated motivation, the most internal extrinsic motivation type, might be the most effective in maintaining behaviour [36, 37]. Integrated means that the patient's identity has transformed and the new behaviour is part of it [35]. Engaging frequently enough for a long enough period might make a behaviour part of themselves shifting to integrated regulation [37]. Intrinsic motivation is motivated by interest, pleasure, or satisfaction. Intrinsic motivation is more vulnerable to barriers because any barriers might influence interest, pleasure, or satisfaction. The Benefit personal health platform tried to motivate users by providing a financial incentive. Rewards are related to the most external form of extrinsic motivation. There were only a few participants that said that these financial incentives worked motivating for them. It might be that this worked for them because they were on this level of motivation. Recent research by Van Velsen et al. [38] has shown that the right way to motivate users depends on personal motivation levels. This might explain why there is no "one size fits all solution" to motivate people. Some of the intrinsically motivated

participants did even have a negative feeling about the financial incentives. Although rewards have proven to be effective in taking action [17, 25, 39, 40], it might be that it undermines intrinsic motivation making the behaviour less likely to maintain [35]. Personal motivation levels might explain why multiple ways to motivate the participants were named and why the rewards worked for some participants but not for others. Motivation levels might also influence if persuasive features are effective or not. Although goal setting and self-monitoring were associated with adherence in the log data analysis, it might be that this was only the case for certain motivation levels.

5.2.2 Extended professional support

The ability to have professional support by asking questions, get motivational support, sharing measurements and getting feedback through the technology was named as one of the most important features during CR. Most participants would like to have continued to have professional support after CR was completed. Extended contact interventions are interventions that include social support that continue after the usual path of care. There are already several examples of extended contact interventions after CR is completed [41–45]. These interventions mostly focus on motivation and ability. Dealing with lapses and preventing relapse are important skills that are learned during these interventions. Interventions that last at least twelve weeks, include two-way interaction, use tailored messaging and use either motivational interviewing techniques or the self-determination theory have better long-term results [41, 46–48]. The moment when they completed CR was also the moment that the professional support on the platform ended. Most participants from the usability tests & interviews did quit shortly after CR was completed. The log data analysis confirmed this, most users had less than fifteen sessions. Calculating for one session a week, this is also shortly after CR was completed.

5.2.3 Suitable & inspiring information

Participants expressed a need for complete, correct, interesting and suitable information. This was in accordance with earlier studies by Neubeck et al. [3] and Coorey et al. [25]. Some participants said that the information on the platform did fit their personal knowledge levels and therefore was suitable to them. It is important that information fits the current level of knowledge for the user to be suitable [49]. Multiple studies show that personalized information is more effective [8, 25, 29, 30, 50]. However, the participants of this study said that they would not be bothered by irrelevant information. It might be that although our participants were not bothered it still could affect their uptake of information. According to the Elaboration Likelihood Model, people are more likely to process, retain and use information that fits the receiver. By eliminating irrelevant information for a target group or individual, only the relevant information is left. This information is likely to get more attention, better understanding and has a greater chance to change behaviour [51]. Participants explained that there was too much text and that the same information was repeated too many times. Particularly one participant mentioned the possibility of using videos and more interesting ways to provide information since the technology could be able to offer this. Earlier research for obesity prevention has shown that video is more efficient than text [52]. Graphs were positively valued by the participants to provide a clear overview of health information. Participants were sometimes missing information or information was unclear. The log data analysis did show limited use of the information component. One possible explanation for this, that the information is not suitable and inspiring, might just have been explained by the participants.

5.3 Technological features

Although it might be hard to keep users motivated in the early maintenance phase through any technology alone, there are technological features that can help. This study has shown three ways on

how technology can support long-term behaviour change: complying with the needs of CVD patients, sending reminders and the use of the persuasive features goal setting and self-monitoring.

5.3.1 User needs

One of the needs of CVD patients is that the technology is easy to use and works fast. Some participants had a smartwatch and tried to connect it. When that failed, they switched to another technology. Beatty et al. [53] already showed the importance of an easy-to-use interface and the possibility for automatic data entry, for example, a smartwatch. Similar to what was done in this study they advise usability testing to find any flaws in the system. Any issues with the usability might negatively impact engagement while a perfect working system is considered normal, this will not improve engagement [54]. Other needs are that the technology should offer the possibility to look back at data and adjust data when required. Comparing current results with the results from the beginning can be interesting and work motivating [43]. Participants explained that goals change during recovery and would like to adjust these when necessary.

