Patient empowerment via a smartwatch activity coach application

Let the patient gain back control over their physical and mental health condition

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Master thesis
Msc Design for Interaction

Executive summary

A new healthcare domain is growing which is called eHealth. eHealth solutions are getting deployed in order to tackle the ongoing problem of an increase in patients with a chronic disease in The Netherlands. Medicine Men has developed a eHealth solution for patients with chronic diseases which is called the Emma Activity Coach. This application runs on a Fitbit smartwatch and is part of the Emma system which consists out of a smartphone application called Emma.6 and a desktop application called Emma dashboard. The aim of the Emma Activity Coach and the Emma system is to empower patients with a chronic disease in monitoring their activity in their own environment with the support of an informal caregiver and a healthcare professional in order to improve the quality of life of the patient.

Project focus

The focus of this project is on exploring the target group of the Emma Activity Coach and its needs in order to improve the Emma system. The user interaction and experience of the user are explored. Problems that come up are translated into design iterations which result in a proposed final design that fulfils the found needs and the set design vison.

The ecosystem of the project consist out of three parties:
- *The patient*
- *The informal caregiver*
- *The healthcare professional*

Target group

Literature research and interviews with several healthcare professionals showed that the use of the Emma Activity Coach would be beneficial for patients with chronic diseases such as COPD, Type 2 diabetes and Cardiovascular Disease (CVD). The target group is characterised by comorbidity; I.e. suffers from more than one chronic disease. This means that there is an overlap of disease symptoms of which activity, and therefore the use of the Emma Activity Coach is found to be beneficial.

Target group challenge and needs

The target group is explored via several patient interviews who suffer from COPD and/or Type 2 diabetes, three informal caregivers and three healthcare professionals. The main challenge for the target group is knowing their activity limits in order to gain back trust in their physical and mental condition. The target group has problems with getting enough activity or sometimes getting too much activity, which is often the case for patients with COPD. Their disease makes it hard for them to recognize their limits due to constant being short of breath. The challenge of the target group is translated into four needs; the need for autonomy, security, stimulation and support. Several design criteria are setup according to these needs and translated in the concluding design vision; *to make the patient feel in control of their physical and mental health condition, by providing clear feedback on their activity.*

Design process

Several user studies with COPD patients who had experience with the use of the Emma Activity Coach on a Fitbit smartwatch were performed. Interviews, observations and user tests revealed multiple design and comprehensibility problems with the current design of the Emma Activity Coach. These problems were tackled via three iteration rounds with the target group participants.

The Emma dashboard of the healthcare professional, with the focus on physiotherapists, is also explored by interviewing 4 physiotherapists who have made use or still use the Emma dashboard in combination with the Emma Activity Coach. The iteration is presented as a starting point for further development.

The evaluation with the target group shows that the proposed design of the Emma Activity Coach achieves the set design vision of this project.

Glossary

HCP - *Healthcare professional*

GP - *General practitioner*

COPD - *Chronic Obstructive Pulmonary Disease*

CVD - *Cardiovascular disease*

UX - *User eXperience*

UI - *User Interface*

USP - *Unique Selling Point*

Image 1: Roadmap of locations visited during the graduation project

Acknowledgements

I would like to thank several people who have supported me during my graduation project.

Medicine Men

First of all, I would like to Medicine Men and in special Oscar, for giving me the opportunity to graduate at Medicine Men. I appreciate the freedom I got in how I worked on and formulated the project. This project would have been a lot more stressfull without the knowledge and connections that Oscar has in the (eHealth) healthcare domain and shared with me throughout my graduation process. In addition I would like to thank Thomas, Chee Keung, Jasper and Rinske from Medicine Men as well for always being available to help me with questions, arranging patient and healthcare professional meetings and discussing designs that I made.

TU Delft

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Participants

I would not have had the presented results and insights without the participants that helped me during this project. I want to thank Inge Peeters from FysioHolland Zeeland in special for her cooperation with arranging multiple participants that fit the target group of the project and providing me a practice room in the physiotherapy practice in Zeeland in which I tested my designs with the participants.

Assignment & approach

Medicine Men has developed the Emma Activity Coach smartwatch application. The Emma Activity Coach is part of a product-service system of Medicine Men that is called Emma. The aim of this product-service systeem is to offer patients, who need their activity regulated and monitored, a tool to do so. The patient can monitor their activity with the help of the Emma Activity Coach smartwatch application in order for them to reach their activity goals and recognize their activity limits. The goal of this project is to explore the use and interaction of the Emma Activity Coach and the Emma system around it in order to improve the user experience of the Emma system. This is translated into the main research question of the thesis;

How can the Emma Activity Coach and the Emma system around it be improved in order to create a better user experience for the patient in which they feel in control of their chronic condition management?

Iterations will be made to come up with a new design which motivates and informs the user on their activity and healthcare in order to take the control over their chronic condition management. The patient will be able to control their health in their own daily routine without returning visits to the healthcare professional (HCP). The HCP and informal caregiver will support the patient throughout the intervention with the Emma Activity Coach.

Problem statement

The patients are able to control their own health from out of their own environmont with less visits to the HCP with the help of the Emma system. This means a change in the role of the patient and the HCP. New interactions will come into play with the implementation of eHealth solutions like the Emma Activity Coach and patient empowerment. This change in healthcare is facilitating the patient to take on an active role in obtaining information about their disease and monitoring their own health in order to make informed decisions. It is key to understand the principle of this concept and the current attitude of the patient and the healthcare professional on this matter. What keeps patients from taking control over their health(care) and what are the main limitations and needs for the activity of the patient? These gaps are about the interaction and communication between the patient, the healthcare professionals but also the informal caregiver. The scope header discusses which of the gaps will be explored during this thesis.
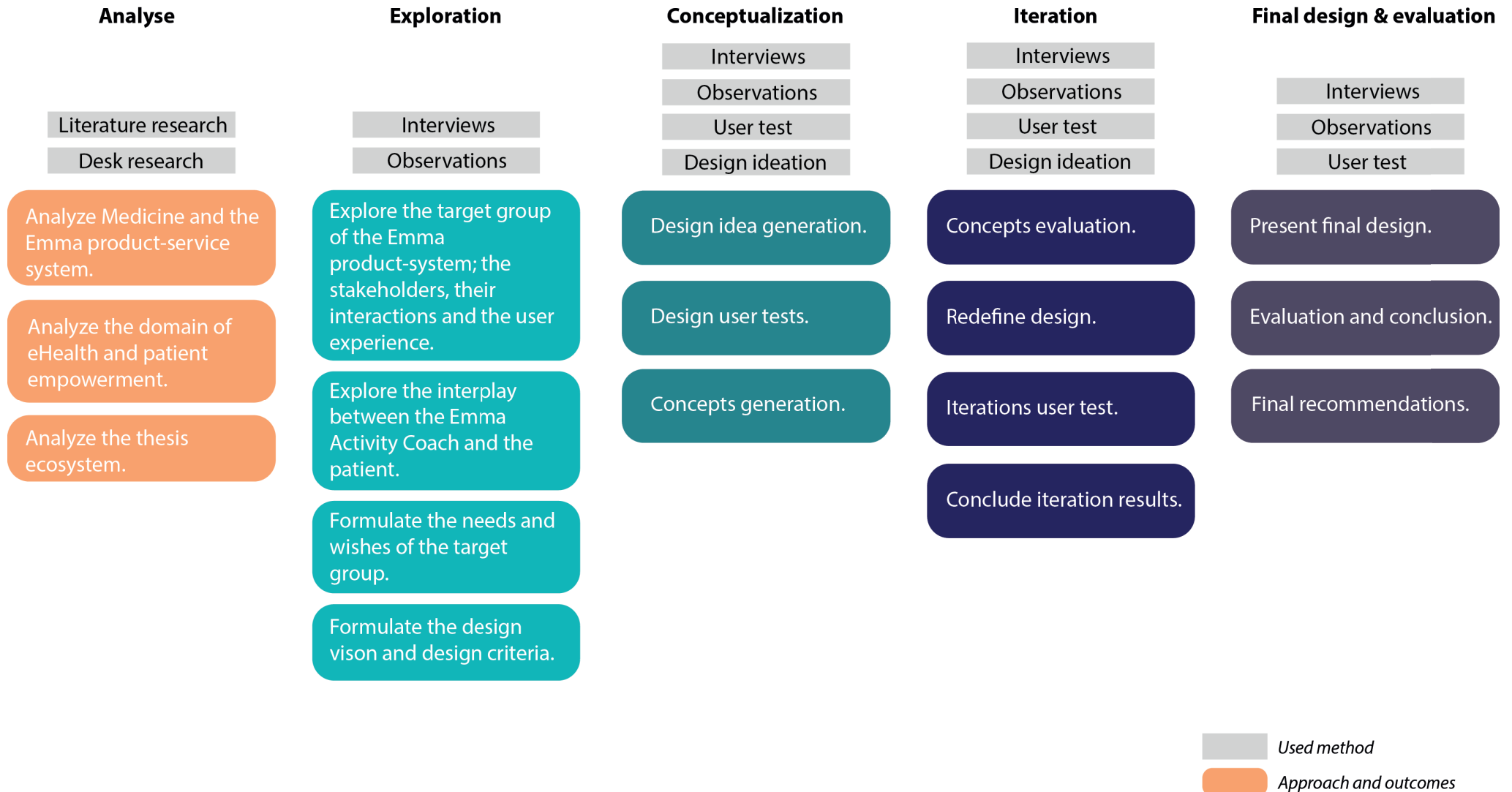
Scope

The main focus of this thesis is on the activity information management of the patient via the Emma Activity Coach in order for the patient to take back the control over their own health. The Emma Activity Coach is connected to the Emma desktop dashboard and the Emma.6 smartphone application. Those two components of the Emma system will also be explored in addition during this project. This will lead to a holistic design in which the patient has day-to-day management over their chronic disease. The design direction is depending on the different patient groups that fit into the category of needed activity. Interviews with several healthcare professionals will give answers on the questions which patient groups struggle with their health control, which have problems with getting enough activity and why?

The design criteria to further optimise the Activity Coach will be defined out of this research and patient interviews.

Approach

The illustration below shows an overview of the five project phases in combination with the used methods, approach and outcomes;

Analyse	Exploration	Conceptualization	Iteration	Final design & evaluation
		Interviews	Interviews	
		Observations	Observations	Interviews
Literature research	Interviews	User test	User test	Observations
Desk research	Observations	Design ideation	Design ideation	User test
Analyze Medicine and the Emma product-service system.	Explore the target group of the Emma product-system; the stakeholders, their interactions and the user experience.	Design idea generation.	Concepts evaluation.	Present final design.
Analyze the domain of eHealth and patient empowerment.		Design user tests.	Redefine design.	Evaluation and conclusion.
Analyze the thesis ecosystem.	Explore the interplay between the Emma Activity Coach and the patient.	Concepts generation.	Iterations user test.	Final recommendations.
	Formulate the needs and wishes of the target group.		Conclude iteration results.	
	Formulate the design vison and design criteria.			

Used method

Approach and outcomes

Table of contents

1. Introduction

*The following chapter introduces the company
Medicine Men and their developed product-service
named Emma, which will be the focus of this project.
The Emma product-service system consist of the Emma
dashboard for patients and healthcare professionals,
the Emma.6 smartphone application and the Emma
Activity Coach which runs on the Fitbit smartwatch.
Finally, an overview is given of how these applications
are connected with each other in the Emma system.*

1.1 Medicine Men & Emma

Medicine Men is a software company, located in Abcoude, The Neetherlands, which has its focus in the healthcare domain. They develop software that connects to third party medical hardware, such as the Medicine Men blood pressure smartphone application connected to a Microlife blood pressure monitor device. The third party of hardware within this project is Fitbit, known for their activity trackers/smartwatches.

1.1.2 Emma

The product developed by Medicine Men is called Emma [image 2]. It consists of Emma.6, which is the name of the smartphone application, the Emma desktop dashboard and a smartwatch application called the Emma Activity Coach. The origin of Emma is based on therapy adherence of the patient, to remind them to take in their medication. It has shifted through the years into a self-management platform for patients with chronic diseases, such as Chronic Obstructive Pulmonary Disease, also known as COPD. The main focus of the Emma platform is currently on home blood pressure monitoring (EmmaHBPM) and patients with COPD (EmmaCOPD).

The platform is used by the patient, the informal caregiver of the patient and the healthcare professional to inform on and monitor the health of the patient.

Image 3 shows the working principle of Medicine Men and the Emma platform. The rings represent the action lines of the Emma platform. The patient is placed central in the first ring together with the connected devices, which are shown in the first ring of image 3. The patient is given the tools to monitor their own health and is the first in line to act upon it. Ring two contains the informal caregiver of the patient. Informal caregivers can be the partner of the patient, family, friend or a neighbour for instance. They are the closest communication line of the patient and are mostlikely the first one to recieve information about the health of the patient. The third ring contains the HCPs. The HCP consists out of a general practicioner, a registerered nurse or a physiotherapist. They can monitor the health of the patient from a distance via the Emma platform. The informal caregiver and HCP get alerted via the Emma platform if symptoms of the patients disease worsen.

Image 2: Emma product-service system: Emma desktop, Emma smartphone application and the Emma Activity Coach smartwatch application running on a Fitbit smartwatch.
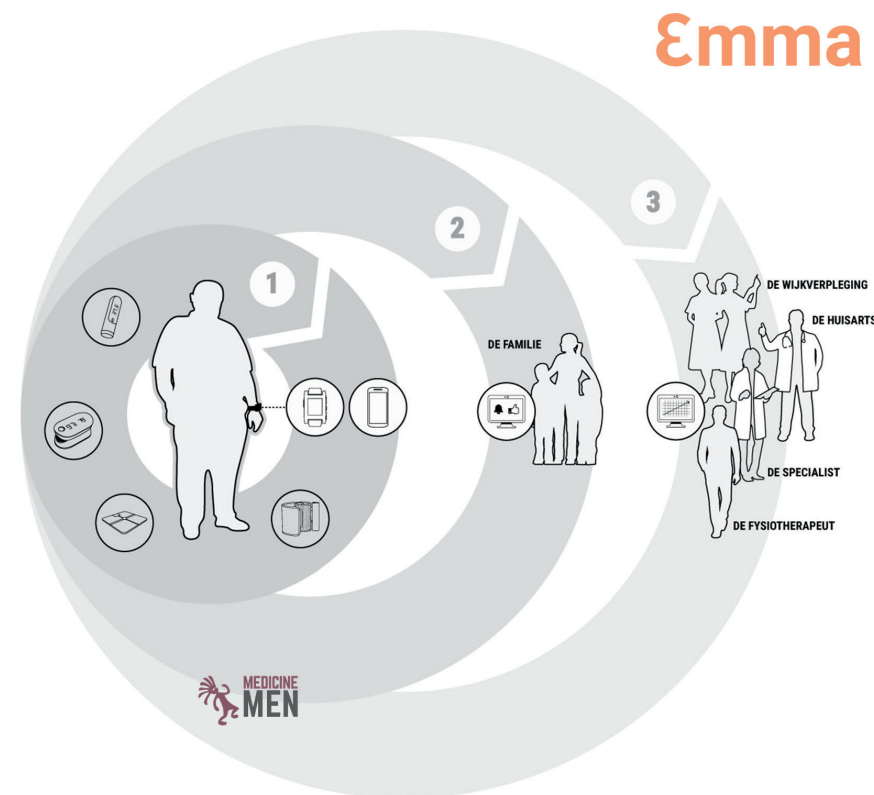

Image 3: Emma care rings. The patient is placed central in the first ring. The second ring contains the informal caregiver of the patient. The final ring contains the HCPs.

1.1.3 Emma dashboard

The Emma dashboard is a part of the product-service system of Emma and is made for the patient and the HCP. The patient and the HCP both have their own version of the dashboard, but with a similar design. The HCP Emma dashboard is used to set the activity goals of the patient and monitor the patients activity and health data, whereas the patients Emma dashboard is used for being able to monitor their activity and health data.

The similarities and differences of the patient and HCP Emma dashboard are shown and discussed further in this chapter according to screenshots of both dashboards in order to show its aim and the key elements and functions.

1.1.3.1 HCP Emma dashboard

Homepage

The first screen of image 4 shows the homepage tab of the Emma dashboard of the HCP. The homepage shows an overview of the patients who are using the Emma system and are connected to the the Emma dashboard of the HCP. The HCP can select a patient to view their information and health data.
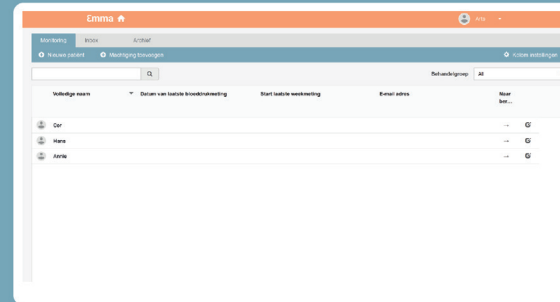
Measurements

The second screen from image 4 shows the measurements tab. The HCP can set the stepgoals and the corresponding bandwidth percentage for the patient in the measurements tab. The set stepgoals are translated to the Emma Activity Coach of the patient. and are the activity goals the patient needs to fullfil. These goals are divided into four day segments; night, morning, afternoon and evening. This is done since patients have different activity patterns per segment of the day; one patient might get more activity in the morning, while another patient gets active later in the day. The physiotherapist can tailor made the activity goals this way to the activity pattern of the patient. A checkbox can be checked to also let the patient know if they get too much activity, since it can also be the cause for certain patients that the do more than their body can handle.

Questionnaires

The Emma system is developed by Medicine Men with the chronic disease Chronic Obstructive Pulmonary Disease (COPD) in mind as the first focus group. An international treatment method for COPD patients is the use of disease
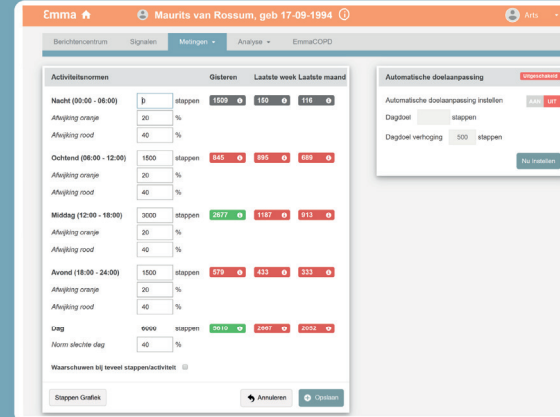

Image 4: HCP Emma dashboard infographic part 1.

symptom questionnaires. The questions in these questionnaires are of subjective nature and are about how the patient perceives their current health condition. The patient and the HCP can easily detect an increase in symptomps via this treatment method and act upon it since the same questionnaire list is on average send to and filled in every week by the patients. Several COPD questionnaires are developed by disease research institutes or professors over time in the healthcare domain of COPD. Each hospital or practice uses one, or a combination of the questionnaires according to their preference.

Most of the practices let the patient fill in the questionnaire on paper during a visit, Medicine Men however has digitalized the questionnaires and added them to their Emma system. The third screen of image 4 shows the questionnaire tab in which the HCP can select and send the questionnaires to the patient. Medicine Men makes use of three COPD questionnaires that are most used in the healthcare domain. These three are the 'Ziektelastmeter', COPD Control Questionnaire (CCQ) and

COPD Assesment Test (CAT). These questionnaire lists can be found in Appendix A. Patients get one of the three questionnaires send out to them by their HCP in a roulating system. They will receive the questions in their Emma dashboard and on their Emma.6 smartphone application, which will be discussed later. The frequency of the questions being send to the patient depends on the severity of the condition of the patient, but in general every week a list of questions is being send via the Emma.6 application for the patient to fill in. The three lists show an overlap of the same questions. This means that the patient gets a mix of new and returning questions. The answers of the patient are compared to previous answers. When a patient fills in that one or more symptoms worsen, the caregiver and HCP are notified via the Emma system.

Analyse - questionnaires

The analyse - questionnaire tab from image 5 shows the HCP the answers that the patient gave to the questions. The responses from the patient are displayed in a graph. The questionnaires add value to the Emma Activity Coach intervention since the physical and the mental condition of the patient can be compared and analysed by the HCP. There is an interaction between the objectief data of the smartwatch and the subjective data of questionaire list. The visualization of the answers in a graph make it easy for the HCP, and the patient, to recognize trends in the health condition of the patient or deviations.

Analyse - activity
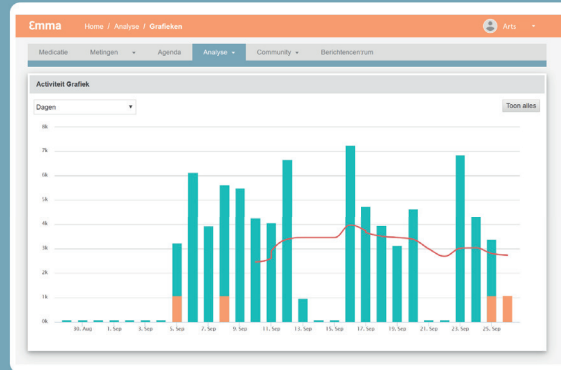
The Analyse - activity screen from image 5 shows the activity data of the patient. The data is visualized in a graph. The data in the graph can be viewed per minute, segment of the day (night, morning, afternoon, evening), day or week. The HCP can view because of this at specific moments of the day or an average activity of the patient over a longer period of time.

Image 5: HCP Emma dashboard infographic part 2.

1.1.3.2 Emma patient dashboard

The patient has its own Emma desktop dashboard. The most important tabs of the patients Emma dashboard, with regard to the scope of this thesis, are shown in the infographic from image 6.

Homepage

The homepage of the Emma patient dashboard of image 6 shows personal information, their connected devices to the system and the connected community members such as the HCP and their informal caregiver. The following tabs are shown in the dashboard: medication, measurements, agenda, analyse, community and a message center which is a chat tool with which the patient and HCP can communicate directly with each other.
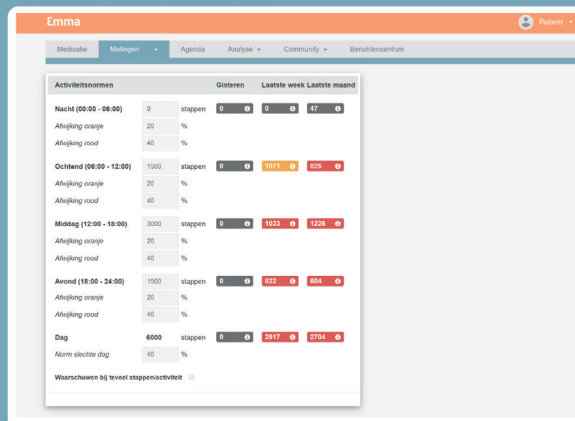
Measurements

The measurements tab in image 6 presents the patients step goals that are set by the HCP. It also shows the taken steps of the patient per day segment from yesterday, the last week and month. The colours green, orange and red indicate if the patient reached their step goals.

Analyse - activity
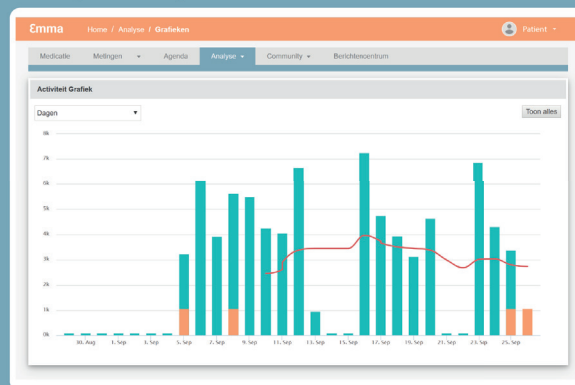
The analyse tab lets the patient view their activity data visualised in a graph. The patient can view their amount of steps taken per minute, day segment (night, morning, afternoon, evening), day and week. This gives the patient the ability to detailed analyse their own activity data. This tab looks and interacts the same as the analyse tab from the HCP Emma dashboard.

In addition to activity, the patient can view additional functions of the Emma system in the Analyse tab:
- set measurement alarms
- alarm history
- INR value (value for the coagulation time of blood)
- weight
- blood pressure
- SPO2 value (oxygen saturation value in the blood)
- 6MWT (6 minute walking test)
- heartbeat
- question list and answers

Image 6: Patient Emma dashboard infographic part 1.

Analyse - questionnaires

The answers that the patient has given to the questions or questionnaires from the HCP can also be viewed under the analyse tab. Those are displayed in a graph. This is done in the same way as with the Analyse question tab of the HCP.
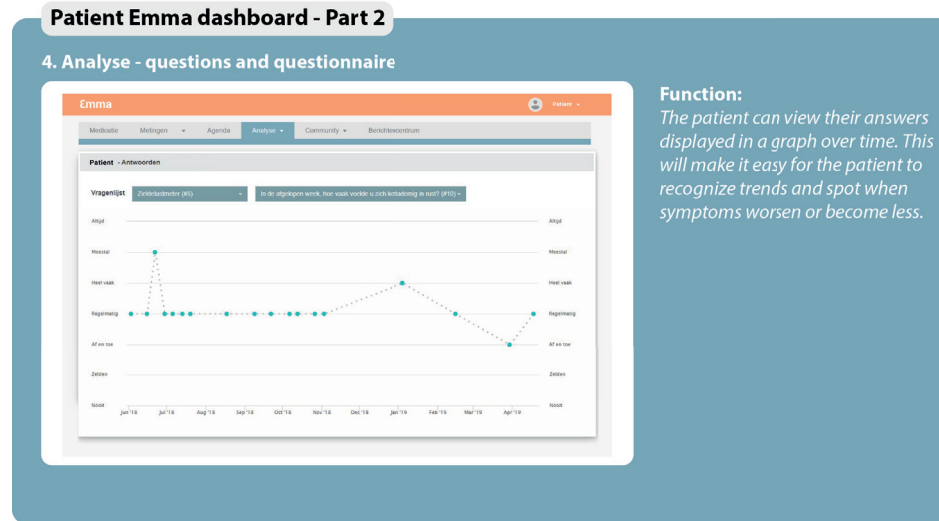
Image 7: Patient Emma dashboard infographic part 2.

1.1.4 Emma.6 smartphone application

The main purpose of the Emma.6 smartphone application is recieving and answering the previous discussed COPD questionnaire lists. In addition, it is used to perform and view the blood pressure measurements that the patient takes with their Microlife blood pressure monitor. This however is not part of the scope of this project and will not be discussed further.

In contrast with the Emma dashboard, their is only version of the Emma.6 application which is made to be used by the patient. The infographic in image 8 shows the Emma.6 application screens with regard to the scope of this project.

The Emma.6 smartphone application makes it possible for the patient to easily recieve and answer the questions from any location, with an internet connection. The patient receives a notification if a questionnaire or question is send by their HCP. As discussed earlier, the questionnaires are aimed at patients who suffer from COPD. The questions are about how they preceive their current health condition. If the

patient fills in that they experience an increase in one or more of the symptoms, their HCP and caregiver are alerted. The patient gets a notification in the Emm.6 application that they should contact their HCP or in case of an alarming increase of a symptom call 112. The patient is also able to communicate directly to the HCP via the Emma.6 application.