5.3.2 Reminders

Another technological feature that could improve the use of the technology is sending a reminder. Reminders have proven to be effective in increasing adherence [17]. In addition to motivation and ability, a trigger is always necessary to perform a certain behaviour [55]. This trigger could be a reminder. This trigger should provide personally relevant information. Earlier literature has shown that especially tailored mail with personal feedback is effective [56]. Participants explained that they would value getting a reminder that new information that is interesting for their health is added to the technology. Of course, it would be better if the technology is so interesting that a reminder is not necessary.

5.3.3 Goal setting & self-monitoring

Both the log data analysis and the usability tests & interviews showed that goal setting & self-monitoring are important persuasive features for long-term behaviour change. The percentage of users that used goal setting & self-monitoring was much higher in adherent users. Although it seems that these features do increase engagement, it might also be that other characteristics influenced this behaviour. Since the study did not collect any demographics or characteristic information it is impossible to make a causal connection. However, the participants from the usability tests & interview study did state that the self-monitoring feature was the most used feature post CR. Self-monitoring was valued because it provided an easy way to keep track of values and the graphs made it easy to see the progress. In the study by Middleton et al. [15] the continuing to self-monitor improved long-term behaviour change for weight loss management positively. Self-monitoring is intertwined with goalsetting as self-monitoring provides the tracking of progress [56]. Most participants did value goal setting. Some participants would only want to create long-term goals and said that short-term goals make things unnecessarily complicated. Other participants were disappointed that they were unable to set new goals or adjust previous goals. They stated that goal setting helps to make you more aware and that it helps in step by step improving their lifestyle. The participants from the mixed methods study by Coorey et al. [25] explained that goal setting increases attention and priority to improve health. Goal setting is an effective way to improve physical activity levels in people over the age of 50 years during cardiac rehabilitation [56]. The success of goal setting might lie in the principle that self-generated goals have more influence than imposed goals [15]. Goal setting might also have a positive outcome on motivation. Achieving goals can boost confidence which in turn increases motivation [43]. In the study by Janssen et al. [44] the use of a pedometer was an effective way to maintain long-term behavioural change. In addition to providing an easy way of self-monitoring it also provided daily feedback.

5.4 Strength and limitations

The main strength of this report is the combination of the mixed methods approach. The results from the log data study are combined with the usability tests & interviews. Some results from the log data could be explained by the experiences and thoughts of the participants.

There are also several weaknesses. The usability tests & interviews were held with twelve participants. This is a small sample of the total users of the Benefit personal health platform. Selection bias might have occurred and caused a more heterogeneous participant group. Participants were relatively young compared to the general CVD population. Since due to COVID-19 all interviews were held online through Microsoft Teams, the participants had to have some technological skills to be able to join the meeting. This combination might have led to a more positive result. Tasks might have been easier to perform than for the general platform user. On the other hand, these users might also have more experience with technology and shared more thoughts about how they would desire or expect things to be. Recall bias might also have occurred. Nearly all participants had stopped using the platform a while ago. Questions about their own experiences might not be remembered correctly. Although the usability tests & interviews only had twelve participants the combination with the larger number of users for the log data analysis agreed on several findings regarding the use of platform components.

There were also some limitations in the log data analysis. The first limitation has to do with the quality of the data. Some variables were missing as these were collected in another part of the Vital10 website. Interesting information about the use of the help function, reminders, webshop and chat could not be collected. Although this information would not change the current results, it may be the case that one of these components is also associated with adherence. A second limitation in the quality of the data is that it was not possible to know if users actually used the platform components or only clicked on them. Therefore, the assumption had to be made, that if it was clicked it was actually used. Since no demographic or characteristic information was collected it is impossible to make a causal relationship between a variable and its predictive value. The validity of the Cox prediction model is limited because of the limited number of (adherent) users and the missing data. The model had an acceptable accuracy, but a low forecasting value. The goal here was not to provide an ideal model but to show that the creation of such a prediction model is possible. The ideal model would be better in predicting non-adherence in advance.

5.5 Recommendations

The results from this study supplemented with other literature have led to multiple recommendations. The choice was made to list the most important recommendations. A full list of recommendations and discovered usability issues have been sent to the organization of the Benefit personal health platform.