Emma.6 application

Homepage
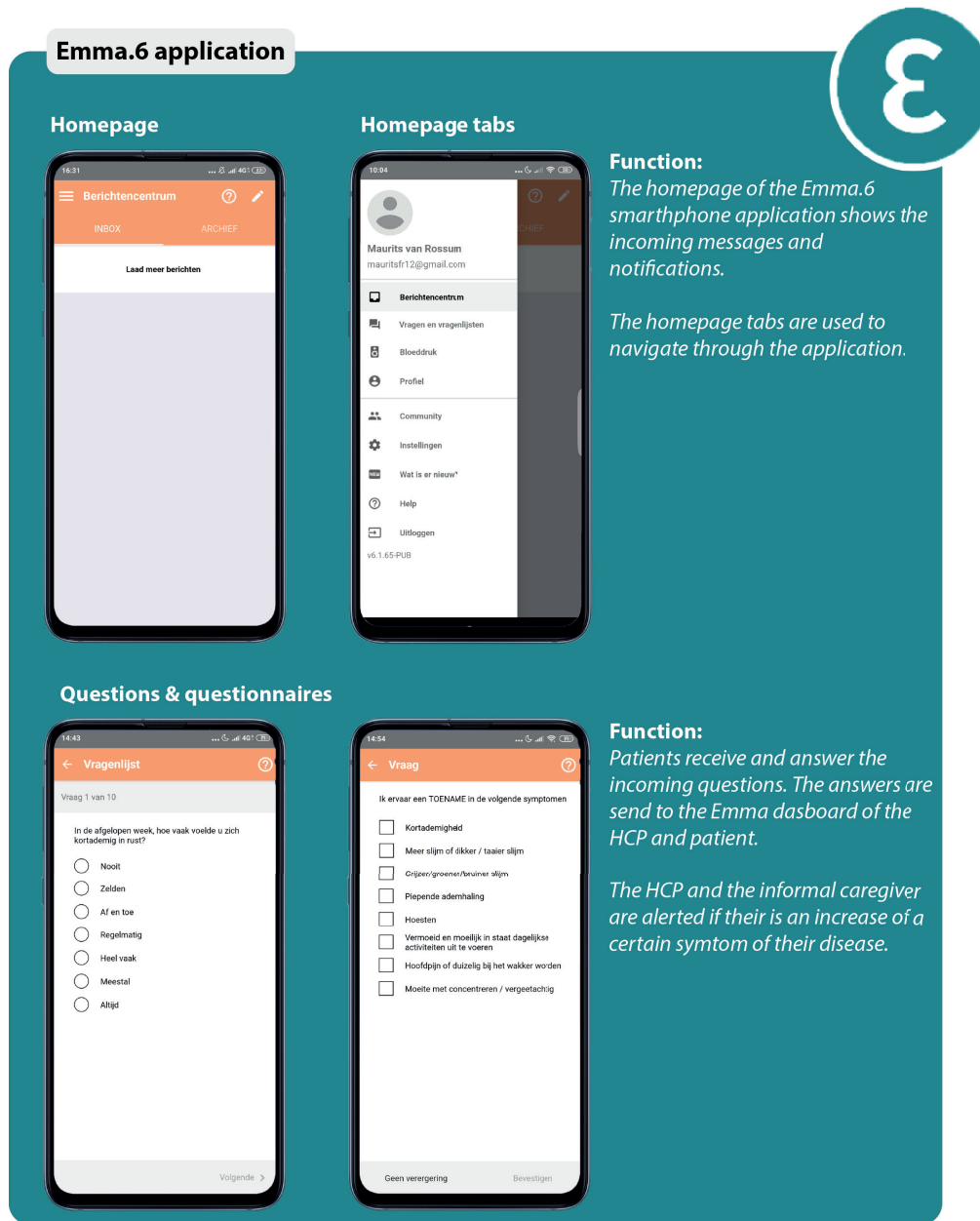
Homepage tabs

Function:
The homepage of the Emma.6 smarthphone application shows the incoming messages and notifications.

The homepage tabs are used to navigate through the application.

Questions & questionnaires

Function:
Patients receive and answer the incoming questions. The answers are send to the Emma dasboard of the HCP and patient.

The HCP and the informal caregiver are alerted if their is an increase of a certain symtom of their disease.

Image 8: Emma.6 smartphone application infographic.

1.1.5 Emma Activity Coach

Medicine Men has developed a Fitbit smartwatch application called the Emma Activity Coach, the infographic in image 9 shows the screens of this application. When a patient with a chronic disease is send to a physiotherapist for activity treatment, they get to wear a Fitbit with the Emma Activity Coach application installed, the inclusion process is further discussed on the next page.

This Fitbit smartwatch tracks the steps of the user with the help of a 3-axis accelerometer which sits in the smartwatch. The captured motion pattern of the user is compared with an algorithm to determine if the motion meets the treshold to make it count as a step ([How does my Fitbit device calculate my daily activity?], w.d.).

Activity battery

The steps taken by the patient are visualized by a battery filling up in the Emma Activity Coach. A small white dott with the current time next to it in the battery visualization shows where the patient should be with their activity. The battery turns green if the patient is active above their set stepgoal, it turns orange if they are below and red if they even drop further away from their stepgoals. The Fitbit will give a short vibration if the patient drops below their goal, and goes from green to orange in the activity battery. The same happens when they go from orange to red and vice versa.

Bad day function

The patient can select the 'bad day' function if they feel that they have or will have an off day with regard to their activity. The stepcount of the patient will be multiplied with a certain percentage. This percentage is set by the physiotherapist during the inclusion of the patient. This process will fill the battery visualization up. A sad smiley will be shown to notify the patient that the function is activated. The HCP and the caregiver of the patient are notified if the patient activates the 'bad day" function. It will also be shown in the activity graphs of the patient in the Emma dashboard when they activated the function.

A full interaction walkthrough with the screens of the Activity Coach application on the Fitbit can be found in appendix B.

Emma Activity Coach

Watchface

The watchface is the first screen of the Emma Activity Coach that the patient will see on their smartwatch. It shows the current time and date, the heart beat of the patient with a color indication (green, orange, red) heart visualization and in the upper right corner an indication of the step goals of the patient. The step goals indication is visualized with a footstep icon. These footsteps change color (green, orange, red) according to the activity achievements of the patient.

Activity battery

The following three screens are the activity stages of the activity battery. The battery represents the activity progress of the patient. The white dot and time indicate where the patients activity progress should be. The battery is filled green if the user is above this point, orange if below, and red if the user is far below.

'Bad day' function

The 'bad day' function can be selected by the patient if they feel that they have a bad day and will not be that active. The stepcount of the patient is multiplied with a certain percentage, which is pre-set by the HCP, when the patient activates this function. A sad smiley informs the user that the function is activated.

Image 9: Emma Activity Coach infographic.

The heart beat of the patient is also tracked by the Fitbit and shown in the Emma Activity Coach watchface. The physiotherapist can set heart beat zones for the patient. If patients do too much in a short periode of time, their heart beat will rise. The patient can see this on their smartwatch and gets a vibration from their smartwatch if they exceed their set heart beat zone.

Double bandwidth

The main principle that distinguishes the Emma Activity Coach from other stepcounter applications is the presence of a double bandwidth in combination with a traffic light color system. This princible is explained in the infographic of image 10.

The physiotherapist sets the amount of steps the patient should take per day segment in the Emma dashboard. Additionally, they set the deviation percentage for the orange and red activity zone. This creates bandwidth system with regard to the activity goals of the patient. Were other activity trackers set a strict goal of a single amount of stepts that need to be reached, Medicine Men's method creates a more fluid activity experience and will take away the

danger of staring blindly at one specific goal. The physiotherapist has the option in the Emma dashboard to activate an aditional bandwidth above the green zone when a patient has the risk of getting too much activity. This is especially the cause for patients with COPD. The physiotherapist creates a double bandwidth system for the patient by selecting this option, they get warned when they have too little but also when they have too much activity.

The activity goal of the patient is real time generated per minute of the day, this means that the activity goal of the patient grows with them during the day, which again helps to create a more fluid activity experience. As can be seen in image 9, the stepcount or stepgoal isn't shown in the battery visualization, since the method of Medicine Men is about getting activity in general and not about reaching a certain number.

Bandwidth setting

Middag (12:00 - 18:00)	3000	stappen
Afwijking oranje	20	%
Afwijking rood	40	%

Above: Example of set step goals by the phystiotherapist.

Right: set step goals translated into the three activity zones with a double bandwidth princinple. The extra bandwidth above the green zone is optional and can be selected by the physiotherapist when a patient has the risk of getting too much activity.

4200 steps
3600 steps
3000 steps
2400 steps

Optional zones

Medicine Men method

Steps

Bandwidth 2 (optional)

Bandwidth 1

Time

Activity:

Other activity trackers

Steps

Goal

Time

Activity: Goal:

| Dag | 6000 | stappen | 0 | 0 | 0 |
| Norm slechte dag | 40 | % | | | |

Waarschuwen bij teveel stappen/activiteit

The physiotherapistchecks the check box to activate the function to create a double bandwith in cause of when a patient has the risk of getting too much activity.

Image 10: Medicine Men Emma Activity Coach activity principle with a double bandwidth.

1.1.6 Emma Activity Coach inclusion

Two patient inclusions were attended at physiotherapist center FysioHolland Zeeland at the start of the project in order to explore the process of including a new patient to the Emma system with the Emma Activity Coach. The patients were included by their physiotherapist. The physiotherapist performed the entire process of downloading the Emma Activity Coach on the Fitbit of the patient and connecting their smartphone and Fitbit smartwatch to the Emma system.

Additionally, the inclusion attendance was done to explore the target group of the Emma Activity Coach. The first patient who got included was a female of 80 years. She suffers from sever COPD and was coughing many times during the inclusion. She had a short periode of exercise in the accompanying gym of the physiotherapist location before meeting the physiotherapist for the inclusion. She clearly had trouble recovering from her earlier done exercise during the rest of the inclusion. It became clear during the inclusion that this patient was digital

illiterate, or as she said: "*I find those smartphones way to complicated, and it stays that way since I will not put any effort in it to learn it*". She noted that her son helped her with several daily chores at home.

The second patient was a female who is 53 years old and also suffers from COPD. She noted that she coughs a lot and always feels tired and stressed. This cases problems for her in regulating her daily life.

Image 11 shows an overview of the inclusion process of the Emma Activity Coach and the first week of use. The physiotherapist explaines the use of the Emma Activity Coach to the patient and determines during the conversation the patients condition and goals. The patient is told not to pay attention to the Fitbit during the first week of used, in order for the physiotherapist to get a baseline reading of the normal activity of the patient. The physiotherpist analysis the first week use of the Fitbit and determines the step goals of the patient during the second consult with the patient. The step goals are set in the patients Emma system and they are ready to use the Emma Activity Coach.
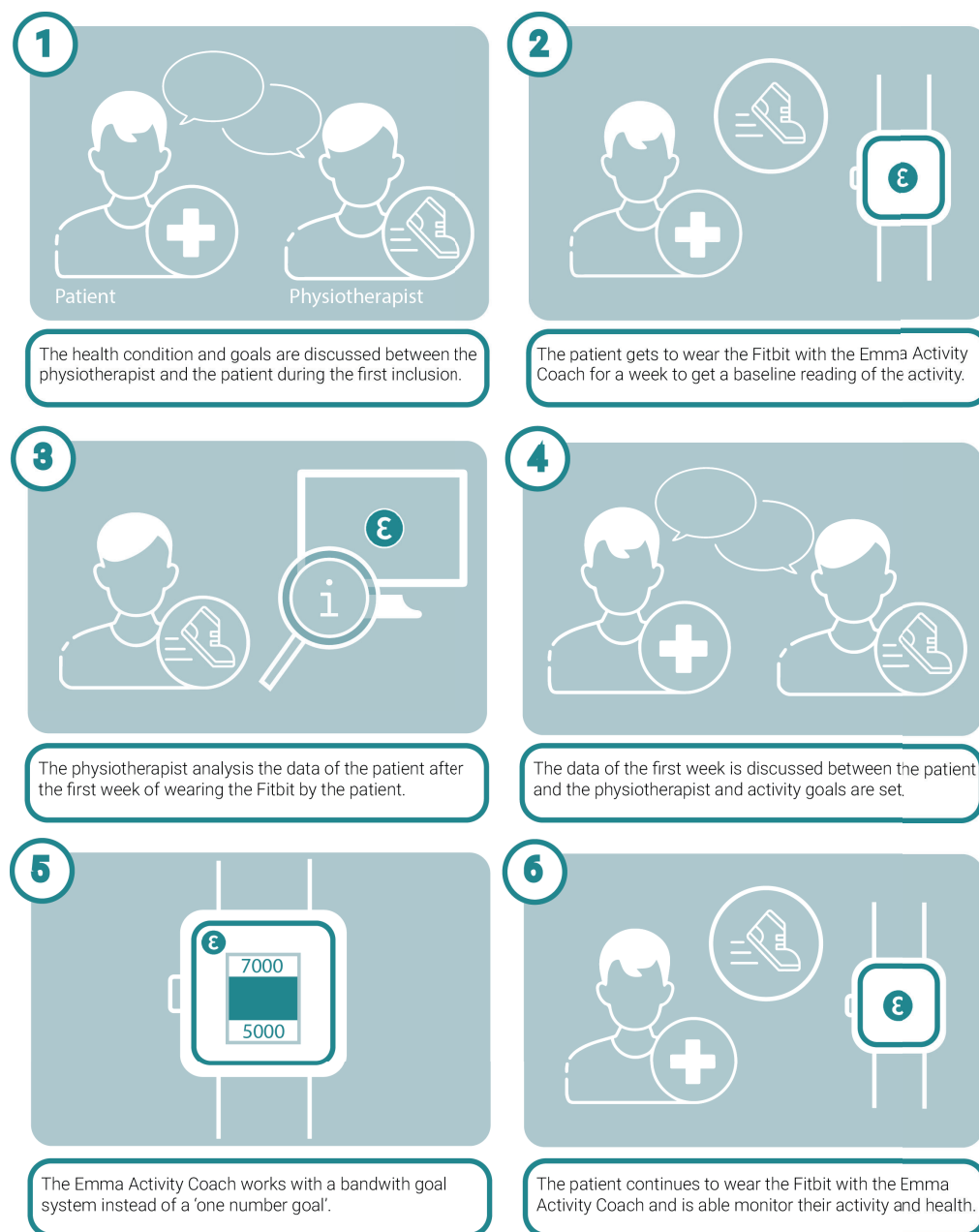
Image 11: Emma Activity Coach inclusion process at the physiotherapist.

1. The health condition and goals are discussed between the physiotherapist and the patient during the first inclusion.

2. The patient gets to wear the Fitbit with the Emma Activity Coach for a week to get a baseline reading of the activity.

3. The physiotherapist analysis the data of the patient after the first week of wearing the Fitbit by the patient.

4. The data of the first week is discussed between the patient and the physiotherapist and activity goals are set.

5. The Emma Activity Coach works with a bandwith goal system instead of a 'one number goal'.

6. The patient continues to wear the Fitbit with the Emma Activity Coach and is able monitor their activity and health.

1.1.7 Fitbit Versa 2

A challenge for Medicine Men is the dependency on the technological usability of the third party hardware products. The Emma Acticity Coach was designed for the Fitbit Versa when I started the project at Medicine Men. A new version of the Fitbit Versa, Versa 2, was launched at the end of September. From that point on, Medicine Men started to work with the Fitbit Versa 2. The biggest change between the Versa and the Versa 2 is the removal of the two right side buttons, as can be seen in image 12. This had implications for the use of the 'bad day' option, since this is selected with the top right side button at the Versa Fitbit model. This function is taken out of the Emma Activity Coach application at the moment. One aspect during this project is to see how the 'bad day' function should be integrated on the new UI and UX of the Fitbit Versa 2. Appendix B and C show the difference in user interaction between the Fitbit Versa and Fitbit Versa 2.

Application vs. watchface

Another change was made during the transition from the Versa to the Versa 2 in the build of the Emma Activity Coach. Image 13 visualizes the previous and new situation of the software. The Emma Activity Coach was build as an application in the previous situation. You had to open the application, as in screen 2 from the previous situation, to run it. A downside to the technology of the Fitbit is that it can not run an application on the background. This ment that the Emma Activity Coach application would needed to be opened the entire time when used by a patient. The result was that the patient isn't able to use other functions of the smartwatch. Additionally, it creates confusion for the user since, as can be seen screen 1 and 3 in the previous situation, the watchface of the Emma Activity Coach is shown in the application while the Fitbit itself also shows a watchface.
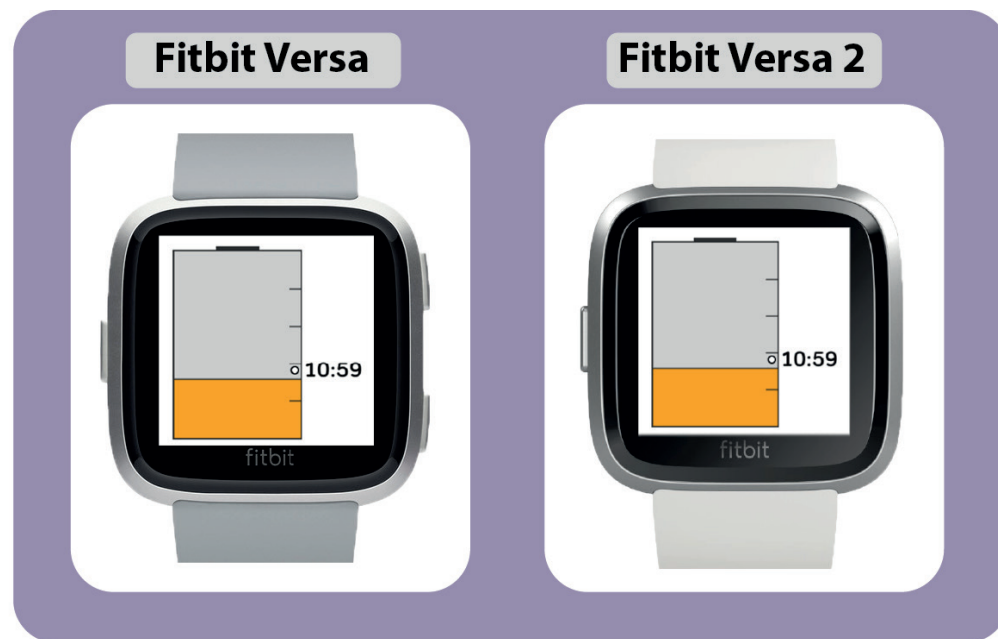
Image 12: The Fitbit Versa next to the new Fitbit Versa 2.

Watchface

A user can download applications for their Fitbit, but also different watchfaces that show the time. The user can personalize their watch this way to their own liking. The Emma Activity Coach is build as such a watchface in the new situation. This means that you don't have an Emma Activity Coach app icon on your Fitbit anymore that you need to open, as shown in the previous situation in image 13, but you immediatley see the Emma Activity Coach as your first screen/watchface on your Fitbit Versa 2, as shown in the new situation in image 13.

Appendix C shows the new usage screens of the Emma Activity Coach running as a watchface on the Fitbit Versa 2. The design and iterations throughout the rest of the project will be focused on the Fitbit Versa 2 and the Emma Acticity Coach build as a watchface.

Image 13: Previous situation with the Emma Activity Coach as an application vs. new situation with the Emma Activity Coach as a watchface installed.

1.1.8 Emma system

Image 14 shows an overview of the Emma platform and how all the different applications are connected with each other. It is quite a complicated system which builds on different products, applications and connections. It is important for this project to understand these connections to know the implications when changes are made in the design.

It starts on the right at the Emma dashboard in which the HCP sets the step goals for the patient. Those are send to the Fitbit smartphone application. The Emma Activity Coach software on the Fitbit Versa 2 takes the set step goals out of the Fitbit smartphone application and translates the taken steps of the user, which are registered by the Fitbit Versa 2, into the battery activity progress visualization. The Fitbit Versa 2 sends the step data via the Fitbit smartphone application to the Fitbit data cloud. The Emma dashboard software takes the step data from the patient out of the Fitbit data cloud and translates them into their own software into activity graphs. The Emma dashboard sends the questionnaires and questions to the Emma.6 application.

1.1.9 Use scenario

This section of the thesis concludes with the scenario of a day in the life of a patient using the Emma Activity Coach which shows an example of the user interaction points of the Emma system.

2. The set step goals are send to the Fitbit smartphone application.

3. The Emma Activity Coach translates the step goals into the battery activity progress visualization.

4. The step data is send from the Fitbit Versa 2 via the Fitbit smartphone application to the Fitbit data cloud.

5. The step data is taken from the Fitbit data cloud and translates into activity graphs in the Emma dashboard.

6. The Emma dashboard sends the questionnaires to the Emma.6 application.

1. The HCP sets the step goals for the patient.

Fitbit Versa 2 Emma Activity Coach

Fitbit

Emma.6

Data cloud

Emma desktop dashboard

Activity & hartbeat data
Stepgoal set by HCP
Questionlists and answers

Patient
HCP

Network
Bluetooth

Image 14: Emma product-service system with all the connections between the different hardware and software.
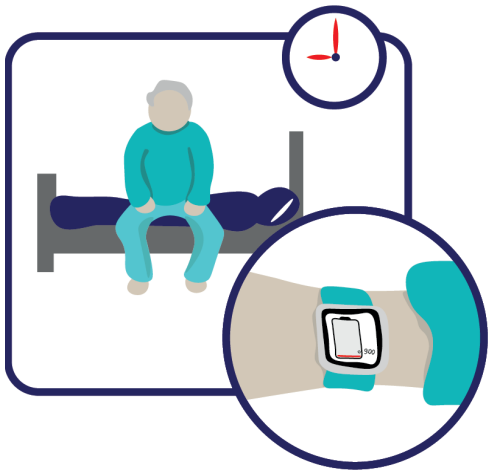
The patient wakes up and sees that the Emma Activity Coach is in the red zone
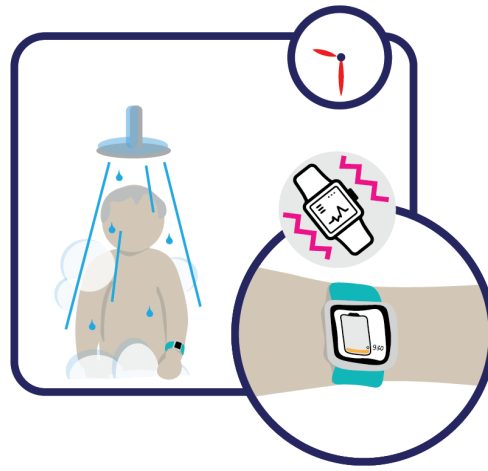
The patient does his morning routine and gets a vibration of the Fitbit to indicate that his activity has brought him in the orange zone

The patient receives a message on its smartphone that it is time to fill in the COPD questionnaire list in the Emma.6 application
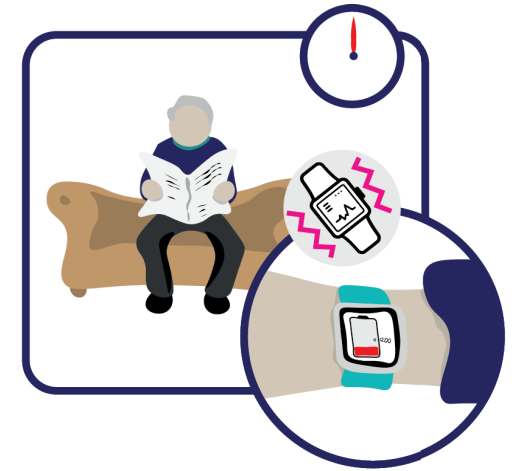
The patient takes it easy in the morning and gets a vibration of the Fitbit to indicate that his activity has dropped back in the red activity zone

The patient has an appointment with his physiotherapist in the afternoon. He decides to walk to the physiotherapist practice to get his activity back in green. He gets a notification during his walk when this happens
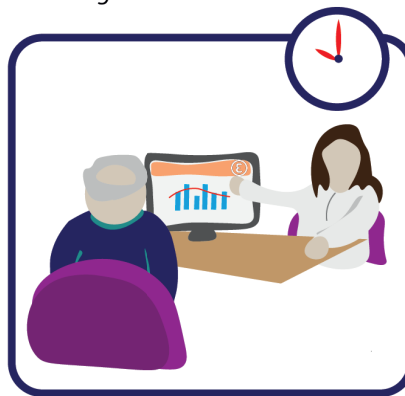
The patient discussed his progress and condition with the physiotherapist by looking at his activity data on the Emma dashboard of the physiotherapist
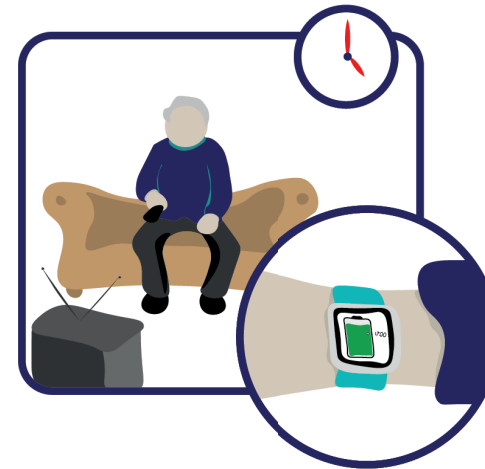
The patient checks his Fitbit at the end of the afternoon and sees that all his activity of the day has made him surpass his activity goal
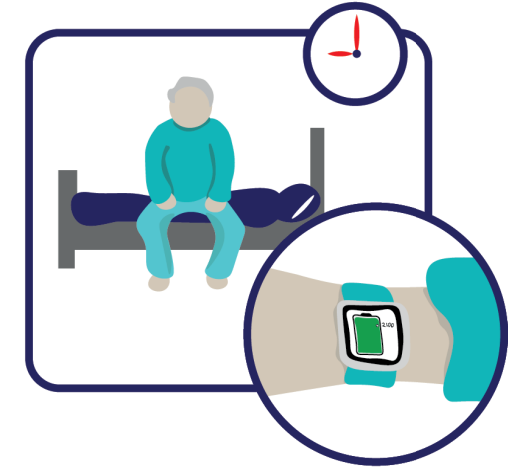
The patient is tired and goes to bed. He sees that his activity zone is still far in green. He is proud of himself and goes to bed satisfied

23

2. Analyse

The analyse chapter aims to understand the domain in which the Emma product-service system operates. Desk research is done in order to explore the competition of the Emma system. Additionally, the rise of a new healthcare system named eHealth is explained and discussed in combination with the aim of facilitating patient empowerment with the use of the Emma Activity Coach. The Emma system domain is further zoomed in by showing the ecosystem and explaining the focus of the project. Finally, research about smartwatch UX in general is done in order to implement the learnings in the next phases of the project.

2.1 Competition

The Emma Activity Coach application on the Fitbit Versa 2 is compared with similar product services on the market. Data collection by Saadatfard & Årsand (2016) shows there were 259.000 e-health applications in all the smartphone markets combined in 2016. Therefore, criteria are setup to compare the Emma Activity Coach application with similar products. The competitor should be a combination of a smartwatch and a smartphone application, just like the Emma Activity Coach. Additionally, the focus should be on monitoring your health by tracking your activity.

Fitbit Care, Apple Health and Google Fit were found the major competitors on the market with a serious focus on health monitoring. The three are compared to the Emma Activity Coach on their functionalities, the way the activity is visualized, which hardware it runs on and the who can access the health data. An overview can be found in image 15.

Emma platform
Emma Acitivity Coach

Functions:
Activity tracker
Heart rate monitor

Expansion: Emma Medication, Emma HBPM (home blood pressure monitor), Emma COPD

Activity visualization:
Double bandwith without numbers

Runs on:
Fitbit smartwatch, mobile, tablet and desktop

Connectivity:
Patient, HCP, caregiver

Apple Watch
Apple Health

Functions:
Activity tracker
Heart rate monitor/ECG-app
Fitness coach
Fall detection
Medical ID
Medication reminder
Nutricion
Sleep
Mindfulness
Sound level
Cycle Tracking

Activity visualization:
Progress bar without numbers

Runs on:
Apple Watch, iPhone and iPad

Connectivity:
Patient

Source:
https://www.apple.com/apple-watch-series-5/health/

Fitbit Care

Functions:
Activity tracker
Heart rate monitor
Fitness coach
Medication reminder

Activity pvisualization:
Steps and stepgoal in numbers

Runs on:
Fitbit smartwatch, mobile, tablet and desktop

Connectivity:
Patient

Source:
https://healthsolutions.fitbit.com/healthcoaching/

Google Fit

Functions:
Activity tracker
Heart rate monitor
Fitness coach

Activity visualization:
Progress bar with numbers

Runs on:
Wear smartwatch, mobile, tablet and desktop

Connectivity:
Patient

Source:
https://www.google.com/fit/

Image 15: Emma Activity Coach competition study.