Providing support during the maintenance phase

This study made it clear that most technologies are more focused on making the change rather than being supportive during the maintenance phase. Technologies should also focus on this phase. Motivation, ability and a trigger are necessary to perform behaviour [55]. Technologies should incorporate all these preconditions for behaviour change.

Motivation

Motivation might be the most challenging as this might depend on personal motivation levels. Even though more research into these motivation levels and their effect is necessary, the participants did name two ways on how to get motivated. The first was suitable and interesting information. Technology should be personally relevant and use of videos and other multimedia than text should be used. Sending all users personal information might be too time-consuming and costly. Vosbergen et

al. [57] describe a way to send tailored messages based on nine user preferences. Information should also be complete and correct; users want to know how a certain score is calculated. Any technology should test their information with (potential) users to learn if they understand and how they feel about the information. The second way that users could be motivated is by continuation of professional support. Professional support should not stop at the moment that CR is completed as it is challenging for CVD patients to maintain their new learned behaviour when normal life continues. The possibility and cost-effectiveness of extended professional support should be researched. Support could be transferred to lifestyle coaches. Lifestyle coaches should be able to take over the professional side of the technology. Enabling them to support their patients through the technology.

Ability

Patients often learn information on how to improve their lifestyle but skills about how to deal with challenges are less common. These challenges might cause lapses and eventually relapse. Learning the skills on how to deal with these lapses might prevent relapse. Providing users with the skills on how to deal with lapses and prevent relapse is important to maintain behaviour. Preferably, the technology should provide the teaching of these skills.

Trigger

Technology may provide the trigger that is necessary to perform a behaviour. Reminders about new information or asking how the user is doing with a goal can be useful triggers. Information should be added regularly and if this information matches the goal of the user a mail can be sent that there is new information. Persuasive features goal setting & self-monitoring can also provide a trigger. Especially goal setting can create a sense of priority to perform a certain behaviour.

5.6 Implications for future research

Research on tailored strategies for different motivation levels is relatively new. The effect of persuasive features might not only depend on motivation level but also on demographics and the stages of change [38, 58, 59]. More research is needed to find out which persuasive features are effective for CVD patients during different stages of change and with different motivation levels. Beinema et al. [59] used four motivation levels to test the effectiveness of different persuasive features and positive and negative feedback strategies in older adults. Similar research could be conducted specifically for CVD patients with the inclusion of the stages of change. With the results, persuasive features in technology can be more effectively tailored to match the motivation level, stages of change and demographics of users. The final goal is to develop and improve technology to be more effective in supporting users in taking action and maintaining behaviour change.

6 Conclusion

This study has shown that there is much to gain to improve long-term engagement with a health-related technology to support CVD patients during behaviour change. Improving engagement is even more complicated and more factors can influence it than explained in figure 1 of the introduction. Usability is a precondition rather than a factor for engagement. Technology with low usability, will not be used in the long term. Complying with the needs of the users is both a precondition and a factor. If a technology does not fulfill any needs of the user, the technology won't be used. The more needs that can be fulfilled with the technology the higher the chance of engagement. Persuasive features are another factor for engagement. The extent to which different persuasive features influence engagement might depend on motivation level, demographics and the stages of change. Persuasive features goal setting and self-monitoring have proven to be effective in increasing engagement in both the log data analysis and the usability tests & interview results. Reminders were named as positive in the usability tests & interviews and other literature. Besides the need for suitable and credible information, there is also a need for inspiring information to improve engagement. Professional support is another factor that influences engagement. Many participants felt the need for support and feedback by a professional in their process of behaviour change. Other literature has shown that extended contact interventions, especially if self-regulation skills are learned, are effective in long-term behaviour change for CVD patients. The final and most complicated factor is motivation. The motivation level of the user might directly influence engagement. Motivation might also interact with other factors. Depending on the motivation level, demographics and the stages of change of a user certain features might be effective, ineffective or even negatively influence motivation. Future research will need to search for effective persuasive features based on user characteristics. This study did show that certain technological features are successful in supporting CVD patients in maintaining behaviour. Finding the balance between professional and technological support to maintain behaviour change will be the challenge for future research.

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Appendix 1: Informed consent form (in Dutch)

Informed Consent Formulier

We all BENEFIT

In te vullen door de deelnemer

Ik verklaar op een voor mij duidelijke wijze te zijn ingelicht over de aard, methode, doel en belasting van het onderzoek. Ik weet dat de gegevens en resultaten van het onderzoek alleen anoniem en vertrouwelijk aan derden bekend gemaakt zullen worden. Mijn vragen zijn naar tevredenheid beantwoord. Ik had genoeg tijd om te beslissen of ik meedoe.

Ik stem geheel vrijwillig in met deelname aan dit onderzoek. Ik weet dat ik op elk moment zonder opgaaf van redenen mijn deelname aan dit onderzoek kan beëindigen.

Ik weet dat sommige mensen mijn gegevens kunnen zien. Die mensen staan vermeld in de informatiebrief.

Ik geef toestemming om mijn gegevens te gebruiken, voor de doelen die in de informatiebrief staan.

Ik geef toestemming om mijn onderzoeksgegevens 10 jaar na afloop van dit onderzoek te bewaren.

Ik ga er ***wel / niet*** (doorstrepen wat niet van toepassing is) mee akkoord dat de onderzoekers in de toekomst eventueel contact met mij opnemen over de voortzetting van dit onderzoek.

Ik wil ***wel / niet*** (doorstrepen wat niet van toepassing is) geïnformeerd worden over de uitkomsten van dit onderzoek.

Naam deelnemer: .....

Datum: ..... Handtekening deelnemer: .....

Appendix 2: Protocol for the usability tests and interviews (in Dutch)

Protocol usability test / interview *maart - april 2021*

Voorbereiding

Tijd	Taak	Doel
Voorbereiding	A) Participanten ontvangen na bevestiging deelname een mail met daarin de datum en tijd van de afspraak, de inloggegevens en wachtwoord voor het platform, contactgegevens om mij te kunnen bereiken bij vragen en de PIF. B) Participanten ontvangen enkele dagen voor de afspraak een uitnodiging voor de Teams bijeenkomst. C) Het Vital10 account wordt voorbereid op de bijeenkomst - Invullen van enkele gegevens in het account - Versturen van V-cheqs - Gezondheidstegels aanpassen D) Overige - Toegang tot de Gmail accounts waarop de beveiligingscode voor het inloggen wordt verstuurd. - Testen van het systeem voor Teams en zorgen voor extra opname mogelijkheid buiten Teams om (eenmalig).	Participanten informeren Herinnering afspraak Platform gebruiksklaar maken Ervoor zorgen dat er vanuit mijn kant een zo klein mogelijke kans op technische problemen is.

Inleiding / opening gesprek (7 minuten)

Tijd	Taak	Doel
Voor aanvang van het gesprek	*Tijdig inloggen voor de meeting en op het Gmail account voor de beveiligingscode* *Zorgen dat ik de PIF (informed consent) open heb staan*	*Tijdig kunnen beginnen*
1 minuut	1) Mezelf voorstellen aan de deelnemer 2) Bent u al een beetje gewend aan het beeldbellen?	Voorstellen / kennismaken
1 minuut	3) Het eerste deel van het onderzoek is gericht op het testen van de gebruiksvriendelijkheid van het Vital10 platform, dat gericht is op het verbeteren van de leefstijl van hartpatiënten. Ik ga u vragen om bepaalde taken die mogelijk zijn binnen het platform uit te voeren. Daarbij wil ik u vragen om hardop uw gedachten uit te spreken. Hardop denken voelt misschien niet altijd natuurlijk. Als u vergeet om hardop te denken, dan zal ik u hieraan herinneren. U probeert de taken zo uit te voeren zoals u dat normaal gesproken zou doen, er zijn geen foute antwoorden. U kunt het niet verkeerd doen. Tijdens het doorlopen van de verschillende taken vraag ik u naar uw eigen gebruik en ervaringen hiermee. Door te kijken naar hoe u en andere deelnemers het platform gebruiken en wat daarbij de gedachten zijn kunnen we het Vital10 platform verbeteren. 4) Het tweede deel van het onderzoek is een kort interview over uw ervaringen, wensen en verwachtingen van het platform. Hiermee kunnen we ervoor zorgen dat het platform beter bij de wensen en het dagelijkse leven van gebruikers past. 5) Heeft u hier vragen over?	Doel van het onderzoek en taken uitleggen
1 minuut	6) Voor dit onderzoek vraag ik u zo meteen om u scherm te delen zodat ik ook mee kan kijken met wat u op het platform doet. Om dit onderzoek juist te kunnen uitvoeren is het nodig om spraak en video op te nemen. Het is eventueel wel mogelijk om de camera uit te zetten. Deze video wordt alleen gedeeld met andere leden van het onderzoeksproject. Voor mijn afstudeerrapport en eventuele andere verslagen worden uw gegevens geanonimiseerd. 7) Heeft u hier vragen over? Gaat u hiermee akkoord?	Uitleggen opname en gebruik gegevens
2 minuten	8) Vraag de participant de PIF uit de mail te openen. Loop het informed consent stap voor stap (oplezen) door met de participant en vraag de persoon of hij/zij toestemming geeft voor deelname. 9) Om het onderzoek te mogen uitvoeren is mondelinge toestemming van u nodig. Ik wil u zo vragen om dit aan het begin van de opname te bevestigen.	Toelichten van voorwaarden waar participant mee akkoord gaat bij deelname
2 minuten	10) We zijn nu in principe klaar om te beginnen. Heeft u nog ergens vragen over? 11) Dan mag u inloggen in het Vital10 account dat u gekregen heeft in de mail. *Ik geef de beveiligingscode* 12) Dan wil ik u vragen om uw scherm te delen (evt ondersteunen) *Zorg voor een voorbeeld van een geprinte "scherm delen" afbeelding in Teams*	Vragen Inloggen account Scherm delen Start opname