Emma Activity Coach

The Emma Activity Coach is the only platform that implements the direct connection with a HCP and caregiver. The HCP and caregiver can view the data of the patient and support the patient if needed. Apple Health has the option for the patient to send selected data to the HCP of the patient. The patient is the one in charge to make the call to send data or not. Although this fits to the topic of patient empowerment, the HCP is depending on the actions of the patient and can maybe miss important data or symptoms if the patient does not send their data.

The Emma Activity Coach is also the only platform that lets the HCP set the activity goals. The competition lets the patient set the activity goals by the patient themselves. Off course, the patient can set these goals according to the advise of a HCP, but it leaves room for the patient to alter their goals whenever they want. Letting the HCP set the goals and monitor on them is a strength of the Emma Activity Coach compared to the competition.

Apple Watch & Apple Health

Apple is building a strong health platform. They have developed a lot of health modules for different interventions. The strength of Apple is their clean and easy to understand UI and UX design in combination with their operating system iOS. Although they are the only one who do not provide a desktop version of their health application, they have a strong product portfolio and iOS which makes connectivity between different Apple products effortless. This is important for an elder target group which lacks technological knowledge and does not want to hassle around with connecting different products to each other.

The Emma Activity Coach uses a battery visualization with traffic light zones activity zones. They don't show your steps in this visualisation, since it is about getting the movement and not about reaching a specific step goal. Apple Health works according to the same principle of not showing the stepping numbers, but visualize the activity with clever circular bars and colours. The red coloured outer ring on the Apple watch in image 15 represents the movement and the active calories that the user burns.

The yellow middle ring is the exercise ring that stands for intensive activity. The inner blue ring is a interesting one, this ring represents the minutes that the user is not being active. Apple Health lets the user be reminded of not only the activity of the user, but also the inactive moments. They are the only party from the competitors list that uses this principle. This principle causes a double motivation trigger for the patient to get active, not only seeing that there is insufficient activity can motivate them but also seeing that they have been inactive to long.

Fitbit Care & Google Fit

Fitbit and Google Fit both make use of showing the activity of the user in numbers. Google Fit shows in addition an progress bar. The usage of direct numbers has a risk of making the patient too much goal-driven. The user can get obsessed by the presence of the activity numbers which can cause over achievement. Over achievement can be a risk for chronic diseased patient since their health condition might not be ready to cope with such intense activity.

Conclusion

Apple Health shows with their colour ring visualisation an interesting and strong difference in their application compared to the Emma Activity Coach. Fitbit and Google Fit are quite similar in their approach, but are more goal oriented which can be harmful for chronic patients. The Emma Activity Coach stands out to the competition by having a direct connection with the HCP on the platform who can view the data of the patient and set goals.

2.2 eHealth

The Emma product-service system is part of a new healthcare domain called eHealth. This chapter explores this domain with the help of desk research in order to get a better understanding what role there is to be fulfilled for the Emma product-service system in this healthcare domain.

What is eHealth?

An extensive definition of eHealth is given by Barbabella et al. (2017); "*eHealth is an umbrella term that covers a wide range of health and care services delivered through information and communication technologies (ICTs) such as electronic health records (EHRs), health information systems, remote monitoring and consultation services (e.g. telehealth, telemedicine, telecare), tools for selfmanagement, and health data analytics.*" (p. 7). As described by this defenition, the sharing of health information between patients, informal caregivers and HCPs and selfmanagement is an important aspect of eHealth solutions.

A large part of the e-health domain consists of a system,in which the patient has a wearable sensor that is connected to their smartphone and a web interface. The data of the patient in this system is linked to a cloud server which can be accessed by the healthcare professional on their computer or tablet at the care clinic. The wearable sensor of the patient consists of smartwatch in case of the Emma product-service system. Medicine Men has chosen to use a smartwatch for their eHealth intervention since they found that it has a couple of interesting advantages. For starters, the patient gets their health monitored the entire day and night, if they wear the smartwatch. The patient wears it just as a normal watch. It can track mainy health related aspects such as the patients heart rate, activity and sleep cycle. Another advantage of a smartwatch is how it is perceived by the patients surrounding. A smartwatch is seen as an accessory or jewelry. This has the benefit for the patient to monitor their health unnoticed without them being stigmatised as being ill by their surrounding.

Advantages of eHealth

The introduction and use of eHealth has brought several improvements in the healthcare domain. Image 16 illustrates three main improvements found by Barbabella et al. (2017).

eHealth benefits

1.
Improvement in communication and sharing information between healthcare professional and the patient

2.
Support self-management and therapy adherence by giving the needed tools and feedback.

3.
Give easy acces to healthcare for patients living far away from medical institutes, or patients who are not able to travel due to conditions.

Source: Barbabella et al. (2017) in How can eHealth improve care for people with multimorbidity in Europe?
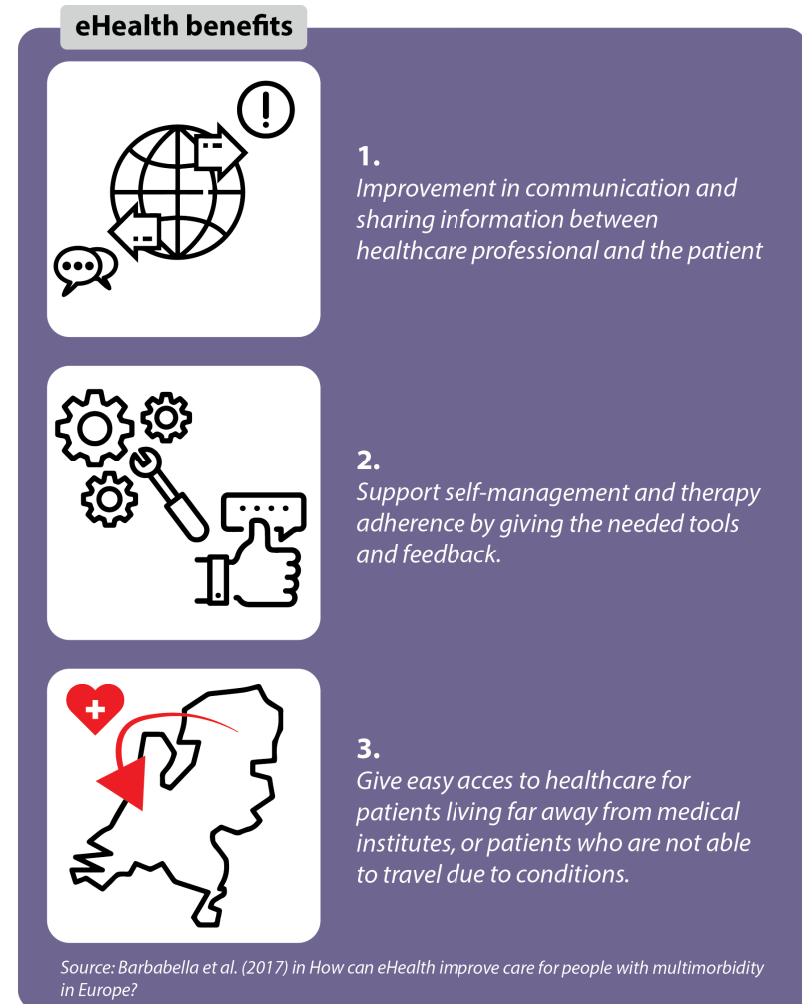
Image 16: Three of the main eHealth benefits, taken from Barbabella et al. (2017).

These three advantages are explained with the Emma system as an example.

1. The Emma system facilitates direct contact between the patient and HCP which makes it easy to communicate with each other. As a result, the HCP is up to date with the health condition and situation of the patient since they have acces to real time information sharing.

2. The patient is given the tools with the use of the Emma system to control and monitor their own health condition. This changes the role of the patient from passive into active.

3. The facilitation of digital communication via the Emma system means that the patient can stay at home while recieving information from their HCP. This also means that patients who have difficulties with traveling to see a HCP, due to their health condition or other situations, can get sufficient treatment and care.

Implementation
Although eHealth shows improvements in the patients health care, research by Nijhof (2013)

shows that the implementation of eHealth solution is still troublesome most of the times. Her study shows that reasons for implementation problems are mainly due to a lack of *information management* and *inadequate inter-agency cooperation* in the healthcare domain. Additionally, a study by Huygens (2017) adds to the latter by showing that half of his patient test subjects were unaware of the existence and availability of eHealth applications and tools. This shows that HCPs could improve the implementation of eHealth soluation by informing the patients more about this subject. Further on, the research by Huygens (2017) with chronic diseased patients showed that patients who precieve more impact on their daily life from their disease are more willing to implement eHealth solutions. Nijhof (2013) adds that knowing the day to day life situation of the patient is truly important in order to fulfill their needs and have a succesful implementation of an eHealth solution.

Medicine Men has a solution to make sure that the implementation of their Emma eHealth intervention is

succesful. They serve as the technical connection between the patient and the Emma product-service system. They have direct contact with the patient in case of connectivity problems or when the patient has questions about their devices or software. Additionally, they check if measurements are going according to the set appointments and are recorded correctly. By doing this, they take over a part of the rol of the HCP by monitoring the patient as well. This gives relieve in the HCPs workload and prevends a negative attitude of the HCP towards the Emma system if problems occur.

Conclusion
The introduction of eHealth shows promising advantages for the healthcare management of the patient. But, the implementation of the eHealth solution should be done with care in order for it to be succesful. An important aspect is the patients day to day situation and will be further explored during the project in order to find out how to succesfuly support the patient via the eHealth solution of Medicin Men.

One of the aims of eHealth and Medicine Men is patient empowerment. Patient empowerment started as a health management strategy to counter the growing chronical conditions. This chapter discusses the definition of patient empowerment in order to apply it in the design process later on in the project.

The World Health Organisation (WHO) has the following definition of patient empowerment according to Cerezo et al. (2016): *"a process through which people gain greater control over decisions and actions affecting their health, and as such individuals and communities need to develop skills, have access to information and resources, and the opportunity to participate in and influence the factors that affect their health and well-being"*. This definition is translated by Bravo et al. (2015) into three actions that the patient should take in order to obtain patient empowerment. Image 17 illustrates these three actions in combination with the outcome of these actions according to Chiauzzi et al. (2016). Chiauzzi et al. (2016) notes that the three outcomes of patient empowerment, *knowledge and cofidence, positive attitude* and

sense of control. These outcomes can be measured on three factors: *patient comprehension, patient satisfaction*, and *active involvement in treatment*. The fulfillment of these factors by the patient will lead to a day-to-day management of their chronic disease.

Effect on HCP

Patient empowerment could also have a positive effect on the workload of the HCPs. The Dutch news frequently mentions the increasing workload experienced by HCPs, more patients are visiting while time is becoming less. A study by the CBS (2019) shows that 44 percent of the employees in the healthcare sector experience a high to very high workload. Additionally, two out of three note a growing workload compared to last year. The same study tells that the main reason of the increase in workload is due to arrangement and administration pressure as well as shortening in staff personal in combination with overtime. Anderson and Funnell (2004) add to the latter that HCP are working under the stress of working more efficient; they have to see more patients in less time. Patient empowerment can relieve the pressure on the healthcare professional by letting the patient be
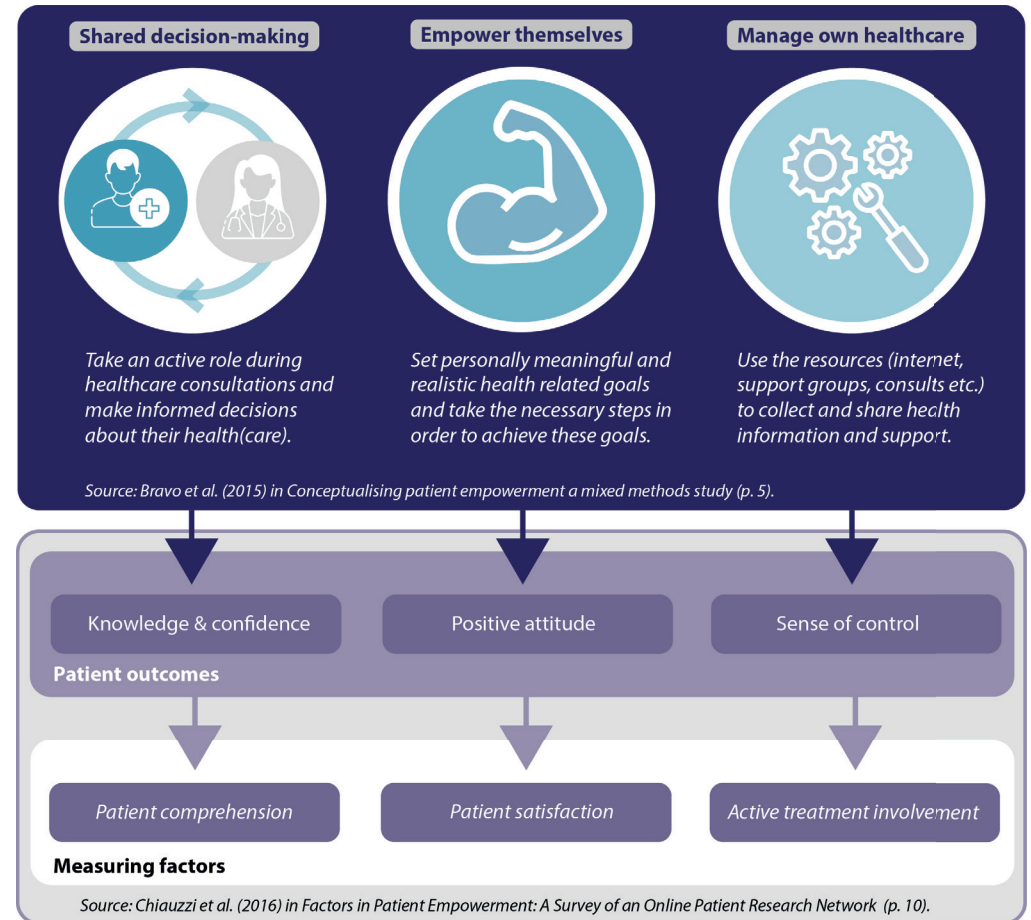
Image 17: Three actions that need to be taken to obtain patient empowerment, together with their outcomes and measuring factors.

more in control of their own health. Patients monitor their own health from their home environment which will reduce the amount of visits to a HCP. The HCP will see a reduction in patient visits and a reduction in workload. This will result in better health care with more attention to personal care.

Conclusion

The literature research shows that three factors are important to focus on during the redesign process of the Emma Activity Coach and the system around it. The patient should be made active in gathering the needed knowledge about their condition in order for them to be confident that they are comprehensive enough to manage their own health. The redesign of the Emma Activity Coach should satisfy the patient in fulfilling their personal needs and goals in order to create a positive attitude to the intervention. Additionally, they should feel in control over their condition and healthcare when using the Emma Activity Coach. This will lead to treatment adherence.

2.4 Emma ecosystem

The previous chapters discussed the domain in which the Emma system operates. This chapter zooms in on the ecosystem of the Emma system in order to understand which stakeholders are involved in the system and where the foucs will be on during this project. An overview is illustrated in image 18.

Patient

The patient takes in the central place of the Emma product-service ecosystem. The patient is the one we needs to take control over their own health. Medicine Men gives the patient the opportunity to self-control their health(care) with the help of the Activity Coach on the patients Fitbit smartwatch, the Emma smartphone application and the Emma desktop dashboard of the patient.

Informal caregiver

Some patients get support by a caregiver. The caregiver is in this project defined as an informal caregiver. The informal caregiver is most of the time the partner of the patient, family, friends or other associates of the patient who support the patient with activities such as housekeeping, getting groceries, and inform/discuss the patients physical and mental health condition with the patient. Caregivers can play an important role in the self-controlling of the health of the patient since most of the health care takes place in the personal environment of the patient in which the caregiver is also present. Nakken et al. (2014) shows that patients with the help of a caregiver even have less visits to healthcare professionals, better exercise management and overall a better quality of life. In return, the same paper argues that the healthcare of a caregiver can result in a growing dependency of the patient. This will cause a decrease in self-care behaviour of the patient. It is key to find the right balance between support and care.

Medicine Men underlines the important role of the caregiver. The caregiver is the first one to get an alert in the Emma platform when the patient is not reaching its activity goals with the Emma Activity Coach. Although Medicine Men sees the potential of the role of the caregiver, there is no research in this area yet. Therefore it is interesting to include the caregiver into the focus of the project and investigate how their role and needs influence the Activity Coach design and interaction.
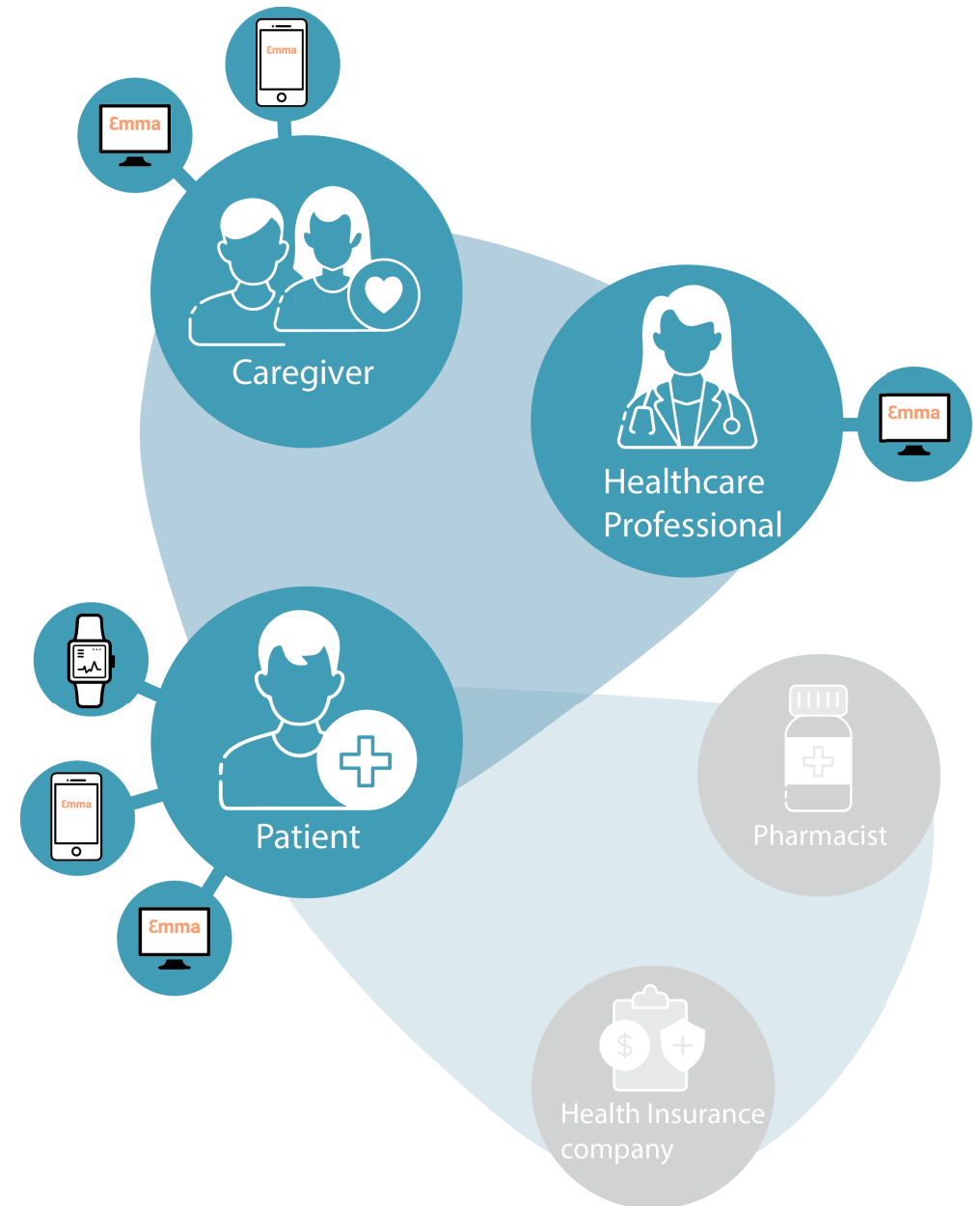

Image 18:Patient ecosystem and focus of the thesis.

Healthcare professional (HCP)

The HCP can be the general practitioner, practice assistant, medical specialist, a registered nurse or the physiotherapist. The focus will be the most on the physiotherapist since they set the activity goals for the patient and get the most contact with the Emma product-service system since the system is focussed on the exercise of the user. The physiotherapist studies the exercise behaviour of the patient and sets the stepping goals. The progress of the patient is checked during returning visits of the patient to the physiotherapist. The general practitioner or medical specialist can monitor the activity progress and condition of the patient at any time when the patient uses the Emma Activity Coach.

Pharmacist and health insurance company

The health insurance companies play an interesting role in the growing eHealth domain. The financing of healthcare organisations such as hospitals in The Netherlands is partly done by health insurance companies who represent the patient. A hospital gets funds per patient that stays in their hospital. The goal of an eHealth intervention is to let the patient manage their health outside a medical clinic. The patient will have less hospitalised days if the eHealth intervention is effective. This would mean less income for the hospitals in The Netherlands. Therefore, health orginisations like hospitals are at the moment unsure of how to implement beneficial eHealth interventions in their system. A new economic system has to be thought of when it comes to implementing e-health solutions in healthcare organisations. Even though this is an essential part of eHealth application development, it is more in line with a Strategic Product Design research direction. However, this is not in the scope of the project.

Conclusion

The focus of the project will be on the patient, HCP and informal caregiver of the patient. Especially the physiotherapist will be focused on as a HCP since they are most likely to set the activity goals of the patient and monitor their progress. The pharmacist does not participate in the interactions on the Emma platform, therefore they are left out of the scope of this project.

2.5 Smartwatch UX

Research is done about smartwatch user experience design since designing for a small screen as a Fitbit Versa 2 brings certain design guidelines. These found design guidelines and UX and UI aspects are taken into action later during the redesign phase of this project. Three important guidelines are visualized in image 19 and are further discussed in this chapter.

Glanceability
Glanceability means that notifications should be displayed clear and direct. Research done by Cecchinato et al. (2017) about smartwatch user experience showed that an important design criteria for smartwatches is obtaining glanceable information. The paper talks about the two second interaction rule when it comes to glanceable information for smartwatches; the user should see and understand incoming notifications on their smartwatch within two seconds.

Notifications
The user does not want to be interrupted all the time, but only in case of important information. Although a smartwatch is a great device for quick and clear notifications, Nahre (2016) notes

that the frequency of notification is important. A smartwatch is worn around your wrist and stays in your eye vision most of the time, whereas a smartphone is stored in your pocket or bag and needs to be actively taken out when interacting with it. If the user gets too much notifications on their smartwatch, they can get bored or irritated which causes negative interaction with the application. Medicine Men uses as a rule of thumb that there should only be a maximum of three notifications per day on the smartwatch in order to prevend irritating interruption in the users daily life.

Screensize
Information on a small smartwatch screen should be readable and easy to interact with. The size of the tap targets are important if touch actions are needed on a smartwatch touchscreen. The size of a regular finger can already block half of the screen when trying to tap on a certain tap target, this means that there is a chance that users will tap in the wrong places.
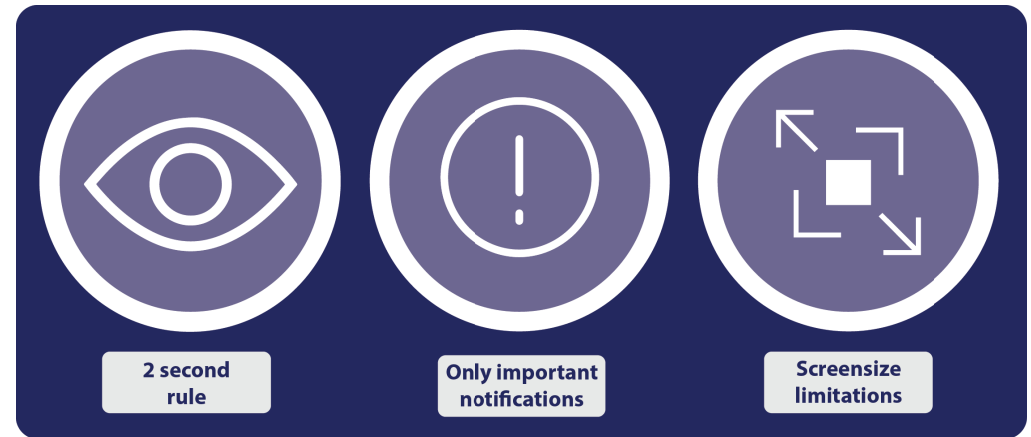

Image 19: Smartwatch UX and UI design guidelines.

Image 20: Fitbit guidelines redirect QR code.

If a smartwatch application is linked to a smartphone application or desktop application, which is the case for the Emma platform of Medicine Men, a holistic design should be achieved. This means that the connection between the different applications on different devices should link with each other visually and UX whise. This will expand the use on the different platforms and it prevents that certain information stays locked in one device.

Fitbit has their own webpage that holds all the design guidelines for developing applications for their smartwatches. These guidelines and tips and trics are taking into account in the conceptualization and finalization phase. The QR code in image 20 brings you to the Fitbit guideline page.

Conclusion

The redesign of the Emma Activity Coach on the Fitbit Versa 2 should show information that is clear and quick to understand for the user. The size limitation of the screen should be kept in mind during the redesign phase. The information and notifications that are being shown should be made clearly visable and understandable. Screen interaction should therefore be designed in a way that the user knows where to interact and prevend that they tab wrong interaction points on the screen. Additionally, the notifications should be kept minimal in order to prevend irritating interuption in the users daily life.

3. Exploration

The previous chapters analyzed the Emma product-service system and its operating domain. The following chapter dives deeper in the domain by exploring the user experience of the Emma system and setting up the target group as well. The chapter is tackled from two aspects, on one hand that of the healthcare professionals and on the other the perspective of the patient and their informal caregiver. Each group is further explored via field study interviews in order to get a complete picture of the target group of this project together with their needs and wishes. The needs and wishes are translated into a concluding design vision for the project together with setting up the design criteria for the conceptualization phase of the project. The chapter concludes with understanding the process that the patient goes through before and during use of an intervention such as the Emma Activity Coach by combining the found results from the field study with literature about designing for behaviour change.

Medicine Men currently has its main focus on the chronical lung disease COPD. But they are interested if the Emma Activity Coach could be implemented for the treatment of other chronic diseases then only COPD, and if so, what this would mean for the current design and interactions.

Goal

The problems and needs of the target group were explored via two interviews with HCPs. Additionally, the HCPs were asked about their interaction with the Emma system in order to find out their experience with the system.

Participants

The two interviewed HCPs are a rehabilitation physiotherapist from the Universitair Medisch Centrum (UMC) Utrecht and a geriatrics physiotherapist of FysioHolland.

Method

Research questions were made to be used as a quideline throughout the interview. These research questions can be found, together with the rest of the interview data of the HCP in appendix D. The interviews were held at the practicing location of the HCP. The interview was recorded with the consent of the HCP and transcribed later for further analysis.

Result

The outcome of the HCP interviews is visualized in image 21. The HCP noted that patients have problems with getting enough activity, but also with getting too much activity. Too much activity is especially the case for patients with COPD. They tend to overdo their activity and exceed their limits. A third option is a patient who does not know how to have the right activity balance.