	Mocht het echt niet lukken is plan B om mijn scherm te delen en de deelnemer te vragen om mij door het platform heen te begeleiden. 13) Vind u het goed als ik nu de opname start, en indien ja, start de opname.	

Usability test (28 minuten)

Tijd	Taak	Doel
	Extra hulpzinnen om mensen pratende te houden: - *Kunt u uitleggen waarom u dit doet?* - *Kunt u aangeven hoe u hierover denkt?* - *Wat vindt u van deze mogelijkheid/hiervan?* - *Wat vindt u van deze optie?* - *Kunt u blijven vertellen wat u doet en denkt?*	
1 minuut	14) We hebben zojuist het informed consent formulier uit de PIF doorgesproken. Ik wil u nu vragen om te bevestigen dat u akkoord gaat met vrijwillige deelname aan het onderzoek.	Mondelinge toestemming
1 minuut	*Alleen nieuwe deelnemers* 15) U heeft het platform natuurlijk al eerder gezien. Weet u nog wat uw eerste indruk of ervaringen met het platform waren?	Eerste indruk / ijsbreker
Invullen V-cheq + - 3 minuten	16) Zou u de V-cheq “van doel naar challenge” willen openen? 17) U mag nu een doel invoeren. Dit hoeft geen echt doel van u te zijn maar u mag er gewoon even een verzinnen. - Heeft u dit zelf ook gebruikt? - Wat vindt u van de mogelijkheid om op deze wijze een doel te stellen (makkelijk / moeilijk, zinvol / niet zinvol, voldoende vrijheid / ondersteuning). - Vindt u dat u ondersteund werd in het verbeteren of volhouden van uw levensstijl door het invoeren van uw doelen via het platform? - Zo ja, hoe heeft het platform u ondersteund? - Zo nee, is er een mogelijkheid waarin het platform u wel had kunnen ondersteunen? Op welke wijze?	Gebruik en ervaringen met het stellen van **doelen** op deze wijze.
Chat + - 3 minuten	18) U twijfelt toch nog over uw bloeddruk en wilt hierover een bericht versturen naar uw zorgverlener. Hoe kunt u dit doen? - Heeft u dit zelf ook gebruikt?	Gebruik en ervaringen met de mogelijkheid om via het platform **contact op te nemen met een zorgverlener**.

	- Wat vindt u van de mogelijkheid om via het platform een zorgverlener te kunnen bereiken? (zinvol / zinloos) - Zo ja, kunt u dat iets verder toelichten? - Zo nee, is er een mogelijkheid waarin het platform u wel had kunnen ondersteunen? Op welke wijze?	
Stress tegel toevoegen in gezondheid + - 3 minuten	19) Uw zorgverlener heeft naar uw eerdere vragenlijsten gekeken en daaruit blijkt dat de score voor stress behoorlijk hoog is. U reageert dat u inderdaad regelmatig veel stress ervaart. Ze adviseert u om de komende tijd de “stress score” bij te houden. Deze wil je nu toevoegen en daarna zodanig plaatsen dat deze op het dashboard zichtbaar is. - Heeft u uw eigen platform aangepast naar uw wensen? - Wat vindt u van de mogelijkheid om via het platform aan te kunnen passen? - Hoe vindt u het als er informatie in het platform staat die niet van toepassing op uw gezondheid?	Het **personaliseren** van het platform naar wensen en interesse
Webshop / V-points + - 3 minuten	20) Helaas is uw bloeddrukmeter kapotgegaan en u wil graag een nieuwe. Omdat u het platform al een langere tijd gebruikt heeft u behoorlijk veel v-points gespaard. Met deze v-points wil u graag een nieuwe bloeddrukmeter kopen. Waar op het platform is dit mogelijk? - Wat vindt u van de mogelijkheid om V-points te verzamelen? (motiverend / neutraal / demotiverend, leuk / onzin). - Heeft u zelf wel eens iets in de webshop gekocht? Waarom wel of niet? - Zou het platform u op een andere wijze (meer) kunnen motiveren?	**Motivatie middels v-points**. Gebruik en ervaringen met de webshop.
Hulppagina + - 3 minuten	21) Met uw nieuwe bloeddrukmeter kan u de bloeddrukmeting rechtstreeks overzetten naar het platform. U weet alleen nog niet hoe dit moet. Kunt u de hulppagina vinden waarop wordt uitgelegd hoe u een nieuw apparaat kunt koppelen? - Er staat onder andere ook een uitlegfilmpje met uitleg en voorbeelden van de mogelijkheden van het platform. Heeft u hier aan het begin gebruik van gemaakt? - Zo ja, heeft dit u geholpen in het gebruik van het platform? - Zo nee, had u het wenselijk gevonden om dit eerder te bekijken? (Bijvoorbeeld om meer te weten over de mogelijkheden van het platform).	Ondersteuning bij het **leren kennen van het platform**. Leren wat de **mogelijkheden van het platform** zijn.
Waarden gewicht invoeren	22) Eén keer per week voert u uw gewicht in. Vandaag weegt u 80 kg. U mag deze nu invoeren? *Deze staat of op het dashboard of in gezondheid*	Gebruik en ervaringen met het invoeren en bijhouden van **zelfgemeten waarden** op deze wijze.

+ - 3 minuten	- Waarschijnlijk bent u tijdens de hartrevalidatie ook gevraagd om regelmatig zelf te meten. Hoe vond u dit? - Heeft u na de hartrevalidatie zelf ook nog waarden ingevoerd? - Hoe vindt u het dat u een overzicht kan zien van uw eigen gemeten waarden?	
Dossier, bekijken resultaat bloedprikken + - 3 minuten	23) U bent nu enkele maanden verder en heeft hard aan uw gezondheid gewerkt. Vorige week bent u bij de huisarts geweest voor controle voor uw bloedsuiker, die was namelijk de vorige keer iets te hoog. U weet niet meer precies wat de waarde is en wil deze daarom graag even terugzoeken via het platform. Waar kunt u uw deze uitslag zien? - Heeft u via het platform wel eens zelf naar uw medische gegevens gekeken? - Hoe vindt u het dat uw medische gegevens hier staan? (praktisch / onnodig / onveilig) - Wat vindt u van het omgekeerde, dat u metingen worden gedeeld met uw zorgverleners? (praktisch / onnodig / onveilig) - Met welke zorgverlener zou u uw gegevens willen delen? Wie mag de resultaten van ook andere zorgverleners inzien? (Bijvoorbeeld gegevens cardioloog naar huisarts en andersom)	Gebruik en ervaringen met de mogelijkheid om de **eigen medische gegevens** in te zien. **Delen metingen met zorgverleners**
Afronding + - 2 minuten	24) Dit was voor mij de laatste taak van de gebruikerstest. Heeft u zelf tijdens u gebruik van het platform nog iets ervaren wat u niet helemaal begrijpt of graag even wil navragen? - Zo ja, proberen te ondersteunen / uit te leggen. *Lukt het nu niet dan aangeven dit na te vragen en dit aan de deelnemer terug te koppelen.* 25) Bedankt voor het delen van uw ervaringen tijdens de gebruikerstest. Het eerste deel van het onderzoek is nu afgerond.	Afronding en mogelijke overige **usability issues**.