The interviewed HCP noted three reasons for the activity problems of the patient. First, the cognitive capacity of a patient is an important factor for understanding their condition and acting upon it. COPD patients are for instance know by HCPs as a patient group that on average has a lower cognitive capability. Second, the patient can have a lack of trust in their body. This uncertainty araises since suddenly they can't do certain activities anymore due to their condition, which before they could. The third reason is linked to the second one, a patient can be unaware of their activity limits. Patients with chronic diseases percieve a change in their physical and mental condition due to their illness. They find it hard to adapt to their condition and are unaware of what they can and can't do. They are therefore held back in their activity which will result into a held back attitude in their daily life in general.
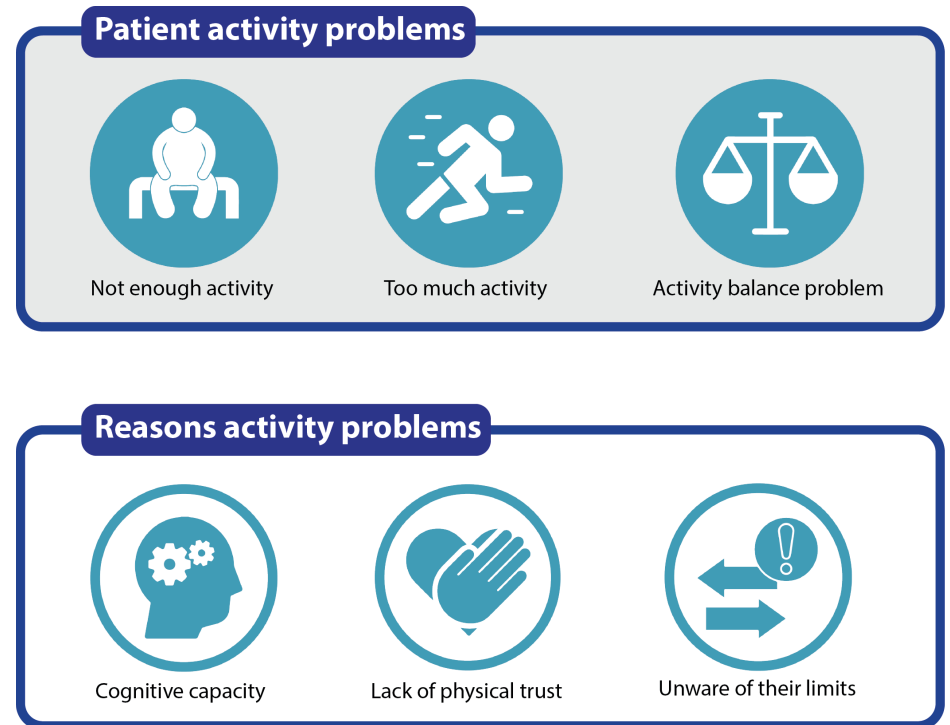

Image 21: HCP interview results patient activity.

One of the research questions for these interviews with the HCPs was about their interaction with the Emma system. One of the physiotherapists noted that he only looked at the data of the patient in the Emma system during a consult with the patient. He didn't monitor the patients data at any other days. He told that he simply didn't have the time for it. His ideal situation would be if he could have one hour a day to completely spent on going through all the data of his patients and monitor how they are doing, but he could not find a free hour to do so.

Target group exploration
The goal of the Emma Activity Coach is to let the user take control over their health by monitoring their exercise. When asking the questions to HCPs which group of patients benefits the most from exercise, both answered that sufficient exercise is beneficial in general for healthy and unhealthy people and not specific for a certain group of patients alone.

Both HCPs noted during the interview that the three most common chronic diseases are COPD, Cardiovascular Disease (CVD) such as heartfailure and Type 2 diabetes. Most of the patients in this category have comorbidity, which means that they have a combination of these three chronic diseases or suffer from all three of them. Both healthcare professionals noted that these patients most of the time fit the age group of 50 plus. The next page discusses the importance of interventions for chronic diseases and the connection with activity. Additionally, COPD, CVD, and Type 2 diabetes are shortly explained.

HCP activity monitoring
The question was asked about the monitoring of the activity of the patient; what does the HCP find interesting to look at, with regard to the activity of the patient? The interview results showed that the HCP is not that much interested in a patient reaching their goal, but more how the patient devides their activity over a day. Especially the aspect of a patient learning their limits and knowing when they can be activite or need to slow down a bit. This is in line with the earlier discussed activity principle of Medicine Men shown in image 10. One of the interviewed physiotherapists added that he likes how Fitbit tries to achieve an activity devision of the user over a day, they have a standard goal in their system of reaching 250 steps per hour.

3.1.1. Chronic disease literature study

The previous chapter discussed the decision to focus on chronic diseased. This chapter adds to this decision by illustrating the severatity in the healthcare of chronic diseased patients in The Netherlands.

Around 9,9 million people suffers from one or more chronic diseases in The Netherlands in 2018 according to numbers of the Volksgezondheidenzorg (2019). A rise in chronic diseases can be seen in image 22 from the age of 50, with a height of 95% of chronic diseased people over the age of 75. Important contributors to chronic diseases are smoking, insufficient physical activity and unhealthy eating habits. Although most of the time there is no chance on full recovery for the patient, making a change in the contributors mentioned above can improve the quality of life of the patient. Patients who have a chronic disease know that they most likely will live with the implications of the disease the rest of their lives. Therefore, it is important that the patient gains trust over their mental and physical condition, security and self-efficacy in order

to improve their wellbeing in their daily lives. This feeling of wellbeing and quality of life is an important factor for patients with chronic diseases. The patient does not want to be reminded all the time that they are ill. They want to experience as little as possible restrictions by their disease. If a patient is hold back due to their disease, they feel that they are a burden to their surrounding which can result in social isolation and depression according to studies by Boing et al. (2012).

Physical activity can play an enormous role to overcome the implications of the chronic disease. Research by Winter et al. (2012) has shown that the patient does not have to perform intense exercise routines to make an change. Only 30 minutes of normal physical activity per day for over a few days a week is enough for the patient to see positive effects on their health. But to get the patient to be active for 30 minutes a day is most of the time already a task on its own. Some barriers for chronic diseased patients to be active are a lack of time, physical not able to exercise or having a aversion to exercise in general (Dontje, 2014).

Number of people that have one or more chronic conditions on 1 January 2018:
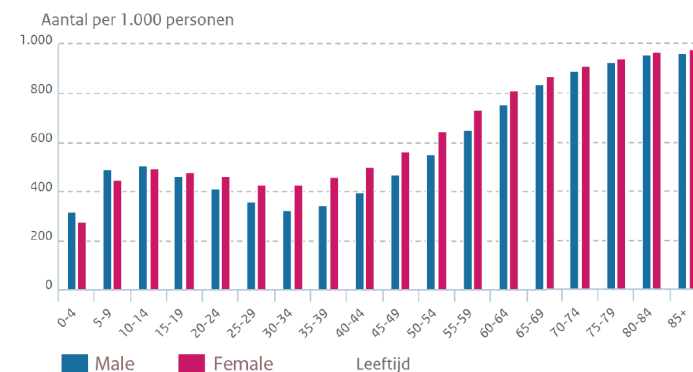
Number of people that have a chronic condition and are in contact with a general practitioner in 2018:
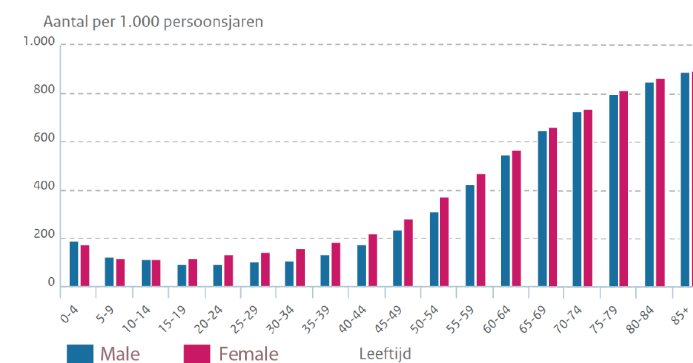
Source: Nivel Zorgregistraties eerste lijn. Taken from Volksgezondheidenzorg.info (2019).

Image 22: Graphs from the Volksgezondheisenzorg that show the deviation in people with chronic conditions in The Netherlands on 1 January 2018. A significant growth can be seen from an age of 50.

The HCP interview results showed that COPD, CVD and Type 2 diabetes are the three most common chronic diseases, with the addition of most of the patients having comorbidity. A better understanding of the health conditions of the target group is given by explaining these three chronic diseases in short and a visualization in image 23.

COPD
COPD is a condition at which the lungs are damaged. Breathing becomes troublesome for the patient which causes energy problems and restrictions in their daily life. COPD can consist out of chronical bronchitis or emphysema. Chronical bronchitis means that the bronchi, which are the branching of the trachea to the lungs, are infected and cause extra mucus and difficulty with breathing. Emphysema is the name for the process of lung bladders breaking down. Lung bladders make sure that oxygen gets into your blood after inhaling. Breathing is becoming cramped when the amount of lung bladders is decreasing. COPD is categorized in four groups from mild to very severe COPD: GOLD I, GOLD II, GOLD III and GOLD IV.

GOLD stands for Global Initiative for Chronic Obstructive Lung Disease (GOLD report, 2019). The focus of this project is on patients with GOLD III and GOLD IV COPD (severe and very severe). Around 600.000 people have COPD in The Netherlands (Longfonds.nl, w.d.)

CVD
Cardiovascular disease (CVD) is an umbrella term for several disorders of the heart and blood vessels that for instance contain thrombosis, heart attacks, strokes or coronary heart disease. These conditions are related to the clogging of blood vessels, which prevents blood flowing through the body. CVD is the number one cause of death globally according to the WHO (2017).

Type 2 diabetes
Your blood does not reacted to insulin as it should be when having Type 2 diabetes. Insulin is a hormone that regulates the blood sugar levels. The insulin is not detected by the body which causes an increase of sugar in the blood. 1.1 million people suffer from Type 2 diabetes in The Netherlands according to diabetes Fonds (w.d.).
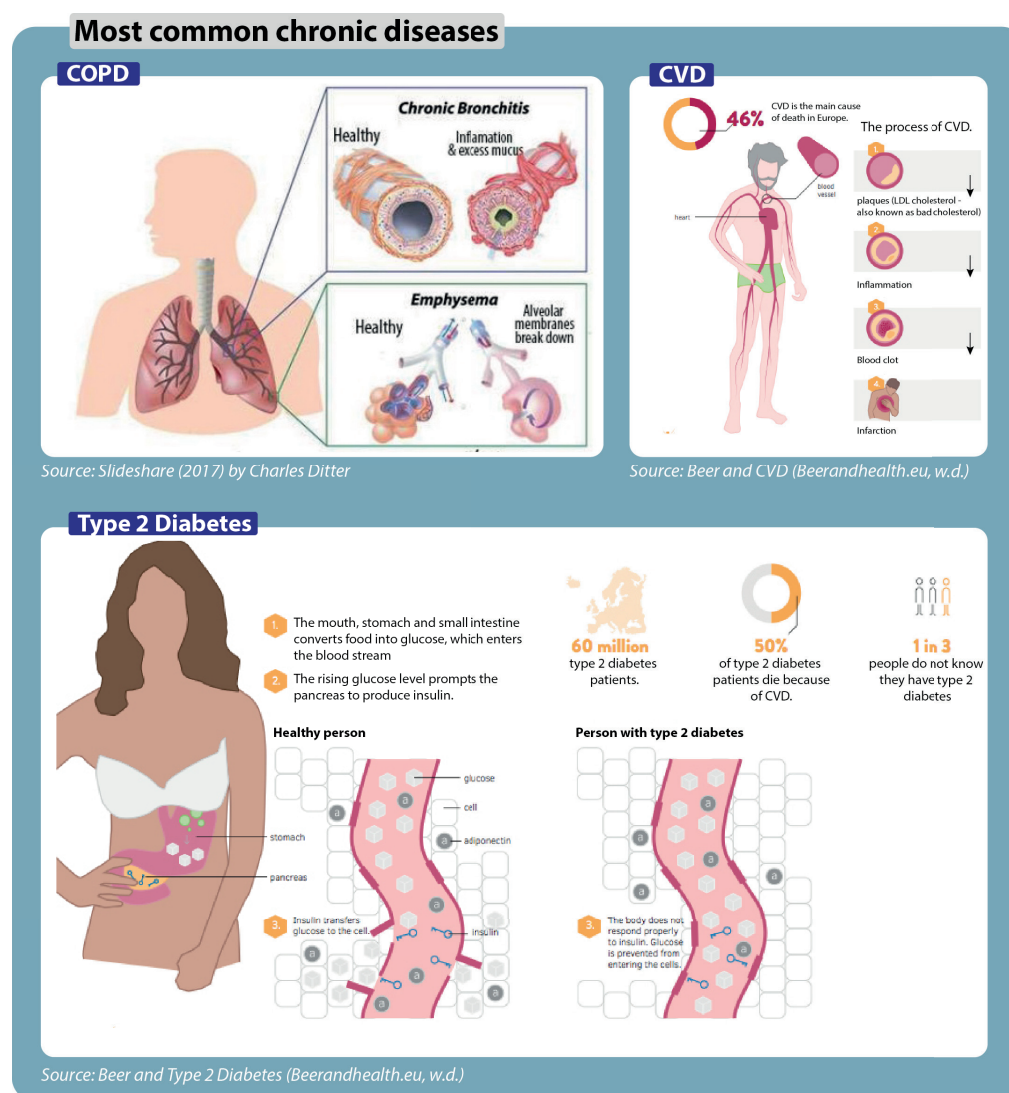
Image 23: Infographic of the three most common chronic diseases; COPD, CVD and Type 2 diabetes

All three chronic diseases have in common that they are mostly caused by behavioural factors such as smoking, not enough exercise, an unhealthy diet and obesity. Additionally, diabetes patients have a higher CVD risk.

Conclusion

The interview results with the HCPs showed that activity, and therefore the Emma Activity Coach is beneficial for healthy and unhealthy people and not specific for a certain group of patients alone. However, the decision is made to focus on the group of patients with chronic diseases since their condition and health problems are permanent and in some cases even slowly decreasing. This will make it extra important for this group to monitor their health and exercise to prevent as much change as possible in their daily routines and remain a good quality of life despite their condition.

The focus is on patients with the three most commen chronic diseases; COPD, CVA and Type 2 diabetes. The target group is over the age of 50, since research shows that a rise in chronic diseases can be seen from that age. Additionally, from this age implecations are growing from chronic diseases that effect the quality of life of the patient. Therefore, the eHealth solution of Medicine Men can play an important role for this age group.

Image 24 summarizes the target group of this thesis.

Image 24: Project target group infographic.

3.2 Target group field study

The target group is further explored via interviews with three chronic diseased patients. The qualitative interviews provided thorough user experience insight, since the interviewed patients alr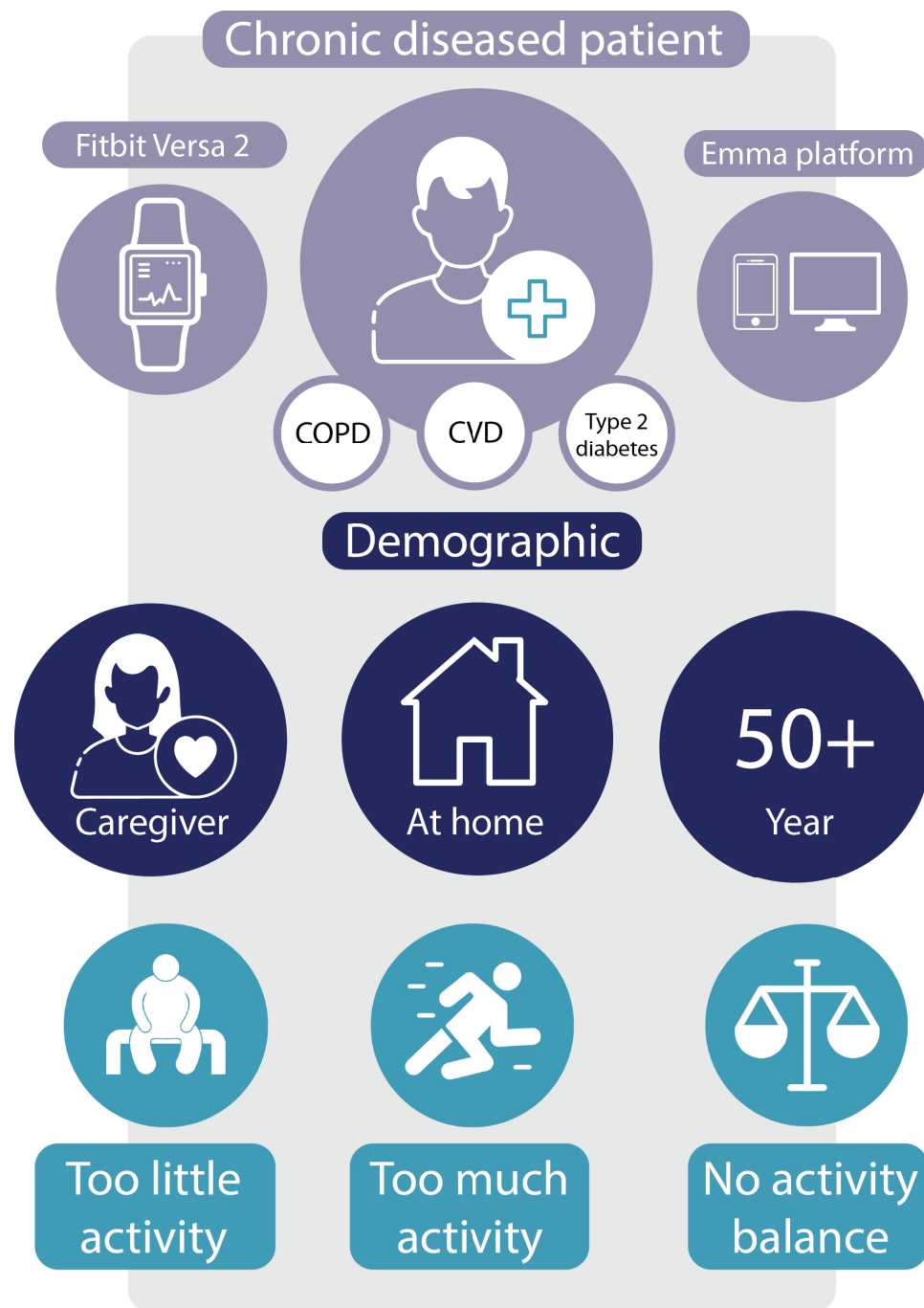eady have two years of experience with using an earlier version of the Emma Activity Coach that runs on the Pebble smartwatch, which is the predecessor of Fitbit. Next to the patients, three caregivers were interviewed as well.

Goal

The goal of these interviews was to further explore the target group, by getting insights from the patient and caregivers themselves. It was studied how the chronic disease effects their daily life and what their perception on it is.

Method

Two of the three patients and two of the three caregivers were interviewed at their home. One patient and one caregiver preferred the interview to be held via the telephone. The audio of the interviews was recorded, with consent from the participants, and afterwards transcribed. Research questions were set up and used as a guideline through the interviews. This list of research questions can be found in appendix E.

Statement cards were made in order to transform the interview data into knowledge, via the DIKW scheme of Ackoff [image 25] (Sanders & Stappers, 2014). Image 26 shows examples of statement cards that are transformed out of the interview data. Interesting quotes from the interviews were interpreted and paraphrase into a statement. These statements were grouped into themes to find the main needs of the users in order to formulate the design criteria. An enlarged version of image 27 can be found in appendix F.

Image 25: DIKW scheme.

Wisdom

Knowledge

Information

Data
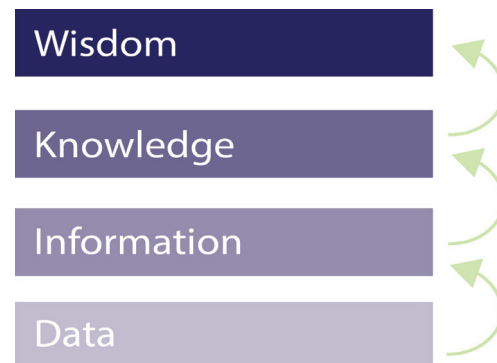
Conditie

Ze ervaren socialen belemmering door hun gezondheidsproblemen.

"Je gaat hier naar de stad, even winkelen. Ja daar heeft zij dan geen erg in, maar je bent elkaar tot last. Je stapt uit die auto en zij [beeld uit dat partner ervandoor wandelt] dan denk ik 'ho, ho'."

MS

Stimulatie

Vergelijken van stappendata van andere dagen creëert een doel.

"Kijk dit is volgens de gegevens in de Pebble app het aantal stappen voor een 'typical woensdag', vorige week had ik 5368 en nu 5794 dus, het zijn er wel niet veel maar toch 400 meer. En wanneer het niet gaat houdt het op natuurlijk."

CB

Image 26: Example of statement cards made out of the interview data.
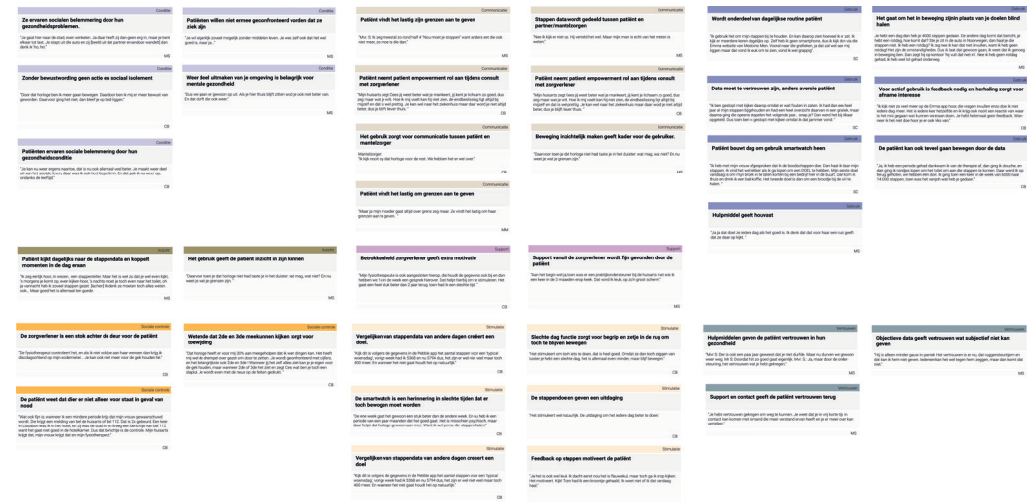
Image 27: Impression of the categorization of the statement cards, see appendix F for full version.

Participants

A description is given on the right of the interviewed patients which gives a rich image that explains the demographic, condition and environment of the target group.

P1

Gender: Male
Age: 81

Chronic disease: COPD (due to smoking)
Situation: Retired, lives together with his wife who is his informal caregiver (C1)

Condition
P1 became very limited in his daily life due to his disease. He was hospitalised several times due to an exacerbation of his disease. This resulted in physical and mental uncertainty for him and his wife.

Attitude
P1 was a stubborn patient at first when he was diagnosed with COPD. He thought that he didn't need any tools to help him in managing his condition, he found them nonsense tools. When his condition worsened, he and his wife visited several COPD meetings with HCPs and other COPD patients. They decided to try several tools to lighten the condition of P1 after gathering information at those meetings.

eHealth tools
*He is using the Emma Activity Coach for over one and a half year now on the Pebble smartwatch. He uses an oxygen tank with a portable inhaler to take with hem on the road and he has a portable mobility scooter.*

Outcome
He and his wife gained back trust and control over his physical condition, which resulted in a positive mental condition. Additionally, he noted that he does not feel like a burden to his wife anymore because of the positive effect of the health improvement tools. P1 and his wife even went on holiday with the caravan to Norway this year, something that they never imaged was ever possible again a few years ago.

P2

Gender: Male
Age: 61

Chronic disease: Comorbidity: COPD and former diabetic.
Situation: working, lives together with his wife who is his informal caregiver (C2)

Condition
His health condition controlled his daily life for his entire life, with a very negative period three years ago. In this period he was taken into revalidation care for 12 weeks two times. He couldn't return home since he wasn't able to go up the stairs to enter his house.

Attitude
P2 always stood open for new treatment methods and is positive again about the futher due to his condition improvements with the Emma Activity Coach.He admits that he was obsessed with improving his step count in the begin period of use, which resulted into him walking circles through the café that he owns just to get a higher step count than the day before.

eHealth tools
P2 uses the Emma Activity Coach for two years now on a Pebble smartwatch. He also had a scale connected to the Emma platform for his weight.

Outcome
His condition improved enormous when using the Emma Activity Coach and he now lives home again. He sees the physiotherapist ones a week at which they discus his progress and goals. P2 finds it stimulating that he can now see his activity results. His physiotherapist had to call him back on this behaviour since it resulted into an unbalanced activity pattern.

P3

Gender: Male
Age: 60
Chronic disease: Type 2 diabetic
Situation: working, single

Condition
P3 is a diabetic who has trouble staying on a healthy weight.

Attitude
He started using the Emma Activity Coach to lose weight and to get a grip on his health. P3 does not own a smartphone and has a minimalistic attitude when it comes to materialism.

eHealth tools
P3 uses the Emma Activity Coach on the Pebble smartwatch for two years now.

Outcome
P3 has built his daily activities completely around getting his steps. Going for groceries for instance is not specific aimed at the groceries, he tells, but more at getting outdoor and taking some steps. He looks at his activity progress multiple times a day, since he enjoys watching the graphs that show his activity results.

Patient interview results

The needs of the target group were defined by comparing the outcome of the patient interview analysis via statement cards to the list of six user experience needs by Lenz et al. (2014). These six needs are: autonomy, competence, relatedness, popularity, stimulation, and security. Meaningful user interaction design will be met when fulfilling one or more of these needs according to Lenz et al. (2014). Therefore, the statement card interview analysis is compared to the classification of these six needs in order to be able to categorize the data. The main needs of *autonomy, security* and *stimulation* apply the most for the experiences of the interviewed patients and caregivers. These needs of the target group are explained on the right according to the found interview results.

Autonomy

The interview data analysis showed that autonomy is an important need for patients when it comes to patient empowerment. The interviewed patients understand that they are in charge of their own actions with regard to their health management. They stop waiting and actively manage their chronic disease with the help of different tools such as e-health. Before, patients felt that their condition was a burden to their surrounding. By fulfilling the need of autonomy, they bring back the pleasure in their daily life.

Security

It became clear out of the interviews that patients with chronic diseases live an uncertain life. They don't know when there condition can worsen. This uncertainty can cause restrictions in their daily life because they don't know what their limits are and can't plan their day according to it. It can even cause the user to completely stop undertaking activities and stay at home all day with social isolation as a result. Therefore, security is an important need for the patient in order to take back the trust over their body and make them learn to recognize their physical limits.

Stimulation

The interviewed patients noted that in order to obtain autonomy, stimulation is a need that needs to be fulfilled. A patient can't change their behaviour just by a HCP telling them. The need of stimulation helps the patient to create a goal. It is key to make it a fun experience for them. This will create therapy adherence which is beneficial for the patients health and quality of life.

3.2.1 Informal cargiver

Three caregivers are interviewed. The caregiver of the patient is part of the second ring of the Emma ecosystem and can acces the Emma dashboard of the patient in order to monitor their health. Their situation and experience is explored as well.

Goal

The goal of the interviews with the caregivers was to explore the role of the caregiver and how the care for a patient effects their daily life. In addition, their level of involvement and interaction with the Emma system was explored. This was done to get an understanding of the connection of the first and second ring of the Emma system and find out in what degree the caregiver would be involved in the design process.

Method

Three caregivers were interviewed. This was done during the same interview session as discussed on page 41. Two caregivers were interviewed in person and one via a telephone conversation. The research questions can be found in appendix E. A description is given on the right of the interviewed caregivers.

C1

Gender: Female **Situation:** Informal caregiver of P1
Age: 76

Situation
C1 helps P1 with small chores in the house such as getting something from upstairs, since P1 is quickly out of breath. The use of the Emma Activity Coach by P1 has given C1 trust and convidence in the condition of her husband. She knows that there is support now and that they are up to date with his health situation and can act upon it.

Involvement patient eHealth data
C1 notes that she does not watch the activity data of her partner herself; her partner watches his data several times a week on his smartphone and shows it to C1.

C2

Gender: Female **Situation:** Informal caregiver of P2
Age: 56

Situation
Although P2 noted that he sees a positive improvement in his health, C2 is still a bit reluctant to be positive since P2 has had health troubles his entire life.

Involvement patient eHealth data
C2 does not look into the activity data of her partner. She notes that the talk about it sometimes. She finds it comfirming that she gets alerted via Emma if symptoms of P2 worsen.

C3

Gender: Female **Situation:** Informal caregiver of her mother of 76 who suffers from severe COPD
Age: 53

Situation
C3 helps her mother with daily chores such as cleaning the house and getting groceries. She notes that her mother can't do anything anymore and only moves between her bed, the couch and the toilet. Her farther lives together with her mother and also tries to help were he can with daily chores.Her mother finds it hard to recognize her limits; although she is physical not able to perform daily chores, she can't let it go and does it anyways. This makes C3 worried about the health of her mother.

Involvement patient eHealth data
She does not watch the activity data of her mother on Emma. She finds that such information is private. She discusses the condition with her mother by asking her how it goes.

Caregiver interview results

Supporting role

It became clear out of the interviews that the caregiver mainly has a supporting role by being a listening ear for their partner. The three interviewed caregivers all noted that they are not actively looking at the Emma Activity Coach data of their partner, but that their partner would share the information with them during conversations. The visibility of the activity data in the Emma platform gives the patient the ability to discuss their health condition to their caregivers. This shows that an important role of the Emma platform is to function as a conversation starter for the patient to discuss their health with their caregiver. Additionally, the interviewed caregivers noted that they help the patient with daily chores such as doing groceries. This isn't a problem to them since they note that it feels natural to help the patient in their daily needs.

Up to date

The Emma system makes sure that the patient and caregiver are constant up to date on the situation of the patients health condition. P2 en C2 illustrate this by telling a story that P2 stayed in the hotel during a holiday in Lisbon while C2 went into the city center. P2 recieved a COPD questionnaire via Emma that moment while he was in the hotel alone. He filled in that some symptoms had worsen. His partner, C2, directly recieved a message on her Emma smartphone application that she needed to go check on P2 in the hotel. The patient and caregiver found this monitor and alert system of Emma a very reasuring tool.

Caregivers quality of life improvement

The eHealth intervention does not only improve the quality of life of the patient, but also that of the caregiver. Caregivers noted during interviews that their day to day routine was restricted by the uncertainties of the health condition of the patient in the past. The result of these uncertainties was social isolation for the patient and the caregiver, since they didn't know the limits of the patients condition and therefore didn't undergo any actions or activities. The eHealth intervention gave the ability to self-monitor the health condition of the patient and take away the physical condition uncertainties. The patient and the caregiver are able to plan their day to day routines again and get out of their house more often without having the stress and uncertainties they experienced in the past. This was found to be a large improvement in quality of life. The change from uncertainty to trust and control is visualised in image 28.

Conclusion

The eHealth intervention is used by the patient as a conversation starter with their caregiver. The caregiver takes care of the patient by helping with the daily chores in and around the house, since that feels as a natural thing to do for them. The interviewed caregivers did not actively interact with the Emma dashboard to view the activity data of the patient, as mentioned, the patient discussed the activity data during conversations. It is important for the caregiver that they know how the patient is feeling and that the patient has control over their disease since this takes away uncertainties and restriction in their quality of life. These findings are of value during the redesign proces of the Emma Activity Coach.

Past situation patient & caregiver - *uncertainty & social limitations*

Patient

The patient does not know their limits

Uncertainty and no communication about the patients condition

Patient

Caregiver

Social isolation is a common result for the patient and the caregiver
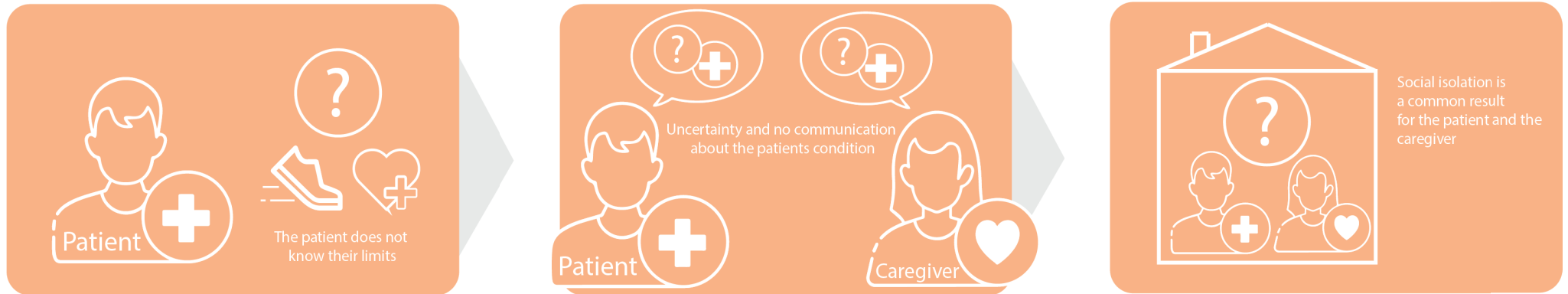
Desired situation patient & caregiver - *trust and control*

Patient

The patient monitors their health condition on their Fitbit

Communication about the patients condition

Patient

Caregiver

The patient and caregiver have the trust and courage to go out

Image 28: Past vs. desired situation of the health data communication between the patient and the caregiver.

3.2.2 Role HCP

The assignment chapter discusses that the role of the HCP is changing from telling what the patient should do to supporting the patient in their own health monitoring. The implementation of e-health interventions, such as the Emma Activity Coach, gives the HCP the opportunity to help the patient from a distance in monitoring their health as well as giving the HCP relieve in their workload due to a reduction in patient visits. The patient gets stimulated to address their own health condition.

Goal

The goal was to explore the role of the HCP and how their role is preceived by the patient.

Method

Three patients and caregivers were questioned about the interaction with their HCP and their level of involvement during their use of the Emma system. This was done withing the same interview session as discussed on page 41. The research questions can be found in appendix E.

Result

The interviewed patients all noted that they started the eHealth intervention after having gathered information about it during organised patient meetings where several patients come together and discuss their experiences with their chronic disease. A HCP leads suchs meetings and answers questions or informs the patients if needed. This shows that these patients fulfill to the earlier discussed patient empowerment aspect of shared-decision making by gathering information about their condition and act upon it. The quote from image 29 by one of the interviewed patients summarizes the changing role of the HCP. The ball has shifted to the court of the patient when it comes to managing their health.

Although the patient is taking more responsibilty for their own health, this doesn't mean that the HCP completely disappears out of the picture. The input and commitment of the HCP is still an important factor for the patient. If the HCP doesn't inform or give feedback on the self monitoring of the health of the patient, the patient is likely to neglect aspects of patient empowerment. This is summarized by a quote giving by a patient during the interviews, image 30, who quit answering questions in the Emma.6 application due to reviewing no feedback from the HCP.

Conclusion

Although autonomy is an important need, the discussed role of the caregiver and HCP should not be forgotten. The design should be made in a way that the patient has the feeling that he or she is in control over their own health, but in case of a setback in their health, the HCP and caregiver have the information they need to act upon it right away. The HCP and caregiver could be described as a safety net that is activated when needed. Research with 30 chronic diseased patients done by Huygens (2017) adds to the later, since the subjects pointed out that eHealth interventions should not replace the traditional healthcare system, but should compliment the personal care of the patient. This need of support adds to the need of security by giving the patient the trust they need.

Patient interview

''My GP tells me:

"you know what is wrong, you know your body so well. Just tell me what you want."

He can't see how I feel. The final decision is always with me, and that is a nice thought to have.''

Image 29: Patient interview quote about the role of the HCP.

Patient interview

''I never get a reaction were it went wrong or what we can do about it. You just don't get any feedback. I even don't hear anything about it when I don't fill in the questions...''

Image 30: Patient interview quote about the lack of feedback by the HCP in the Emma.6 app.

The literature analyses and interviews showed that patients with chronic diseases don't know the limits of what they are capable of because of their disease. They experience a lack of trust in their physical condition and an out of balance activity regulation. The patient isn't able to communicate their condition which leaves an uncertain situation for the patient but also the caregiver. This can result in social isolation due to not undertaking any outdoor activities anymore.

The goal of the Emma Activity Coach intervention with the Fitbit smartwatch is to give the patient the ability to monitor their health and activity in order for them to have the feeling that their chronic disease doesn't feel like a restriction in their daily life activities. It should make the patient aware of their activity limits and motivate them in getting sufficient exercise to control their physical and mental health. The use of the Emma Activity Coach should establish an activity framework for the patient which fits their condition and that shows them an increase on their daily wellbeing. This will generate patient empowerment due to self-efficacy of the patient and getting informed on their disease and health condition.

Conclusion

The design should: *make the patient feel in control of their physical and mental health condition, by providing clear feedback on their activity*

Design vision

*...make the patient feel **in control** of their physical and mental health condition, by providing **clear feedback** on their activity.*

3.4 Defining criteria

Image 31 shows the taken process from finding out the problems of the target group with the help of taking interviews, to translating the data to needs and criteria. An example of this proces is shown in image 31 as well with a problem that was found during the interviews with *patients that they experience difficulty in knowing their activity limit*. The problem was translated into a challenge with the statement cards method. The challenge *to communicate the activity limits to the patient* followed from this method. This challenge would fulfill the need for *security*. The design criteria *'learn the user to listen to their body to know their activity limits'* was derived from this need.

The criteria are divided into the three groups of needs: autonomy, stimulation and security. The need of support that followed out of the interview analyses is placed under the need of security since they contribute to each other.

Patients experience difficulty in knowing their activity limits. — Problem

Communicate activity limits to the patient. — Challenge

*I want to **feel secure.*** — Need

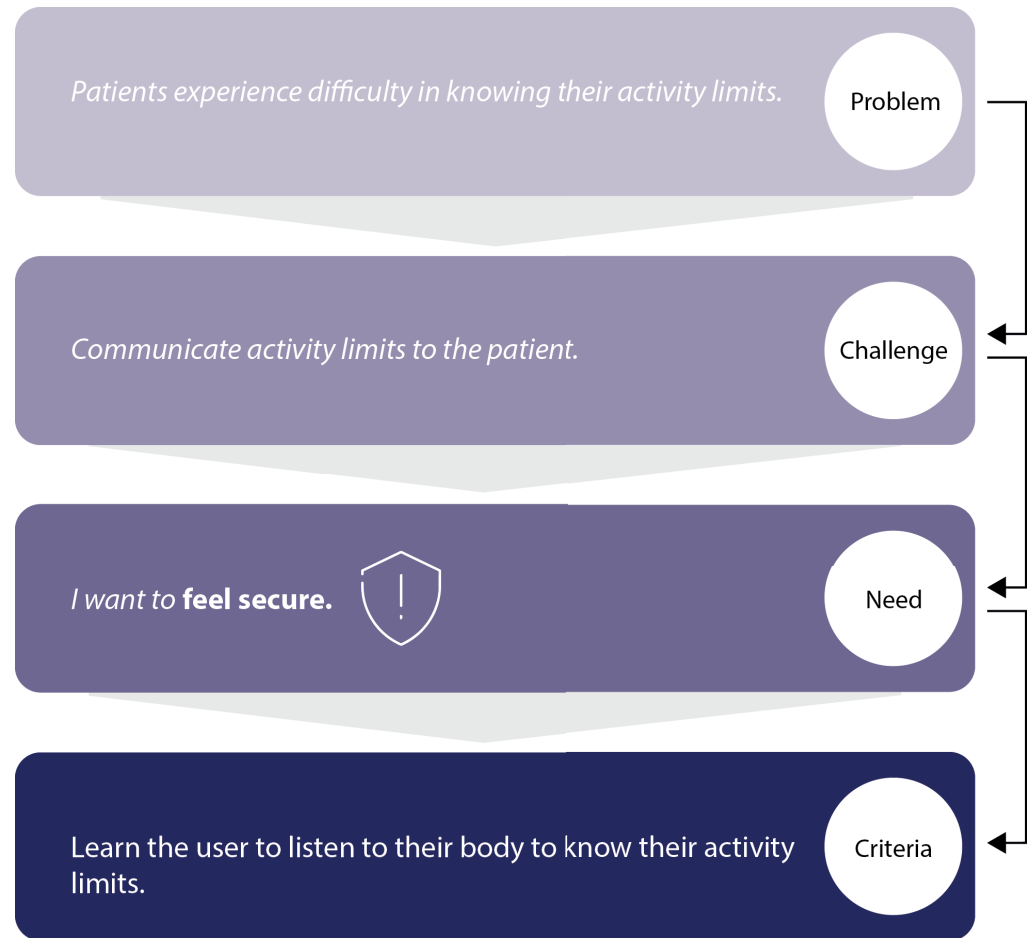Learn the user to listen to their body to know their activity limits. — Criteria

Image 31: Method process from problem to criteria.

3.5 Design criteria

The following criteria followed out of the field study and the design vision. The criteria are categorized by their need.

1. Let the user feel **empowered**

1.1 Notify the user when they have too little or too much exercise.

1.2 Let the user gain awareness over their own health.

1.3 Give the user the feeling that they are not a burden to others.

1.4 Remind the user as little as possible of their illness in their daily routine.

1.5 Give the user a clear and direct overview of their activity progress.

2. Let the user feel **secure**

2.1 Learn the user to link their physical condition with their mental condition.

2.2 Learn the user to listen to their body to know their activity limits.

2.3 Learn the user to gain back trust in their mental and physical condition.

3. Let the user feel **supported**

3.1 Support the user in communicating their condition/disease with their surrounding.

3.2 Support the user in communicating that they experience a bad day.

3.3 Support the user in communicating their condition with their HCP.

4. Let the user feel **stimulated**

4.1 Show the user that they can achieve a better quality of life when being active.

4.2 Give the user positive feedback and/or rewards to stimulate them.

4.3 Give the user an activity goal to fulfil.

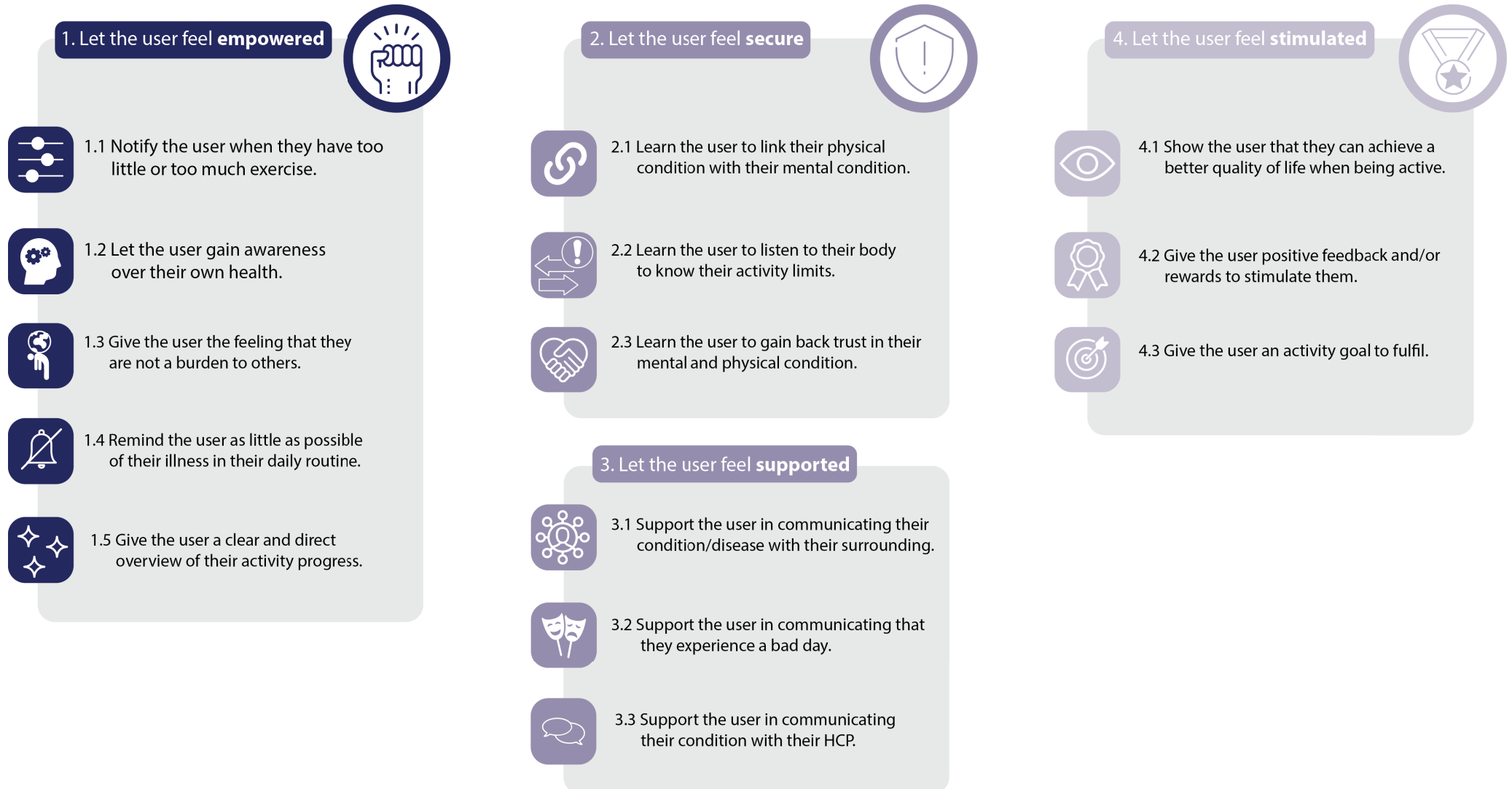*Image 32: Defined design criteria.*

3.6.1 The Transtheoretical Model

In order for the patient to undergo a change in their daily life and take action in monitoring and regulating their own health, a change in their health behaviour is needed. The patients that were interviewed during this project have up to one and a half year experience with an older version of the Emma Activity Coach and are still using it every day. They underwent a change in their health behaviour due to the use. The behavioural change process of these patients is discussed in combination with The Transtheoretical Model of behaviour change (Prochaska & Velicer, 1997), which can be seen in image 33. This model consists of six stages which the user goes through in order to achieve behavioural change. The model is explored and discussed to get a better understanding of the behavioural lifestyle of the target group and the implications and actions that are needed to make a change in their behaviour.

1. Precontemplation
This is the stage in which the user is uninformed about the consequences of their current behaviour. In the case of the patients in this project, it would mean that they live their life without taking any action to improve their health or any intension to do so due to a lack of information.

2. Contemplation
The user is informed by the pros and cons that come with making a change in their current situation. This will further result in the intention to make that change. This stage contributes to the method of motivational interviewing between the patient and the HCP (Miller & Rollnick 2002). The intrinsic motivation of the patient becomes clear during counselling with the HCP. It is key that the autonomy is left with the patient in order for them to act on their own goals. All the interviewed patients noted that they started the use of the Emma Activity Coach after they were informed during a healthcare meeting, were the Emma program was introduced, at which they were invited to by their HCP. The patients weight their current health condition to the benefits that were told during these meetings and thought ''*why not give it a try*''.

3. Preparation
This stage is characterised by the intention to take action. The patient is setting the wheels in motion to come up with a plan of action. This meant for the interviewed patients that they consulted with their HCPs to set up the inclusion of the Emma Activity Coach and the use of the Fitbit.

4. Action
The user has made changes in their daily life to address their health problems. The patient is now wearing a Fitbit with the Emma Activity Coach installed which helps them to monitor their activity and improve their health condition.

5. Maintenance
It is key in the fifth stage that the user prevents relapse. The user is confident that they can maintain there changes over a longer period of time. The interviewed patients adjusted their daily routines in the action stage and are now used to it and monitoring their own health for over one and a half year.

6. Termination
The user is completely self-efficient and is confident that they will not fall back to their previous unhealthy life style in this stage. The literature discusses that this stage is hard to reach for most of the user since it comes with practicalities that are difficult to commit to and strict rules. The interviewed patients have not reached the sixth stage yet since a longer period of maintenance is needed according to the literature. It is important to keep the patient motivated during their maintenance stage by providing feedback to prevent a relapse in their healthcare intervention.

1	2	3	4	5	6
Precontemplation	Contemplation	Preparation	Action	Maintenance	Termination

Image 33: Six stages of The Transtheoretical Model by Prochaska (1997)

3.6.2 Griefing process

Vercoulen (2012) performed a study about motivation for COPD patients to change their behaviour. He found that a grieving process occurs between the first and the second stage of the Transtheoretical Model. This grieving process consists out of four stages and is visualized in image 34 together with the emotions of each stage.

Denial stage
The patient believes that their isn't anything wrong with their health condition. We see this attitude back in the interviewed patient P1 who noted that at first he found that he didn't need any help of certain *nonsense tools.*

Resistance stage
The patient gets frustrated when they notice that their condition has effect on their quality of life. They want their old healthy life back.

Sorrow stage
The patient loses hope of recovering from their condition which turns into sadness and despair.

Acceptance stage
The patient is awakened to take action and change their behaviour in order to improve their quality of life. From this point, the patient gets into the second stage of the Transtheoretical Model.

When the patient has accepted that they need to make change in their behaviour, the aim is to maintain this change in order to improve the quality of life of the patient. Choe et al. (2013) did research on framing persuasive performance feedback and the effect it has on self-efficacy. When performance data is shown in a positive way, by informing the user what they already achieved instead of what was still remaining, the self-efficacy was found the highest. Diclemente (2001) adds to the latter that it is important to personalize the performance feedback in order for the intervention to be effective and maintain treatment adherence.

Conclusion
The patient undergoes several stages before they accept that they need to change their behaviour in order for them to obtain a better quality of life. The literatue research contributes to the understanding of the target group of this project and will help with the design process further on in the project.

Source: Vercoulen (2012) in A simple method to enable patient-tailored treatment and to motivate the patient to change behaviour (p. 3).

Image 34: Four stages before the patient accepts that he needs to change their behaviour in order to obtain a better quality of life.

4. Conceptualization

This chapter starts off by introducing the approach that is taken in the conceptualization process. The two unique selling points of the Emma Activity Coach, which should remain present in the design are discussed. Three concepts are designed and explained according to the results of the exploration phase. Each concept direction focusses on one of the found needs of the target group.

4.1 Conceptualization approach

The research phase showed that the redesign of the Emma Activity Coach should make the patient feel empowered, supported, secure and stimulated in order for them to get back the trust in their mental and physical condition and let them learn their activity limits. This is concluded in the design vision; to make the patient feel in control of their physical and mental health condition, by providing clear feedback on their activity.

Many redesign ideas were made according to the results of the research phase. Those can be found in appendix G,H and I. 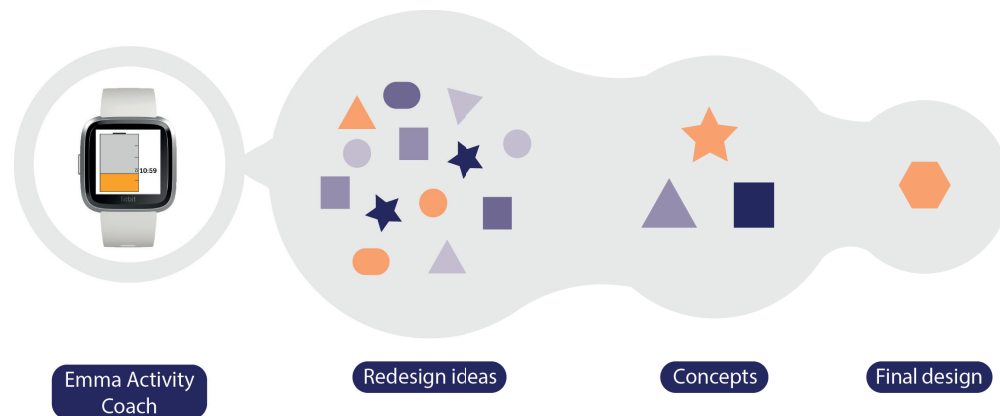The main needs, criteria and design vision were used as a guideline to come up with the redesign ideas. A few aspects of the current Emma Activity Coach were important to keep in the concept designs since they are key to the Medicine Men principle of how the user interaction should be with the Emma Activity Coach. First off, the principle of the double bandwidth system instead of the focus on a single stepping goal. And second, the activity division of the dayparts night, morning, afternoon and evening. Both aspects contribute to the earlier discussed importance of creating a fluent activity experience were the division of activity throughout the day is more important than reaching a single stepping goal quickly. This principle is one of the strengths of Medicine Men that differs them from other smartwatch activity trainers.

In the end, three concept directions derived from the conceptualization process. These directions will be discussed in the following chapters. An visualization of the discussed conceptualization approach is shown in image 35.

4.1.1 Emma Activity Coach unique selling points

The bad day function and the double bandwidth system of the Emma Activity Coach are an unique selling points (USP) of the product of Medicine Men, as discussed before in the introduction of the Emma product-service system and the competition comparison. Therefore, it is key that they should be kept in the design of the Emma Activity Coach during the conceptualization phase in order to maintain the strength of the product.

Emma Activity Coach   Redesign ideas   Concepts   Final design

Image 35: Design approach from ideas to concept to final design.

The design direction DIRECT is built on the design criteria 1.5, from image 32; *give the user a clear and direct overview of their activity progress.* The user only gets to see the most important information and can access this quick and easy.

Background

As discussed earlier, the Emma Activity Coach application is changed to a watch face application with the transition from going to the Fitbit Versa to the Fitbit Versa 2. This gave the opportunity to design a watch face that shows all the needed information in one screen instead of having an application in which you go to different screens in order to find the information you are looking for. It is key in this concept to show the information in a understandable and direct way. The information should be easy to understand and clearly visualized, especially due to the age of the target group. The Fitbit Versa and Versa 2 have a relative small screen. Most of the people over 50 are getting troubles with their eyesight which can cause troubles with reading small text or understanding small images that are portraited on the Fitbit Versa 2 screen.

As mentioned before, the focus of this concept is on giving the patient direct and clear information on their activity progress. Therefore, the decision was made to leave the bad day function out of the concept in the beginning and implement it further in the conceptualization process in order to explore the activity progress communication and visualization more thourough.

Quick user test

Several redesigns were made in which all the information was shown as a watch face. The decision was made to select five redesigns that felt and looked good and test them further with participants in order to select the most fitting one for the concept direction. The five selected redesigns are shown in image 36. Appendix G shows all the redesign ideas from which the concept direction DIRECT designs are taken.

Goal

The goal of the quick user test was to find out which redesign direction was preferred by the participants. Additionally, the understandability and visibility was explored with participants who fitted the age target group of 50 plus. A white version of the five redesigns was made in order to explore the preference of the participants and make a decision of the background color/theme during the further development of the concepts.

Image 36: Concept LESS IS MORE redesign ideas selection

Method

Ten redesigns are tested in total, five black themed and five white themed. These redesigns are made with Adobe Illustrator and exported into single images. These ten images are placed behind each other in a short sequence movie with the help of Adobe Premiere Pro. Each redesign is shown for 5 seconds until the next redesign is shown. This is done to test the glanceability of the designs, as discussed in the smartwatch UX chapter. The designs are numbered in order for the test participants to remember which design they liked the most.

The video was shown on a mobile device to the participants. No interaction was needed from the participant, only to watch the video one time. The images in the video are made true to the size of the Fitbit Versa 2 and the size of its screen. This way, the understandability and readability of the redesigns can be tested. The participants are asked to fill in a short questionnaire after they have watched the video. The questionnaire can be found in appendix J. The ten redesigns are shown again in the questionnaire, but this time next to each other. This

is done to test if a different design preference occurs when the user can compare the designs next to each other instead of seeing them one by one in the earlier video. Image 37 shows a participant viewing the test video of the quick user test.