Het interview (15 minuten)

Onderdeel	Vraag	Doel
Opstarten interview	26) Dan zou ik nu graag verder gaan met het interview.	
Soci demografische gegevens + - 2 min	27) Kunt u mij kort iets vertellen over uzelf? (leeftijd, woonsituatie, gezinssituatie. 28) Kunt u mij wat over uw gezondheidssituatie vertellen? (aandoening, revalidatie, impact) 29) In hoeverre bent u bezig of bezig geweest met het krijgen of behouden van een gezonde leefstijl? (voeding, bewegen, bijhouden gegevens)	Achtergrondinformatie gebruiker en levensstijl.
Gebruik platform + - 2 min	30) Hoe lang gebruikt u het platform en wanneer bent u ermee begonnen? (na ziekenhuis opname, revalidatie, eigen initiatief) Hoe vond u dat? 31) Wat vond u van het moment van starten met het platform? 32) Wat zou het beste moment zijn om te starten? Wat zou u adviseren voor nieuwe gebruikers?	**Adoptie**
Ervaringen + - 2 min	33) Hoe heeft u het gebruik van het platform ervaren tijdens de hartrevalidatie? 34) *Wat vond u goed?* 35) *Wat kon beter?* 36) Hoe heeft u het gebruik van het platform ervaren na de hartrevalidatie? - *Wat vond u goed?* - *Wat kon beter?* 37) Is uw gebruik veranderd is de loop van de periode? - Zo ja, hoe is dit veranderd?	**Ervaringen en verandering wensen**
Ondersteuning middels het platform + - 2 min	38) Vindt u dat het platform u, naast de gebruikelijke zorg, heeft ondersteund met het verbeteren of onderhouden van een gezonde levensstijl? - Zo nee, waarom niet? 39) Hoe zou het platform beter aan kunnen sluiten om ook na de revalidatie te kunnen ondersteunen bij het verbeteren of onderhouden van de levensstijl? 40) Welke meerwaarde vindt u dat het platform heeft?	Wenselijkheid en mogelijkheden voor **ondersteuning middels het platform**
Dagelijks leven + - 2 min	41) Hoeveel tijd heeft u per dag / week nodig om het platform te gebruiken? - Wat vindt u van die tijd? 42) Hoe past het gebruik van het platform in uw dagelijkse leven? (Bijvoorbeeld: kunt u regelmatig uw gegevens invullen)	Hoe past het platform binnen **het dagelijks leven** van de deelnemer.
Sociale ondersteuning	43) We hebben al even gesproken over de rol van verschillende zorgverleners binnen het platform. Daarnaast zouden ook nog andere personen u kunnen ondersteunen middels	**Ondersteuning door eigen netwerk**

+ - 2 min	het platform. Zou u het wenselijk vinden als uw partner, mantelzorger, kinderen toegang krijgen tot uw gegevens op het platform of een deel daarvan? - Zo ja, wat zou u graag willen delen? Wat niet? - Zo nee, waarom vindt u het niet fijn? 44) Zou u het fijn vinden om via het platform in contact te komen met andere hartpatiënten om bijvoorbeeld ervaringen te delen?	**Ondersteuning door peers**
Verandering platform + - 1 min	45) Wat zou u graag willen veranderen aan het platform?	
Afronding + - 2 min	46) Ik heb nu al mijn vragen gesteld. Wilt u zelf nog iets delen over het platform? 47) Dan zal ik nu de opname stoppen. *Stop opname* 48) Mag ik u nog vragen of u nog een korte vragenlijst, van 5 à 10 minuten, zou willen invullen. Deze gaat over het algemene gebruik van het platform en we proberen om van zoveel mogelijk deelnemers antwoorden te krijgen. Deze vragenlijst krijgt u via de mail. 49) Ik wil u bedanken voor de tijd en inbreng tijdens dit onderzoek. U krijgt een mail over de te ontvangen cadeaukaart, als dank voor uw deelname. Heeft u nog vragen of opmerkingen over het onderzoek? Hoe heeft u het onderzoek ervaren?	Ruimte voor overige ervaringen TWEETS vragenlijst Ervaringen onderzoek en cadeaukaart