Participants

24 participants tested the redesigns. 11 participants are students of the Industrial Design Engineering faculty of TU Delft and below the age of 30. 7 participants were between the age of 30 and 50, and 6 participants were of the age of 50 plus, which fits the age of the target group of this project. The decision was made to include participants below the age of 50 as well for the quick user tests in order to get as much feedback as possible from the user test in a small time window. It was taken into account that there would maybe occur differences in results between the three different age groups, since students are grown up with digital devices and might even have more experience with (the UI of) a smartwatch. Additionally, they most likely can see smaller pieces of text or images since the quality of their eyes is on average better than those of a person who is 50 plus. Therefore, the results of the age group of 50 are

compared with the other age groups in order to explore if deviations would occur in the results and to prevent discrepancy.
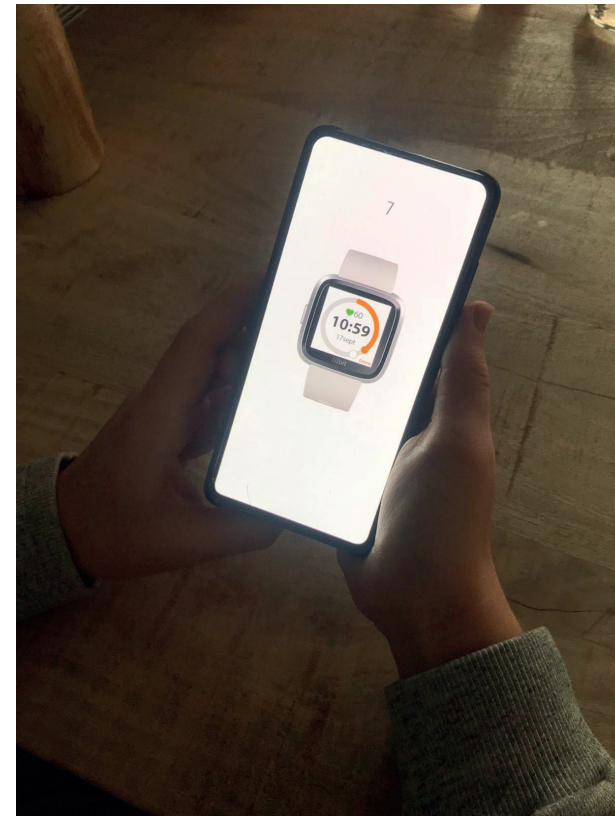
Image 37: Quick user test performed video viewed by a participant

Results

Image 38 shows an overview of the test results with the preferred design. This design was preferred by the participants since it showed clear and recognizable information in a compact way, or as one of the participants said: ''Everything is visible at one glance and it's the info I would want to see''. This quote fits directedly to the description of the DIRECT concept direction.

Activity progress understanding
All the participants also understood that the user did not reach their activity goal in the preferred design, since the orange bar was behind the black dot. Some participants noted that they liked the bow shape and that the activity progress bar goes from left to right. An interesting metaphor, visualised in image 39, was found by one of the participants in this design who noted that the visualization looks like the path of the sun from sunrise to sunset and therefore represents a day.

Black theme
The results showed a clear preference for a black theme, with 19 votes against 4. The target group of 50 plus also showed a preference for a black theme with 5 votes against 1. A black theme was found to be better visible due to a clearer contrast, easier to the eye, having a classy appearance and it was found to be more practical during the evening hours since a white theme would produce a beam of light from your wrist. Additionally, a black themed watch face would use less battery which means that the Fitbit has to be charged less and therefore can be worn longer which results into a better gathering of data of the user. No further striking deviations were found between the results of the different age groups.
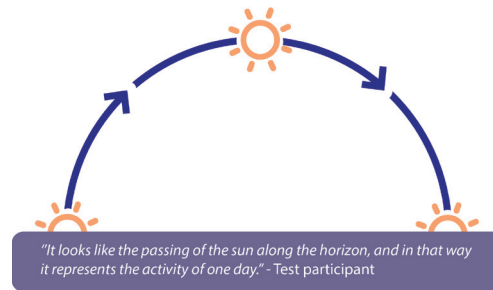

"It looks like the passing of the sun along the horizon, and in that way it represents the activity of one day." - Test participant

Image 39: Design metaphor quote.

Quick user test results

Participants

Age < 30 — 11
Age 30 - 50 — 7
Age > 50 — 6

Winner

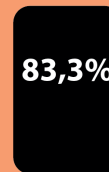**25%** choose this concept as their prefered design.
"Everything is visible at one glance and it's the info I would want to see" - Participant

100% understood the activity progress visualization:
"The circular 'checkbox' hasn't been collor filled yet" - Participant

Theme preference

Black 83,3%
White 16,7%

Reasons
Better visibility
Clearer contrast
Easier to the eye
Classy appearance
Practical during the evening hours

Image 38: Concept DIRECT quick user test results.

Conclusion

The infographic of image 40 shows the design of concept DIRECT. Appendix K shows the scenario of the DIRECT concept. Concept DIRECT shows the activity progress on the watchface of the Emma Activity Coach Fitbit application in order for the user to get a clear and direct overview of their activity progress.

Discussion

It was first tried to prototype the redesigns as actual Fitbit watch face so they could be shown on a Fitbit Versa 2 to the participants. The prototype process involved working with the coding and programming software of Fitbit named Fitbit Studio. There were some struggles with the programming and prototyping the redesigns as actual Fitbit Versa 2 watch faces. It would be recommended to show the prototypes running on a Fitbit Versa 2 to let the participant undergo the true experience but the decision was made to make the prototypes as a video instead of a Fitbit watch face to prevent losing too much time. Additionally, there was no interaction needed in the quick user test with the prototype despite seeing them, so

a video would be sufficient in order to get the needed feedback of the participants.

It turned out after reviewing the results between the white and blacked themed redesigns that the amount of contrast of the white themed redesigns was not met with the black themed redesigns. This could have caused the result of 83% of the participants having selected a preference for the black themed redesigns. A redesign of the white themed redesigned is recommended in which the contrast in the designs is more similar as the black themed redesigns. The decision is made to not redo this quick user test with other white themed redesigns since the reasoning of having a longer battery life with a black themed design and it being more practical in the evening hours (less intense light in your eyes) was the deciding factor to go for a black themed design.

Image 40: Concept DIRECT inforgraphic.

4.3 Concept 2: LINK

The second concept directions is based on the design criteria *learn the user to link their physical condition with their mental condition* in combination with *support the user in communicating their health and activity condition with their surroundings*, criteria 2.1 and 3.1 from image 32. This concept direction is therefore named LINK.

Background

The interview results from the patients and HCPs in the research phase showed that the current COPD questionnaire method in the Emma system was found to be very effective by the patient and HCP because it gave them insight about the connection between their physical and mental condition. This is important for the patient since they are most of the time not capable of connecting their mental condition to their physical condition, which can result in communication problems with their surroundings. The patient must understand why they are held back some days in their activity, in order for them to make the connection between their mental and physical condition to fulfil the need of security. Additionally, it serves as a good conversation starter between

the patient and the HCP during visits and between the patient and their caregiver. Therefore, the COPD questionnaire method was taken as a guideline for developing a concept direction that provides the patient in learning the connection between their physical and mental condition in order for them to recognize and communicate this to their surroundings.

The design

The decision is made to maintain the same watch face as in the current Emma Activity Coach. This was done in order to test the difference in visual lay-out of the interface, since concept one has a new watch face design that also shows the activity progress in the watch face, whereas the LINK concept shows the activity progress in the second screen of the application. The activity progress screen is redesigned as a progress circle in combination with a shoe visualization. This is done since the battery visualization of the previous Emma Activity Coach was sometimes mistaken by patients for the actual battery status of the Fitbit smartwatch. Image 41 shows all the concept Fitbit Versa 2 screens.

Image 41: Concept LINK infographic.

Bad day function

A redesign of the bad day function is implemented in this concept direction. A variation is made were the function is not activated by the patient themselves, but is triggered when they fall back to the red activity zone for a second time a day or stay longer than two hours in the red activity zone. This would indicate that the patient has trouble with getting enough activity during the day. When one of these two situations happen, two questions are send to the Emma.6 smartphone application of the patient. These questions are about the emotion and feeling of the patient in that moment and are shown in image 42. The filled in results by the patient are added to the activity graphs that can be found in the Emma desktop application, as can be seen in image 42. By doing this, the patient is able to see and connect their mental condition with the physical condition. The patient, HCP or caregiver can discover trends between their emotion and activity and get insight in why their activity performance decreases sometimes. Additionally, it serves a tool for the caregiver and HCP to discuss these results. The Emma Activity Coach shows a notification screen when the

patient has reached the state in which the questionnaire is send out to them. The patient is notified that they need to fill in the questions.

It is important that the patient does not get bored or irritated by filling in the questions every time. Therefore, the decision is made to only include two short questions to keep the interruption as minimal as possible. Additionally, the patient is responsible for the amount of times that they get the questions send to them according to their activity progress. The ideal situation is off course that the patient never receives them in the first place and commits to their activity goals.

The HCP and caregiver also receive a notification when a patient gets the questions send to them. This way, they know that the patient has trouble with achieving their activity goals.

Appendix L shows the use scenario for concept LINK.

Image 42: The new bad day function were two questions are send to the patient on their Emma.6 smartphone application. The results are added in the patients activity graphs.

4.4 Concept 3: COACH

This concept builds on the design criteria to let the user gain awareness over their own health by giving hum positive feedback in order to stimulate the patient in their activity. The current design of the Emma Activity Coach does not use nudges or motivational aspect in order to help the user get their activity. A concept direction is thought of in which this absence of motivation and feedback is tackled with a virtual coach, and is therefore called concept COACH.

Background

Interview results with patients showed that they do enjoy motivational design aspects. Additionally, it became clear from the interview analysis that the patient gives value to the support they get from their HCP and caregiver. They felt understood by others which gives them the stimulation to continue working on their health. The same principle works for receiving feedback on their smartwatch; if the user gets feedback, it gives them the feeling that they get noticed which adds to the value of the feedback. Therefore a concept is made that incorporates certain feedback and motivation designs in order to help the user in obtaining their needed activity.

Design

Activity balance was found to be one of the problems of the patient during the research phase. The activity progress visualization is redesigned in this concept by a metaphor of balance. The concept redesign of the Fitbit Versa 2 screens can be seen in image 43. The virtual coach that the patient has selected in the Emma.6 app (explainged further in this chapter) is visualized on a balance ball. The virtual coach and background are in balance when the user is active between their set step bandwidth. Additionally, the balance ball is green. The next screen shows a short motivational quote of your coach to motivate the user. The following screen shows the activity progress of the user. A 'white ghost' version of the virtual coach represents the activity goal of the patient and the colored virtual coach is your actual activity progress.

The coach will start to lose their balance on the balancing ball if the user drops below their step bandwidth. This is visualised by the balancing ball turning orange and the background slighty tilting. The Fitbit gives a vibration to notify the user of this change. The vibration simulates

Image 43: Concept COACH infographic.

the unstable position of the virtual coach on the balance ball. The same occurs when the user drops even further and goes from orange to red.

Bad day function as a balance stick
A redesign is made for the bad day function for the COACH concept. As explained before, the bad day function was found to be formulated to negative and an easy way out for the patient. The redesign of the 'bad day' function, which can be seen in image 44, also plays on the metaphor of balance. The user has the option to press the balance ball if it is orange or red. Next, a question screen pops-up that asks if they need help with a balance stick visualized below the question. Tightrope walkers or acrobats use a balance stick if they need help in obtaining their balance. The balance stick is added on the visualization of the virtual coach on the balance ball when the user selects help, which will change the balance ball back to green again. This is based on the same principle as the previous 'bad day' function were the step goals are reduced with a certain amount of percentage which brings the user most of the time back into green. The balance stick will fade away after an hour, letting the user know that the

help period is over and that they have to take back the control on their own. Additionally, the user is only able to select the balance stick two times a day. This is done to prevent that the user uses the balance stick function as an easy way out to get back into the green region.

Image 44: Concept COACH redesign of the the 'bad day' function as a balance stick help.

Virtual coach

The use of the Emma.6 smartphone application is implemented in the COACH concept. The user starts of by selecting a male or a female version of their virtual coach and gives him or her a name, as can be seen in image 45. The option to personalize and name the virtual coach will give the user again the feeling that they get noticed by someone, plus they make the coach part of their identity which will probably lead to better adherence to the activity goals.

The user can see an overview of their activity balance per day in the Emma.6 application. Additionally, a week overview is show. Both the week overview as the day overview come with a message of your coach who concludes your results and provides further tips.

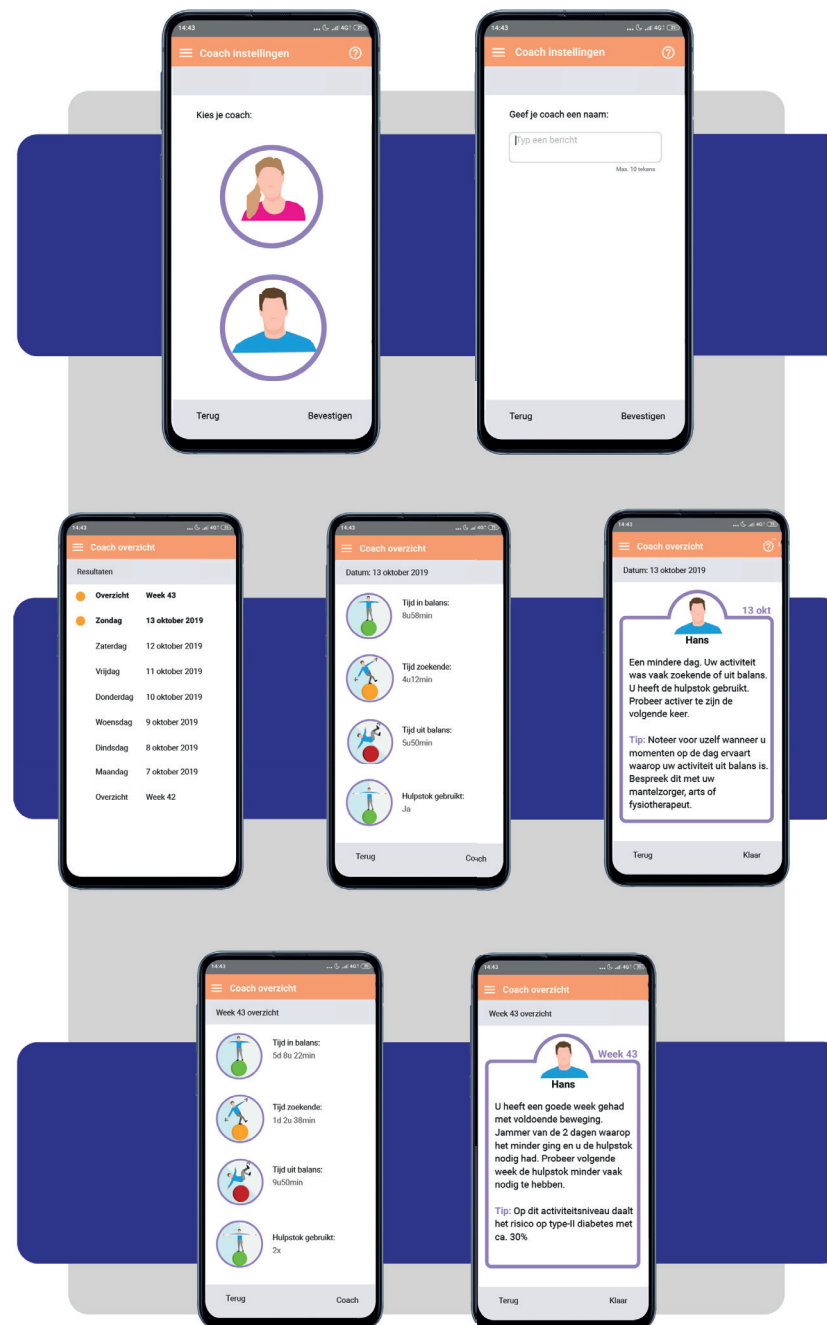Appendix M shows the use scenario for concept COACH.

Image 45: Concept COACH on the Emma.6 smarthphone application with a virtual coach.

5. User testing

The three concept directions that were discussed in the previous chapter are shown and tested with two different HCPs, a rehabilitation physiotherapist from UMC Utrecht and a lung registered nurse from Bravis Ziekenhuis. An insight in difference in treatment, and therefore also design, came to light during these two interviews about patients being treated in different healthcare levels and different treatment periods. The rehabilitation physiotherapist from UMC Utrecht is part of third-line healthcare level and is characterised by a treatment period from around 6 weeks with intensive learning and notifying them about their physical condition, whereas a patient with chronic condition management in the primary healthcare level uses an intervention such as the Emma Activity Coach for a longer period of time by learning in their own pace without constant notifications in their own environment. The difference and implications are further discussed in this chapter. This insight had implications for the focus of the project. Additionally, a change in approach of testing the redesigns is done according to the results of the HCP interviews. The setup of three concepts is replaced by taking each concept aspect individually in order to test quicker and more thorough per aspect.

The redesign aspects are tested with 10 COPD patients who fit the target group of the project. The test results are concluded and iterations are proposed for the next phase.

The three concept directions were prototyped and shown to two HCPs. The descision was made to first show the concepts to HCPs to validate the redesigns before showing them to patients.

Goal

The goal of the HCP test interviews was to validate the concepts and receive feedback from different medical fields before testing the concepts with patients. Information was gathered from the HCPs by showing the concept directions and asking them about their thoughts and recommendations. This was done by asking several research questions, which will be further discussed in the method

Participants

The concept directions were shown to a rehabilitation physiotherapist of UMC Utrecht and a lung registered nurse from Bravis Ziekenhuis. The test interviews were held at the practicing locations of the HCPs.

Method

A list of research questions was setup beforehand as a guideline to the test interview with the HCPs. These research questions can be seen in appendix N. The concept directions were prototyped with the help of Axure and shown on a smartphone. Further information about the concept prototype process can be found in the prototype segment of this chapter. The HCP was shown each concept direction fully before showing the next concept direction. The underlaying idea of each concept was introduced to the HCP, after which the concept was shown. The HCP was asked open questions during the process in order to receive feedback and further information. A full transcribed of the HCPs answers can be found in appendix N. The HCP was asked which concept they would prefer to work with and give to their patients, after they had seen all three concept directions.

Prototype

The concepts directions were first tried to be prototyped as actual Fitbit applications, so they could run on a Fitbit Versa 2 during the concept testing, but this was quite a complex job to fulfil since it involves actual coding with the official Fitbit application builder software. To avoid losing time in my project, the decision was made to work with Axure RP 9

Image 46: Emma Activity Coach concept prototype shown on a smartphone with a Fitbit Versa next to it.

to create the concept directions to test with. This meant that the Fitbit Versa 2 screens would be shown, and interacted with, on a smartphone by HCPs, as can be seen in image 46. The visualization of the Fitbit Versa 2 in the Axure RP 9 prototype was created true to the actual size of a real Fitbit Versa 2 to overcome the downside of not being able of prototyping a concept prototype that runs on an actual Fitbit Versa 2. This meant that the HCPs would still be able to interact with the concept directions in the actual size. The way the user interacts with the prototype would still be the same, since the Fitbit Versa 2 uses touchscreen just as a smartphone. The recommendation would be made to prototype the final concept design as an actual Fitbit Versa 2 prototype in order for the patient to have the prototype on their wrist just as the actual product. This would make the user experience as true as it can get.

Some concept directions involved redesign ideas that took place in the Emma.6 smartphone application. Those concepts were also prototyped in Axure RP 9 and shown on a smartphone during the tests. Image 47 shows some Emma.6 prototypes

displayed on a smartphone. The Fitbit Versa 2 and smartphone application screens from the concept directions were made in Adobe Illustrator and Adobe Photoshop.

Results
An overview of the main results from the HCP concept test interviews can be found in image 48. The results are further explained in this chapter.

Concept aspects & preference
Both HCPs did not choose a single concept, but combined aspects from the three concepts together into one concept. Additionally, it became clear during the conversations that they are interested in tailoring the Emma Activity Coach for each specific patient. As the rehabilitation physiotherapist said: *"I know within 5 minutes during an inclusion what a patient needs, so it would be nice if I could select certain modules or concept aspects depending on the patients needs".*
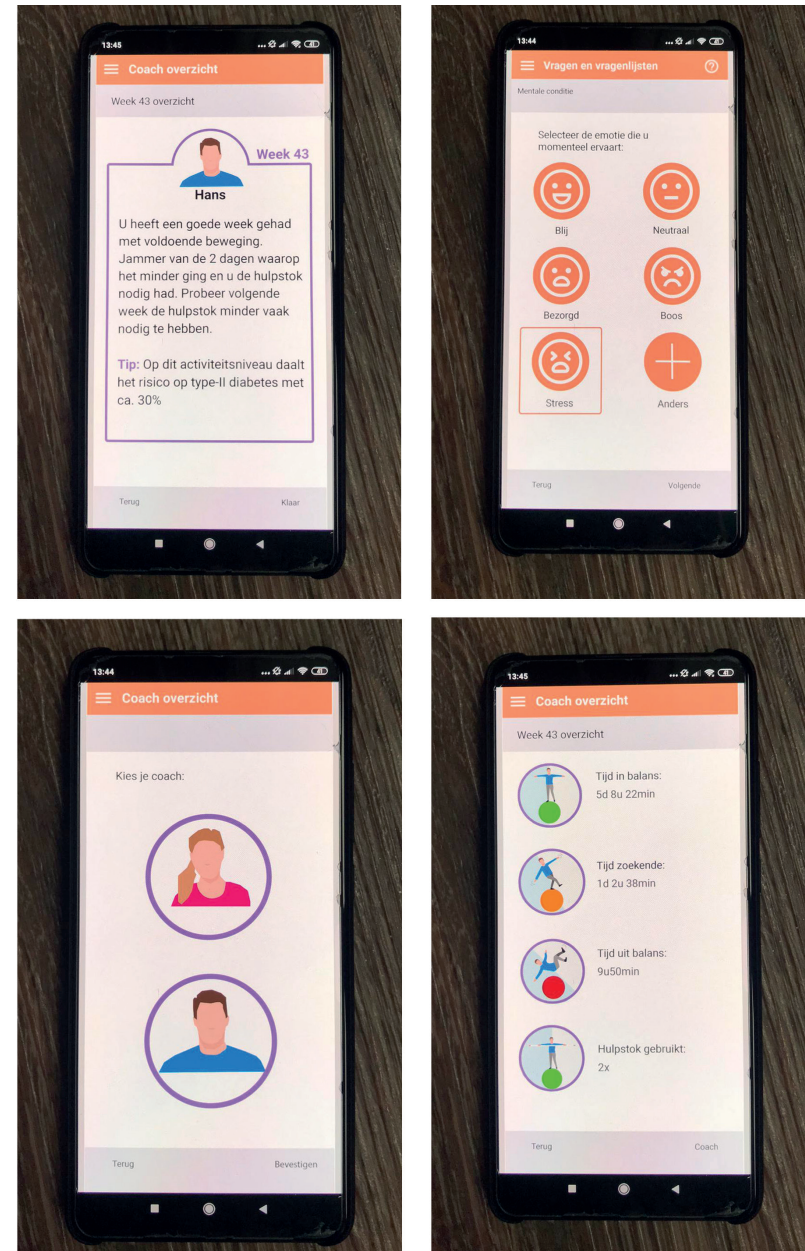

Image 47: Emma.6 prototypes shown on a smartphone.

Both the lung registered nurse from and the rehabilitation physiotherapist preferred the COACH concept direction, in combination with the questionnaire bad day function from the LINK concept. The COACH concept was preferred since it is built on shared-decision making according to the lung registered nurse. Additionally, the informative activity overview in the app, the motivational addition and the visual design were seen as an interesting change compared to the current Emma Activity Coach. The bad day function from LINK concept was found to be very strong by the lung registered nurse since the patient can describe their emotions which add to the understanding of the HCP and the patients surrounding. The HCP asks the patient during consults about their emotions, but they often can't remember how they felt for instance four days ago. Therefore, the information that is obtained via the questionnaire of the LINK concept is of great value to the patient as well as the HCP. The lung registered nurse stressed that the questionnaire in the LINK concept should be as short as possible and effortless to fill in for the patient to prevend as much interuption as possible in their daily life. Additionally, the questions should be made personal in order for them to have meaning to the patient and the HCP as well.

The rehabilitation physiotherapist added that he would always have the DIRECT concept as the home screen and from that point on add other elements depending on the patients needs. This is due to the short period of patient treatment for rehabilitation. The rehabilitation physiotherapist wants his patients to learn their activity limits by giving them as much information as possible in a short period of time.

Terminology
Both HCPs noted that the terminology used in the concepts is very important. The COACH concept for instance has a screen that says *help needed?* (hulp nodig?) when activating the redesign of the bad day function. Both HCPs noted that this is a risky way of saying since the patient would probably think that this would mean that a doctor or even the emergency number is getting contacted. It was advised to set up the questions about the physical or mental condition of the patient in a personal and uncompelling way in order to let the
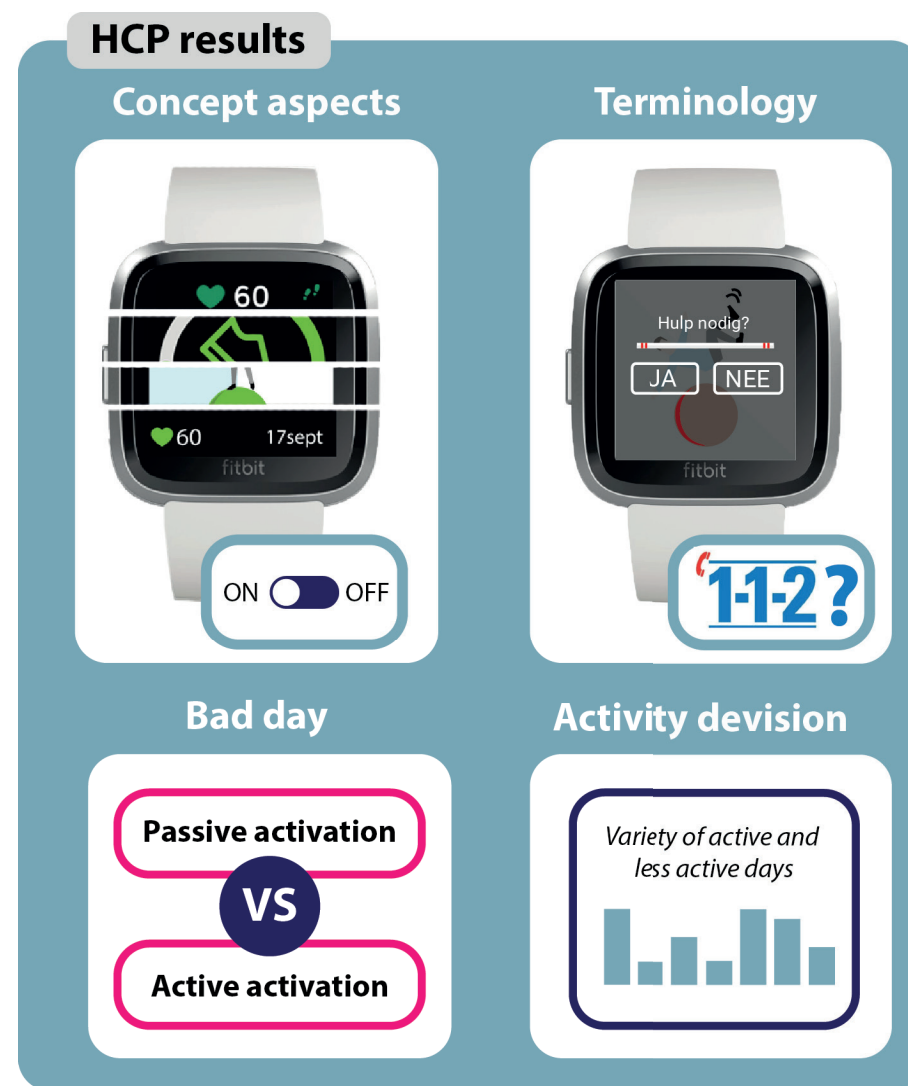

Image 48: Main results HCP concept test interview.

patient feel in charge and not being judged, i.e. *"is there something?"* instead of *"what is going on?"*.

Another comment about sending the right message and meaning to the patient was made by the HCPs about the Emma.6 application design of the COACH concept. Although the concluding messages and tips of the virtual coach in the day and week overview in the Emma.6 application of this concept were found interesting, it was key for both the HCPs that these messages would fit the patient and are true to the situation of the patient. The idea was that these messages would be generated virtualy, since the HCPs don't have the time to go through all the patient results and add them of comments and tips. It was advised to not include such a function, or if so, be very careful with it since one wrong virtual tip or comment might have negative outcomes for the patient.

The use of the metaphor of balance of your activity in the COACH concept was found difficult for the rehabilitation physiotherapist since he uses the metaphor of balance already as a term for the physical strain of the patient. It would become

confusing for the patient if balance is also used for their activity division. The rehabilitation physiotherapist therefore suggest that in the case of using a metaphor for the Emma Activity Coach activity progress, there should be watched that the terminology and meaning would not collide with other medical aspects.

Bad day: passive or active activation
The bad day function was redesigned in the concept COACH and LINK. The decision was made to let the bad day function be activated passive, according to the activity progress of the patient. This way, the patient would be motivated to prevent staying in the red activity zone and additionally use the bad day function as an easy way out. Both the lung registered nurse and the rehabilitation physiotherapist noted that the decision for a passive activation of the bad day function depending of the activity of the patient would have negative results for the patient, since the target group is categorized for having a diverse spectrum of feeling good and bad in a week. A passive activation would therefore mean that they would get several notifications during the week when they are having a feeling bad. This is

not desired for the patient, as well as the HCP, since the HCP warned that the patient would likely neglect filling in the notifications accompanying the passive bad day function or give the same answers every time since it becomes a routine to them. It is therefore better to let the bad day function be activated actively by the patient, is it was designed before by Medicine Men. Further interviews with patients of the target group of this project about the bad day function will be held in order to get a better understanding why and when they activate the function and if they use it as an easy way out.

Activity division
In addition to the insight of the target group having a diverse spectrum of good days that alternate bad days throughout the week, it became clear from both interviews that the HCPs are interested in monitoring the division of the activity of the patient. It is therefore ok if a patient has a day with less activity, knowing that later on in the week they will make this up. The same goes for the activity throughout a day. The HCP wants to see that the patient is active throughout the day, and that they devise their activity according to. It

should not be a competition or goal to get as much as possible activity or reaching your activity goals as fast as possible, but maintain a healthy balance throughout the day and week.

Discussion

The HCP concept interviews provided interesting information to further develop and redesign the Emma Activity Coach, but, as mentioned in the beginning of this chapter, the HCPs took several aspects out of the different concept directions and combined them into one concept. This is because the Emma Activity Coach consists out of different elements, such as for instance the bad day function and the activity progress visualization. It became clear during the tests with the HCP that it was difficult to make a comparison between the different developed concepts which resulted in feedback that felt less thorough and meaningful than desired for the further development of the concepts.

Conclusion

The decision was made to look at each element of the Emma Activity Coach individually in order to design, test and receive more thorough results per product element. An iterative process would be followed in which interviews with HCPs and patients would lead to new information and new iterations on certain product aspects. This method was also found to be beneficial for Medicine Men

since it made it possible to quickly implement certain iterations in the actual application and test them in the field. This meant that the previous test approach, which was as a rather traditional method of diverging the redesign ideas into three concepts in order to test them and come up with a final design, would be replaced with a new test approach in which each aspect would be explored separately. The difference between the new and previous approach is visualized in image 49.
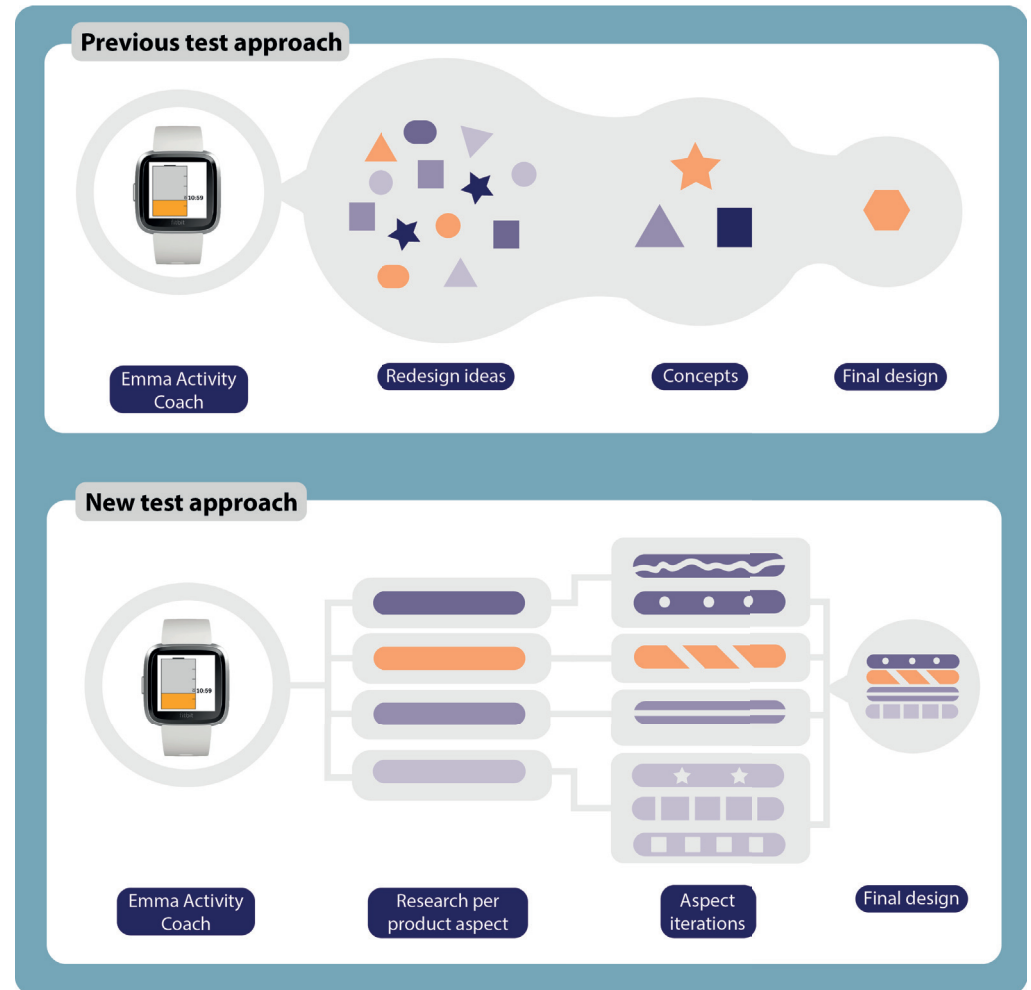

Image 49: Visualization of the new test approach compared to the previous approach.

5.1.1 Rehabilitation vs. chronic condition management

Although the interviewed HCPs see patients from the target group of this project, a difference in treatment approach, patient needs and HCP needs were found during the explanation of the three concept directions to the rehabilitation physiotherapist and the lung registered nurse. This chapter discusses the difference in needs, and thus Emma Activity Coach design, between a chronic diseased patient getting treatment in different healthcare levels.

Dutch healthcare system
The Dutch healthcare system is divided in 4 care levels, as described in image 50;
- Zero-line care (*nuldelijnszorg*):
- Primary care (*eerstelijnszorg*):
- Secondary care(*tweedelijnszorg*):
- Third-line care (*derdelijnszorg*):

The earlier interviewed physiotherapist from FysioHolland Zeeland is part of the primary care and the lung registered nurse secondary care. The interviewed

rehabilitation physiotherapist from UMC Utrecht is part of the third-line care since UMC Utrecht is an academic specialist hospital.

This chapter discusses the difference between rehabilitation patient treatment in the third-line care and patients with chronic condition management in the primary care level. The focus is in both cases on patients that need their activity monitored with the support of a physiotherapist.

The information in this chapter is based on the interview results with the revalidation physiotherapist from UMC Utrecht, the lung registered nurse from Bravis Ziekenhuis and earlier interview results with the physiotherapist from FysioHolland Zeeland.

Healthcare level

0 — The care level in which the patient is helped by people in their surrounding, by informal caregivers, without receiving support from a HCP.

1 — Characterised by care outside of the hospital, whereby the patient can go to the first line of HCPs such as your GP or physiotherapist without a reference.

2 — Healthcare within a general hospital or a care centre. The secondary care level is only accessible by a reference from a HCP.

3 — High specialised care, for instance in an academic specialist hospitals. A second reference is needed for third-line care. Third-line care is known as being expensive.

Image 50: Explanation Dutch healthcare system division in 4 care levels.

Rehabilitation

The term rehabilitation stands for *to recover* and is quite a broad term which can vary in practice from a patient recovering from a twisted ankle till a brain tumour. The goal is in both cases to return as good as possible to the 'old' level of functioning of the patient. In this project we focus on the rehabilitation of patients with chronic diseases, for instance an COPD patient that revalidates from a exacerbation. The rehabilitation treatment is relatively short, mostly around 6 weeks. Image 51 is taken from Rehabilitation for Chronic Conditions Working Group (2017) and shows the taken steps for an average rehabilitation process.

A patient gets a referral from their GPs, practice nurses or care coordinators to go into a rehabilitation treatment.

1. Screening

A screening of the patient takes place in which the patient's ability to improve their physical and mental health is determined. Additionally, the needs and support of the patient are discussed in order to determine the eligibility of the patient to the rehabilitation.
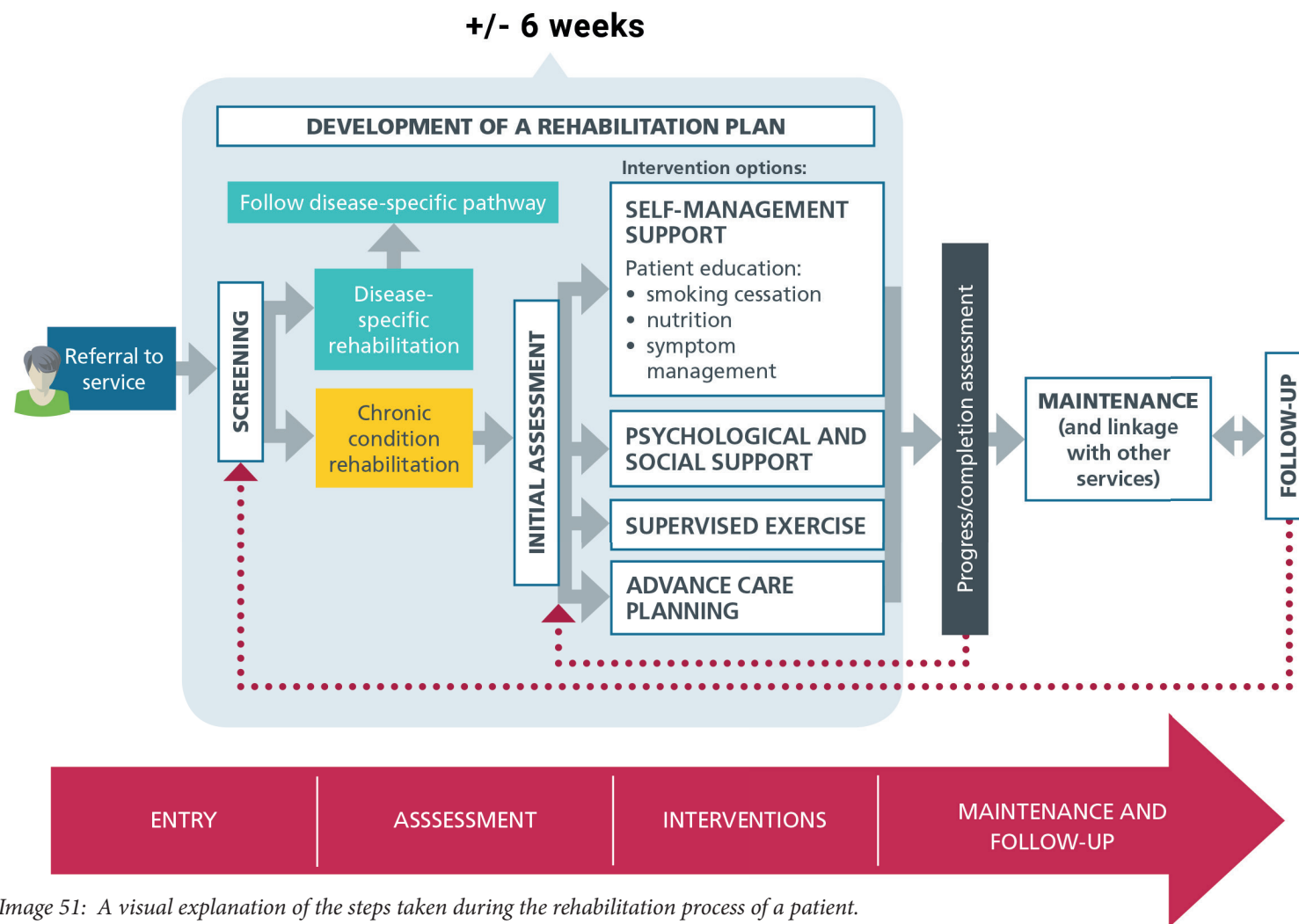
+/- 6 weeks

DEVELOPMENT OF A REHABILITATION PLAN

Referral to service

SCREENING

Follow disease-specific pathway

Disease-specific rehabilitation

Chronic condition rehabilitation

INITIAL ASSESSMENT

Intervention options:

SELF-MANAGEMENT SUPPORT
Patient education:
- smoking cessation
- nutrition
- symptom management

PSYCHOLOGICAL AND SOCIAL SUPPORT

SUPERVISED EXERCISE

ADVANCE CARE PLANNING

Progress/completion assessment

MAINTENANCE (and linkage with other services)

FOLLOW-UP

ENTRY | ASSSESSMENT | INTERVENTIONS | MAINTENANCE AND FOLLOW-UP

Image 51: A visual explanation of the steps taken during the rehabilitation process of a patient.

2. Development rehabilitation plan

The outcomes of the screening process are translated in a rehabilitation plan for the patient together with formulating practical information such as personal details of the patient, medical history, patient social situation and wishes.

3. Initial assessment

An initial assessment is done before starting the intervention in order to determine the patients physical capabilities and to set a reference point at which later on in the rehabilitation process could be compared to. The key problems of the patient are determined during the initial assessment together with setting up the goals. Additionally, the discussed conceptual framework of The Transtheoretical Model from page 51 is used by the HCP in this phase by determining the stage of readiness to change of the patient in order to tailor the intervention.

4. Intervention

The intervention is the time in which the patient works on their rehabilitation in order to achieve the set goals. This period is, as noted earlier, most of the times around 6 weeks. Self-management (together

with the support of an informal caregiver) and disease management is learned by using for instance an intervention tool such as the Emma Activity Coach. The rehabilitation physiotherapist noted that due to the short treatment period, he wants his patients continuously monitor and learning their activity patterns and behaviour by showing them information as direct as possible and notifying them throughout the day in order to adjust their activity and manage the impact on their condition. This resulted in the interviewed rehabilitation physiotherapist having a preference for the watchface of concept DIRECT in which the activity progress visualization is shown in the first screen of the Emma Activity Coach. Image 52 is an iteration of the DIRECT concept according to the preference and wishes of the interviewed rehabilitation physiotherapist.

5. Maintenance and follow-up

The goal is that the patient can execute the rehabilitation learnings in their own environment after the six weeks. Optionally, a follow-up meeting is planned several months later in order to assess the outcomes and progress of the patient.

Rehabilitation desgin direction

Image 52: Iteration of concept DIRECT based on the interview results with the rehabilitation physiotherapist.

Chronic condition management

With chronic condition management is meant the normal treatment of patient with a chronic disease in their own environment with the support of an informal caregiver of the patient, their physiotherapist and other disease specific HCPs. Step 1 till 3 are more or less the same as with the rehabilitation treatment. First, the patient is referred to the physiotherapist in order to investigate the use of an intervention such as the Emma Activity Coach which improves the quality of life of the patient. As discussed earlier in the Emma Activity Coach introduction chapter, the physiotherapist discusses the condition and situation of the patient. Third, an assessment is done in order to set the patients physical base line and find the key problems in order to set the goals according.
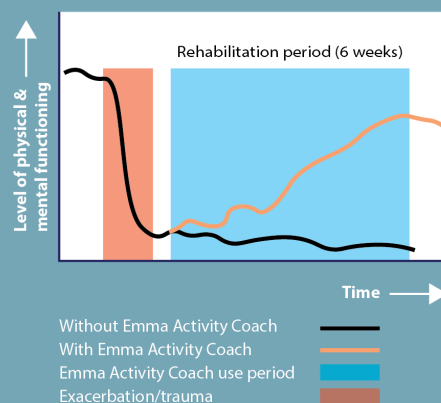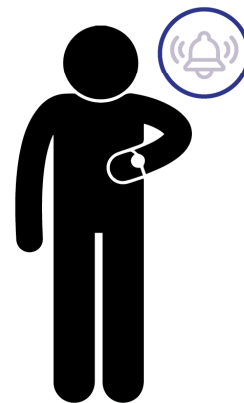
Intervention

Step four is the intervention with for instance the Emma system and the Emma Activity Coach. This step differs from the rehabilitation method. To start with, the intervention period is much longer than that of the rehabilitation method.

Patients use the Emma Activity Coach for at least one year, at which it becomes part of their normal day life. The patient learns in their own environment and pace how to manage their condition and how to get the needed activity in order to improve their quality of life. The patient discovers which activity patterns fit to their condition and improve upon it together with the support of their informal caregiver and the help of their physiotherapist. The interviewed lung registered nurse noted that it is not desired to constant notify the patient on their condition and if they are doing it right or wrong throughout the day since they don't want to be reminded all day of their condition. The lung registered nurse therefore choose specifically for concept LINK from image 41, in which the activity progress visualization is shown in the second screen instead of the watchface as in concept DIRECT. The patient therefore has the option to go to the second screen of the application in order to get more information on their activity, and remains in charge of their own health management.

Rehabilitation patient

⚠ **+/- 6 weeks**

- *Learn the patient the limits of their body in a short period of time to gain back trust in their physical capabilities.*
- *Notify and inform the patient multiple times throughout the day.*

Rehabilitation period (6 weeks)

Level of physical & mental functioning

Time

Without Emma Activity Coach
With Emma Activity Coach
Emma Activity Coach use period
Exacerbation/trauma

Chronic diseased patient

⚠ **+ 1 year**

- *Let the patient experience the use in their own pace without constant reminding them of their condition.*
- *Notify and inform the patient as minimal as possible.*

Chronic condition management (+ 1 year)

Level of physical & mental functioning

Time

Without Emma Activity Coach
With Emma Activity Coach
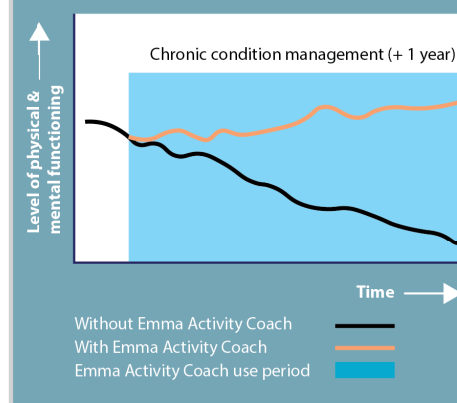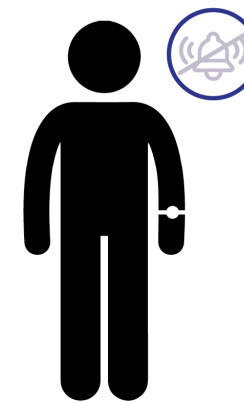Emma Activity Coach use period

Image 53: Difference in giving information between two groups of chronic diseased patients.

Conclusion

The discussed interview insights showed differences in design directions. Therefore a decision is made which direction and healthcare level to focus on further in the project. The focus will be on the group of patients who will use the Emma Activity Coach in the primary care level. These patients use the intervention for a longer period of time. The use in the primary care level is focussed on prevention of the risk of an exacerbation or trauma, instead of solving one. This is a desired situation to focus on with the Emma product-service system. Additionally, the design direction of the chronic condition management in the primary care fits to the principles of Medicine Men since Medicine Men wants the user to be notified and distracted as minimal as possible during use in their daily life. This principle is contrary to the design direction of the rehabilitation treatment. Image 53 sums-up the discussed differences between the two directions together with a graph showing the implications of the use of the Emma Activity Coach would have for both directions.

A recommandation is given on page 128 which shows a design that tackles both design directions.

5.1.2 Bad day function and heartbeat indicator exploration

Two additional research questions arose from the interview results with the rehabilitation physiotherapist and the lung registered nurse;

1. What reasons do patients give for activating the bad day function in the Emma Activity Coach?

2. Is the heartbeat indicator on the watchface of the Emma Activity Coach useful for the patient? In addition, the

The physiotherapist from FysioHolland Zeeland was asked these two questions. She runs a pilot with 30 COPD patients with the use of the Emma Activity Coach and the Emma product-service platform, this pilot is further explained on page 77. Additionally, the bad day function LINK concept design was shown to the physiotherapist.

Result
Bad day function
According to the physiotherapist, a few patients in the pilot have used

the bad day function. These patients have used the bad day function with the reason of being ill. The example is given by the physiotherapist of a patient who used the bad day function 10 times because she was on a treatment with antibiotics. The physiotherapist said that a significant reduction in activity was visible in the patients data on the Emma dashboard during this period. The physiotherapist adds that other reasons for patient activity reduction are in general weather conditions and weekends, especially Sundays. The Sunday showed for almost all the patients a dip in activity. Patients get visited by friends or family and sit down the entire Sunday. The patients have told the physiotherapist that they are aware of this too.

The physiotherapist liked the bad day function of the LINK concept with a questionnaire, seen in image 54, since it gives additional and interesting information about the selecting of a bad day. She noted that sometimes patients are not able to remember why they had selected the bad day function. The bad day function redesign from the LINK concept was seen as a solution to this problem.

Image 54: Interview results form the physiotherapist from FysioHolland about the bad day function.

The physiotherapist was asked which way of selecting and informing a reason for a bad day was preferred. Three options were given, which can be found in image 54; selecting an emotion, selecting an option out of a few reasons or let the patient fill in a reason on their own. The bad day function from the LINK concept was a combination of emotion and filling in, but the physiotherapist noted that she preferred selecting an option out of a few reasons, with the addition of filling it in yourself if your reasons is not included. This was found more effortless and understandable for the patient by the physiotherapist.

Heartbeat indicator
The heartbeat is shown quite prominent in the home screen of the Emma Activity Coach on the Fitbit. The question arose what use this visual has for the HCP and patient. The physiotherapist notes that the heartbeat indicator is used as an indication for the patient to recognise their activity limits, even though it is found that it sometime lacks accuracy. The physiotherapist noted that it is especially useful for COPD patients. If a person without COPD exercises quite intensive, they will get short of breath. But, COPD patients are constantly short of breath which has become normal to them. Therefore, they might not notice that they reach their activity limits. The heartbeat indicator is therefore useful to let the patient see the rise in their heartbeat which means a rise in activity intensity and letting them know their limits. As discussed in the introduction to the Emma Activity Coach application in the beginning in this report, the heartbeat indicator also works with the traffic light system just as the activity battery visualization. The HCP sets the numbers for the green, orange and red heartbeat range per patient.

Discussion
The addition of adding a reason via a questionnaire in the Emma.6 application when selecting the bad day function was found useful by the physiotherapist since it gives her additional information of the patient which can be acted upon during consults. The preference is given to let the patient select a reason for their bad day activation out of a list of reasons in order to keep it as effortless and understandable as possible. The option is given to let the patient fill in a reason if theirs is not included in the list.

Although the heartbeat function of Fitbit in the Emma Activity Coach isn't accurate all the time, the explanation of the interviewed physiotherapist shows that it serves as an good indicator for the patient to let them know their activity limits.

Conclusion
A redesign of the Emma.6 bad day questionnaire will be made with a list of reasons for a bad day selection and shown to several patients in order to further explore their thoughts about the function and the selected reasons.

5.2 Target group user test

Medicine Men has a pilot running since September 2019 with FysioHolland. This pilot tests an algorithm that is built in the Emma Activity Coach that automatically increases or reduces the step goal of a patient. The aim of this pilot is to compare the results of an automated goal setting system to a patient who gets their goals set and evaluated during use by a physiotherapist. This pilot contains a large group of patients that have used the Emma Activity Coach on a Fitbit Versa (or Versa 2) for some months. This pilot group of patients is chosen to interview since they can be seen as experts of the application because of their long time use. Therefore, they are a interesting group to interview and get feedback from.

Goal
The goal of the interviews was to take a step back in the redesign process and gather information per aspect of the Emma Activity Coach ecosystem in order to be able to translate and iterate further on the previous concept directions. Additionally, the general experience and thoughts about the current Emma Activity Coach of the patient was explored in order to find problems that were not thought of yet.

Participants and location
10 patients were interviewed at FysioHolland in Zeeland. All participants have the chronic disease COPD and had several months of experience of wearing a Fitbit Versa (or Versa 2) with the Emma Activity Coach. An overview of the interviewed patients can be seen in image 55. The patients were present at FysioHolland since they had an exercise appointment in the accompanying gym of the clinic. I had a physiotherapists treatment room for myself for the entire day in which I could interview the patients one on one, this setup can be seen in image 56. This setup was familiar for the patients since they already have had several meetings with their physiotherapist in the same room. The patients were invited to be interviewed before or after they had there exercise done. Each interview lasted about 30 minutes.

Patient interview participants

	Age	Gender	Fitbit version	Disease	Use period
P1	76	Female	Versa	COPD	5 months
P2	73	Female	Versa	COPD	5 months
P3	75	Male	Versa 2	COPD	3 months
P4	66	Male	Versa 2	COPD	5 month
P5	66	Male	Versa	COPD	5 months
P6	76	Male	Versa	COPD	5 months
P7	54	Female	Versa	COPD	5 months
P8	72	Male	Versa	COPD	5 months
P9	62	Female	Versa	COPD	5 months
P10	73	Female	Versa	COPD	5 months

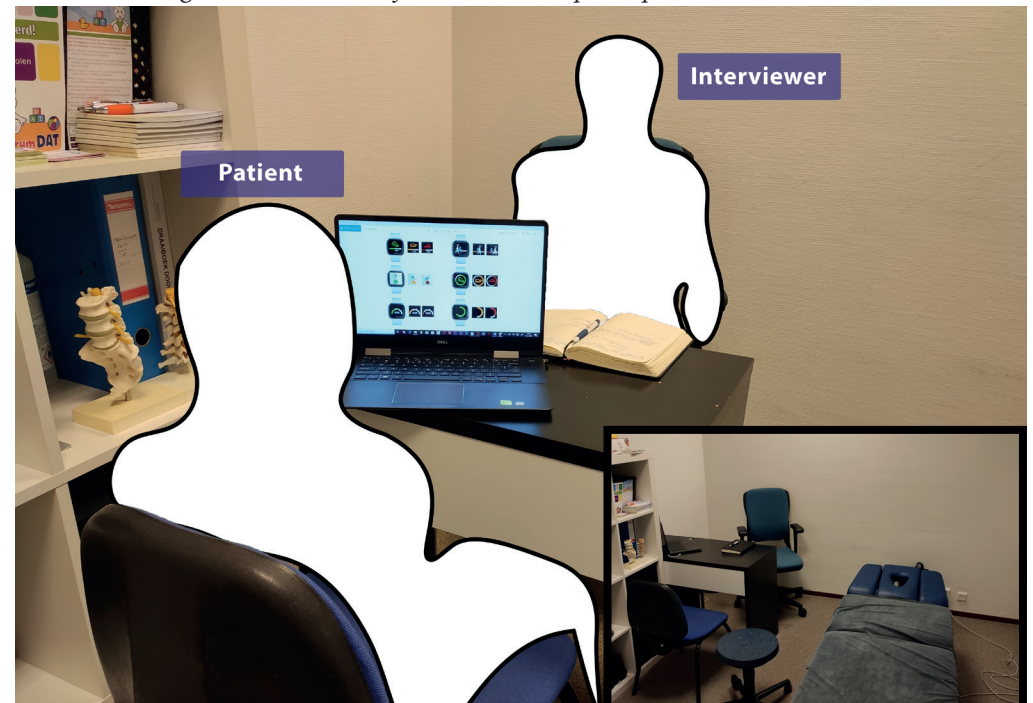*Image 55: An overview of the interviewed participants.*

Image 56: Interview setup; a physiotherapist practice room at FysioHolland Zeeland.

Method

An interview guide was made before the interviews and was used as a guideline throughout the interviews. The interview guide can be found in appendix O. Image 57 shows six redesigns of the battery activity progress visualisation that were made in Adobe Illustrator.

The designs were used as a tool to retrieve information about what type of visualisation the participants understood and were found interesting, instead of a patient picking out one of these six redesigns in specific. The framing of the interview questions was done in this way in order to obtain the information.

Prototype

The designs from image 57 were shown during the interviews as an image on a laptop, which can be seen in image 56.

Activity progress visualization redesign

Image 57: Six redesigns of the activity progress visualization that are shown to the target group.

Results

Several interesting results are taken from the interview data. They are discussed in this chapter together with quotes from the interviewed patients which illustrate the results.

Activity insight & user interaction

10 out of 10 participants noted that the Emma Activity Coach gave them insight in their activity behaviour which stimulated them in being more active. P3 notes: *"First, you did not know what you did. Now you can you see it, which motivates you".*

10 out of 10 participants noted that they have the goal of making the battery visualization full, P6: *"I need to get the battery full",* P4: *"I watch the battery regularly to see if I already have made it full".* This was found to be an important motivation for their activity. **7 out of 10** noted that the most important thing for them is that they end their day in green. They consciously watch their activity progress in the afternoon or at the end of the day, to get an overview of what they have done that day, P3: *"I watch especially in the afternoon and evening, to see how much I did that day".*

Additionally, **6 out of 10** participants noted that the presence of the trafficlight system with the different color zones activates them to get active; P5: *"It sometimes happens that I am in red, I read or puzzle during the day and then I tend to fall asleep easily. The red shows me how I am doing then and makes me become active when I am awake."*

Activity comparison

An important insight was that **5 out of 10** participants noted that they like to compare their activity with previous days, especially if they felt that their activity was low. P4 notes: *"If I think I have a day with less activity, I like to see how much steps I did on a better day."* It became clear that a patient weights good activity days against unactive days. This is a good learning by the patient, since they need to understand that their division of their activity is an important aspect. The previous interview results of the HCPs shows that the patients and HCP look the same way at the activity progress. Both groups are interested in the overall division of activity throughout the week.

Patient interview results

Emma Activity Coach User Interaction

Insight
less active day vs. active day
S M T W T F S
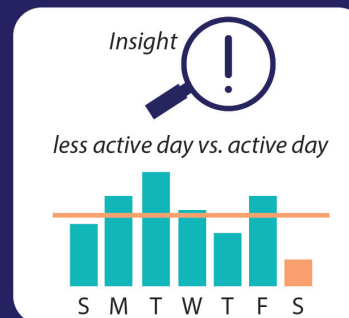
Insight in activity and comparison is important for the patient

♥ 60
17:05
di 5 maa
fitbit

Activity indicator and vibration sparks further interest/interaction

Goal to fill up
10:45
fitbit

Filling up motivates the patient as well as the colors

Image 58: Overal Emma Activity Coach user interaction results overview.

Heartbeat indicator

The heartbeat indicator on the homescreen of the Emma Activity Coach is also kept an eye on by **6 out of 10** participants. Although they note that it is not that accurate all the time, it does give them an indication of their activity intensity and their activity limits, P4; "*I have had a heart surgery and last week I did not feel that good, then I look at my heartbeat to know how far I can go. I know it is not 100% accurate, but still tells me a lot.*"

Vibration and notification

4 out of 10 note that they get alerted by the vibration of the Fitbit which notifies them if a change in activity zone occurs, P5; ''*You feel the vibration, and you watch automatically*''. The vibration did leave some confusion for a few patients; P9: ''*Sometimes I feel it vibrate, then I watch and see nothing… I have bad eyes, so if some message is show, it is already gone by the time I have found my glasses*''.

8 out of 10 participants note that they watch the small footstep indicator on the top right corner in the watchface screen when they watch the time on their Fitbit smartwatch.

Informal caregiver

P10 noted that her husband looked more at her activity data than she did. P10 started off the interview by telling that she was not that positive about the experience with the Emma Activity Coach, she did not like the idea of constant being busy with watching your steps and activity. But, her husband interrupted her by telling that she did get motivated by it and that it showed improvements in her health condition. The conversation is shown in image 59. This conversation goes back to the earlier discussed desired situation between the patient and their informal caregiver, which is again visualized in image 60, and shows the importance of the informal caregiver. The informal caregiver is up to date with the condition and exercise of the patient and therefore is able to communicate with the patient about it. The informal caregiver supports the patient throughout the intervention, they have created a shared goal which they together work on.

P10 and husband conversation

P10: *"I don't like the idea of constant being busy with watching my steps and activity"*

HB: *"But you do get motivated by it!"*

P10: *"Yes, you more as I do haha"*

HB: *"Yeah well, we do it together. And you clearly benefit from it."*

P10: *"Yes, that is true I benefit from the use."*

HB: *"Your condition is much better than before, because we go for walks now. We hate walking, so it was quite a challenge. But now we walk every day two times, in the morning and afternoon."*

P10: *"Than he [HB] asks me how much have you done and how much steps do you need to take.*

HB: *"Yes, I watch her data in the Fitbit app."*

Image 59: User test conversation between a patient and her caregiver about the use of the Emma Activity Coach.

Image 60: Patient and caregiver discusse the condition and situation of the patient.

Activity progress visualization

Another goal of the interviews was finding out what the users thought of the battery visualization of the activity progress. The metaphor of filling up your energy battery was not understood by **9 out of 10** participants and even caused confusion for **4 out of 10** participants with the actual power battery of the Fitbit. P7 even noted: ''*I always am confused if it stands for the actual power battery of the Fitbit, I stopped looking at it because of this confusion.*'' P6 noted: ''*The visualization doesn't tell me anything, I only check the color. The battery has nothing to do with the step counter for me.*'' The six designs from image 61 were shown to the interviewed participants. **10 out of 10** noted that they prefer a visualization that has to do with activity or movement, such as design 1, 4 and 5 from image 61. P3 noted: ''*A shoe visual tells a lot more, it is a step counter, so you know what the colors are about. The battery has the same function but you might not link the colors to your activity, it can also mean that your battery of the device is full.*''

Activity progress visualization redesign

Image 61: Six redesigns of the activity progress visualization that are shown to the target group.

Bad day

The patient monitoring system of Medicine Men showed that P8 had used the bad day function 12 times over a period of 3 months. When asking P8 about the function during the interview he noted that he had never used it and was unaware of the usability of the function: *''What does the cross mean? I have a good day? I have a reasonable good day now... [I tell him that he should then press the cross] Oh, and then nothing happens? Only when I have a bad day?* It became clear that **5 out of 10** participants had comprehensibility problems with the function due to not understanding the icons that are used for (de)activation of the bad day function. Image 62 illustrates the found problem.

A research question was to find out why and when the patients use the bad day function. **2 out of 10** participants noted that they actively had activated the bad day function ones. P7 noted that she has selected the bad day function ones when she was really feeling sick but that she found it hard to do due to the negativity: *''It is not fun to do, it is quite a threshold to overcome. Your goal is doing better, you don't want to commit to something that is negative.*

That's why you don't do it that often I think, you are also going to think 'do I really feel more worse than normal?'. Off course, it is a good thing that it makes you think about it. But, maybe if it is not that negative formulated it is easier to overcome the threshold.'' P9 adds to that by saying that she also has selected the bad day function ones when she felt really sick, but that she did this by advise of her grandchild: *''She said: 'grandma, fill in that you have a bad day!'.*

It turned out that patients do not see this function as an easy way out of getting their activity goals set lower, despite earlier comments made by the interviewed rehabilitation physiotherapist. The patient activates the function only if they realy feel sick. Weather conditions play an important role for COPD patients in how they feel and how active they are, due to their lung disease. Every COPD patient noted that they know that some days are 'just bad' due to the weather. They will not use the bad day function for such days since they see this as a part of their disease and became used to it.

Patient interview results

Bad day function

Negative

Ik heb vandaag een slechte dag

What the patient thinks:

✗ Negative → bad day

✓ Positive → Good day

Intention:

Good day

Bad day

Button comprehensibility issues bad day function & negative threshold

Image 62: Bad day function comprehensibility problems that were revealed during the user test interviews.

Fitbit vs. Emma

10 out of 10 participants showed to be unable to understand the difference between Emma and Fibit. The Emma platform is build on and around the Fitbit platform which causes trouble for the patients to make the distinction between Fitbits software and the software of Emma.

Fitbit has an automatic goal set in their system of 250 steps per hour. They send out notifications every ten minutes before the end of the hour to notify how many steps you need to take for reaching 250. You will also see a celebration notification when reaching 250 steps in an hour, or reaching your Fitbit step goal, see image 63. You can switch these Fitbit goal notifications off, but it turned out that this was not done for the pilot participants. Therefore, they received the Fitbit goals notifications during their use of the Emma Activity Coach. All the participants thought that this was part of one application and didn't notice a difference between the two applications. The participants however noted that they liked the Fitbit motivational notifications and that they even trigger them to get activate.

Additionally, **7 out of 10** interviewed patients noted that they watch their activity data on the Fitbit application. Some patients did watch their data on their Emma dashboard as well, but the Fitbit application was preferred on their smartphone since it was easy and quick to access on their smartphone and showed a lot of information. **2 out of 10** participants mentioned that they also liked the weekly overviews that were send by Fitbit, seen in image 63.
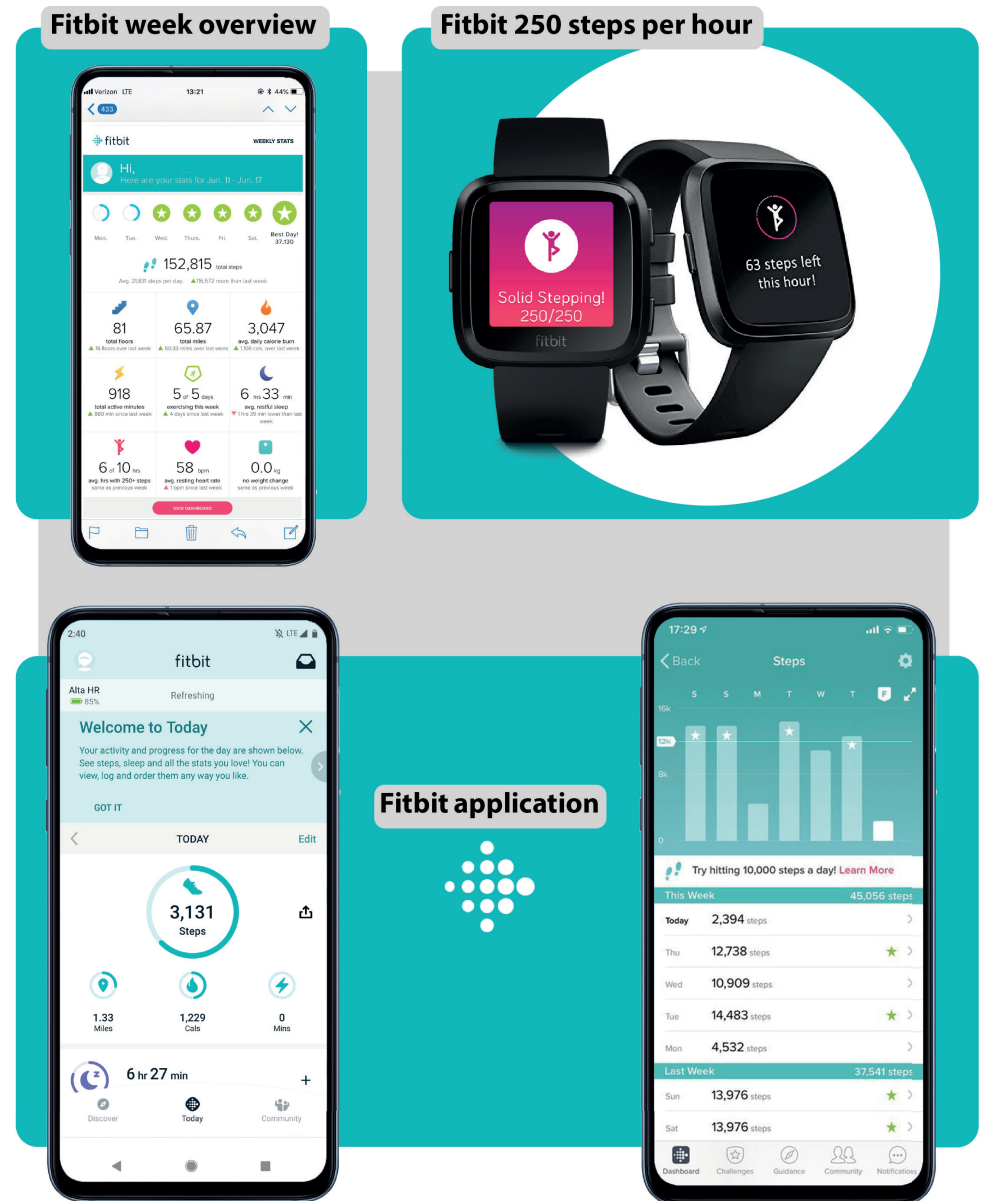

Image 63: An overview of the Fitbit activity applications.

Discussion

Chronic disease overlap

All patients involved in this pilot are diagnosed with COPD. This is one of the earlier discussed top three chronic diseases in The Netherlands and of the target group of this project. As already shortly discussed in the target group exploration chapter on page 39, testing only with COPD patients, instead of also with specific CVD and Type 2 diabetes patients should not be a downside since literature and practice show overlap and similarities in the treatment and effect of activity on these three chronic diseases.

Oloo et al. (2015) shows in his study of exercise and chronic diseases that activity is one of the cornerstone treatments for patients with chronic diseases that shows a positive affect on the health of the patient. Therefore, an intervention in the shape of the Emma Activity Coach is beneficial for the generic problem of the different chronic diseases of getting enough exercise in order to improve their condition and quality of life. Additionally, patients with COPD is a group that is known for having multiple chronic diseases at once (comorbidity). Franssen & Rochester (2013) show in their study of

comorbidities in patients with COPD that CVD diseases and diabetes are commonly associated with COPD. Moreover, Einarson et al. (2018) adds that CVD has a strong link with comorbidity and mortality among patients with Type 2 diabetes. The accompanying physiotherapist of the pilot at FysioHolland confirms the literature findings by what she sees in practice. She notes that the current group of COPD patients has an average of three to four comorbidities and that this is seen as a typical aspect of this patient group in general. Therefore, she noted that the implementation of the Emma Activity Coach could be generalised to several chronic diseases due to the presence of comorbidity and similarities in treatment.
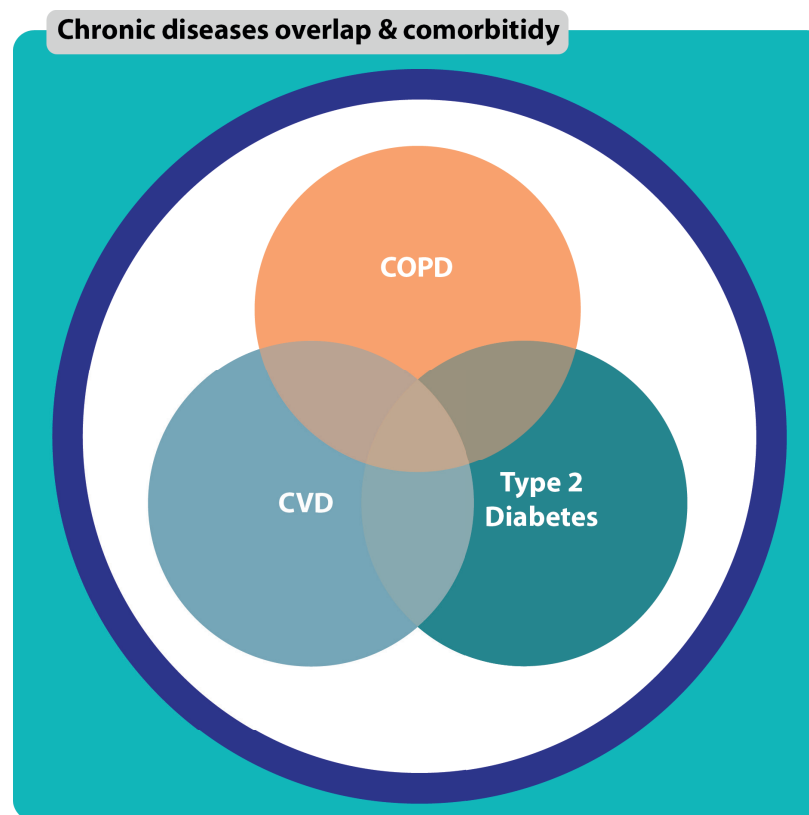

Chronic diseases overlap & comorbitidy

COPD

CVD

Type 2 Diabetes

Image 64: Illustration of the overlap and comorbidity between the three most common chronic diseases; COPD, CVD and Type 2 diabetes.

Fitbit vs. Emma

Although the motivational messages were part of Fitbits application and not of the Emma Activity Coach, the interviews with the target group showed that several patients liked these notifications since they motivated them to get active. The confusion and working of the Fitbit application together with the Emma Activity Coach was discussed with Medicine Men. It is important that the step goals and accompanying notification alerts from Fitbit contain the same stepping goals that are set by the physiotherapist in the Emma Activity Coach, to prevent patients from following the wrong step goals. The overall Fitbit step goal can be set the same as the Emma step goals in the Fitbit app, but the 250 steps per hour Fitbit step goal cannot be adjusted according to the set Emma step goals. Therefore, it is suggested by Medicine Men to deactivate the 250 step goal notification in the Fitbit settings when using the Emma Activity Coach.

Activity progress visualization

The activity progress visualization of a battery filling up turned out to be confusing for several patients, and additionally didn't contribute to the overall design and use of the application. It became clear that the target group would like to see an activity progress visualization that fits to activity, exercise or movement.

Conclusion

The results of the interviews were analysed in order to create iterations in the design to test further with the target group.

Bad day function

The current bad day function showed icon comprehensibility issues and should be redesigned in order for the patient to understand what they are doing.

Activity progress visualization

Iterations of the activity progress visualization will be made that are connected to activity. These will be tested further with the target group. The redesign of the activity progress visualization should fulfil the target groups need to be able to fill the visualization and it should clearly show them how much is left to be filled during the day in order for them to get motivated.

Activity data comparison

Comparing activity data with the data of previous days is found interesting by the target group. An extra screen will be designed in the Emma Activity Coach application that shows a week overview of their activity data in order

for the user to compare their current activity with previous days. Several designs will be made and tested further with the target group in order to explore how to portrait the activity overview clear and understandable for the target group.

Fitbit vs. Emma

Motivational notification designs will be made that could be implemented in the Emma Activity Coach and replace the 250 step notification from Fitbit. The designs will be shown to the target group in order to explore their thoughts and wishes on this topic.

6. Redefine

The results from the user tests from the previous chapter are translated into iterations. A division is made between the Emma Activity Coach and the Emma HCP dashboard in this chapter. The iterations of the Emma Activity Coach are focussed on the following product aspects; the activity progression visualization, the bad day function, a weekly activity overview, informing and motivational notifications. The discussed iterations are tested with 5 COPD patients who fit the target group of the project.

6.1 Emma Activity Coach iterations

The outcomes of the interviews with the patients from the target group and the HCPs were processed and translated into several iterations. Each design aspect iteration will be shown and discussed in the following chapter.

Activity progress visualization

It became clear that the target group would like to see an activity progress visualization that matches the topic of activity and movement. 4 new iterations are made, which are shown in image 65 as redesign 1 till 4, together with the two previous designed visualizations, 5 and 6. Iteration 1, 3 and 4 shows an image of a person walking when the user is in the green zone. The image of the person is visualized walking slower when the user drops to the orange zone. An image of a person standing still is shown when the user drops al the way to the red activity zone. This should motivate the user to transform the image in a walking visualization again by going back via the orange zone to the green zone. The walking person visualization is made white in iteration 4 in order to explore how the target group would like the traffic light color system to

be communicated in compared with iteration 1 and 3. Iteration 2 shows the footstep indicator visual from the homescreen of the Emma Activity Coach. This iteration is done to test the difference between a singe image being used, as in iteration 2, compared to a changing visualization, as in iteration 1 for instance. The earlier made redesign 5 and 6 were preferred by the interviewed participants out of the previous made designs. They are included with the new redesigns in order to compare them with the newly made iterations.

Activity progress visualization iterations

Image 65: Six activity progress visualization iterations that are made after the first user test interview results.

Bad day function

The bad day function is redesigned in order to resolve the discovered button comprehensibility problems. The iteration from image 66 shows a replacement of the mark and cross symbols, which caused the comprehensibility problems, by the words *yes* and *no* in order to make it more understandable for the user what they select. The addition of a highlighted *cancel* (*annuleer*) button is added since it was observed during the previous interviews with the target group that they find themselves sometimes accidentally in the wrong screen of the application and do not know how to exit from it.

User interaction

The *cancel* button changes into a *confirmation* (*bevestigen*) button when the patient selects *yes* or *no.* The *confirmation* button is added to prevent accidental activation of the bad day function by letting the user confirm their action with another button. A notification message is shown to the patient after activation of the bad day function which informs the patient that the bad day questionnaire is send to the Emma.6 application. The patient has to fill

in the questionnaire in the Emma.6 application. The notification message is dismissed by pressing the ok button.

Activation indicator

The previous bad day function showed a red negative smiley in the upper right corner of the screen after activating the function. An iteration is made, which can be seen in the fourth screen of image 66, were the smiley is replaced by red dot to communicate to the user that they have activated the bad day function. This is done since some patients noted in previous interviews that the red smiley is too negative.

Emma.6

An iteration is made on the concept LINK design of the Emma.6 bad day questionnaire. The use of emoticons is replaced by a selection of most occurring reasons for activating the bad day function, according to the interview results from chapter 5.2 and the physiotherapist of FysioHolland Zeeland. The physiotherapist noted that choosing a reason out of a list is effortless and understandable for the patient.

Bad day function iteration

Old bad day function that showed button comprehensibility problems due to a contradicting conception of the use of a mark and cross symbol. A red negative smiley is shown in the upper right corner after activating the function.

Emma Activity Coach bad day iteration
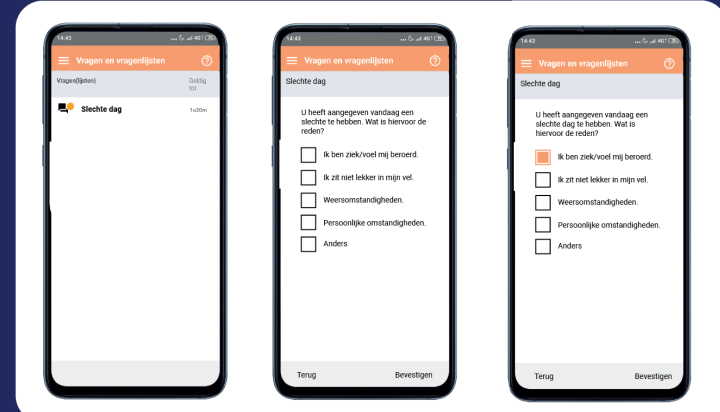
Emma.6 application questionnaire iteration

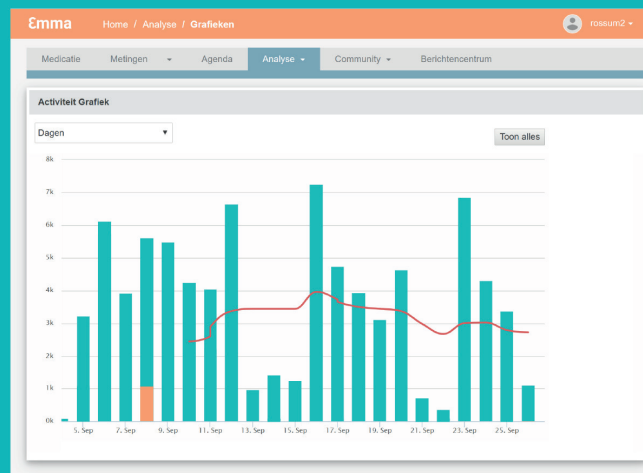*Image 66: Infographic of the bad day function iteration.*

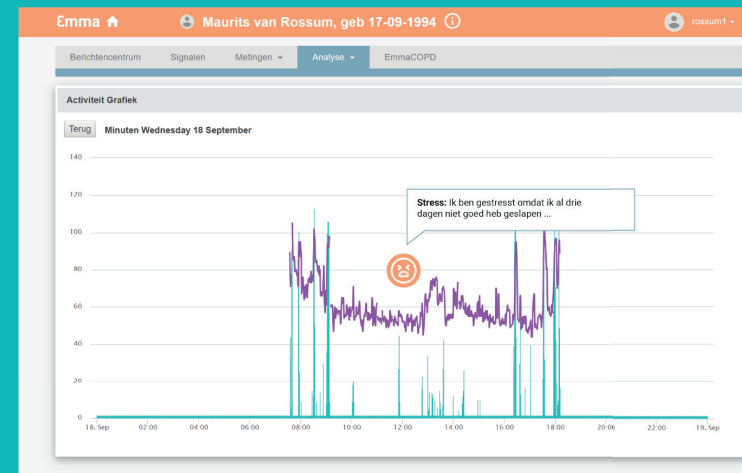## Emma dashboard bad day function

The display of the bad day function information in the Emma dashboard is also iterated and is shown in image 67. The use of emoticons was removed in the Emm.6 application questionnaire and therefore also in the Emma dashboard design. The previous design, from concept LINK, was based on the idea that the filled in emoticon by the patient would appear at that moment in their activity graph of that day as can be seen in screen 2 from image 67. The HCP, or patient, had to click on the salmon pink colored bad day activation indicatior (shown in screen 1, 4th column) in this redesign idea in order to get to screen number 2. This was found to be not benefit for the glanceability of the Emma dashboard activity graph. The iteration in screen 3 shows the same image as screen 1. When you go over the bad day activation indicator with the mouse, the specific amount of steps of that day are shown in combination with the reason of activation of the bad day function according to what the patient has filled in in the Emma.6 questionnaire on their mobile phone. This way, the HCP can easily and direct view all the needed information in one screen.

When you mouseover the salmon pink colored bad day bar, you will see more information about the reason for the bad day, which is filled in by the patient via the Emma.6 application on their smartphone.

Image 67: Inforgraphic of the bad day function iteration of the Emma dashboard.

Activation bad day function

A design challenge of this project was to find a new way of activating the bad day function on the Fitbit Versa 2 due to the removal of the two side buttons on the right side of the device, which were present on the Fitbit Versa and used previously to activate the bad day function. Only one button remains on the Fitbit Versa 2, which is de side button on the left. This button functions as a return/home button in the overal use of the Fitbit and can therefore not be used for the activation of the bad day function.

Another option is using the touchscreen of the Fitbit Versa 2 by designing an in screen button which should be touched to activate the bad day function. But, this idea was not followed up after experiencing the user interaction of the target group with the Fitbit during the patient interviews. Observations during the target group interviews showed that the the target group is typed by trial and error touch interaction with the Fitbit smartwatch. This would mean that the chance is relatively plausible that a touch button for the bad day activation can be activated by accident. Additionally, a touch button for the bad day function would be shown in the user interface of the Emma Activity Coach which is not desirable since it reminds the user of the function and could have negative implications.

The decision is made to go for a swipe movement to show the screen were the bad day function can be activated. Observations during the target group interviews showed that the swipe movement is an interaction that is not made a lot by the target group and therefore reduces the possibility of accidentally bringing up the bad day function activation screen. Image 68 shows the exploration of determining which swipe direction to use. 4 options are possible since the Fitbit Versa 2 has a square screen; top to bottom (1), bottom to top (2), right to left (3) and from left to right (4). It turned out that 3 of the 4 swipe directions are already occupied with other functions that are set in the Fitbit software and therefore cannot be changed. The top to bottom direction is occupied by the general settings and notifications of Fitbit. Bottom to top swipe direction brings up an overview of the Fitbit activity data and right to left takes you out of the Emma Activity Coach and into the application overview of the Fitbit Versa 2. The swipe direction from left to right is not occupied yet and is therefore used as the activation of the bad day function menu in the iteration design.
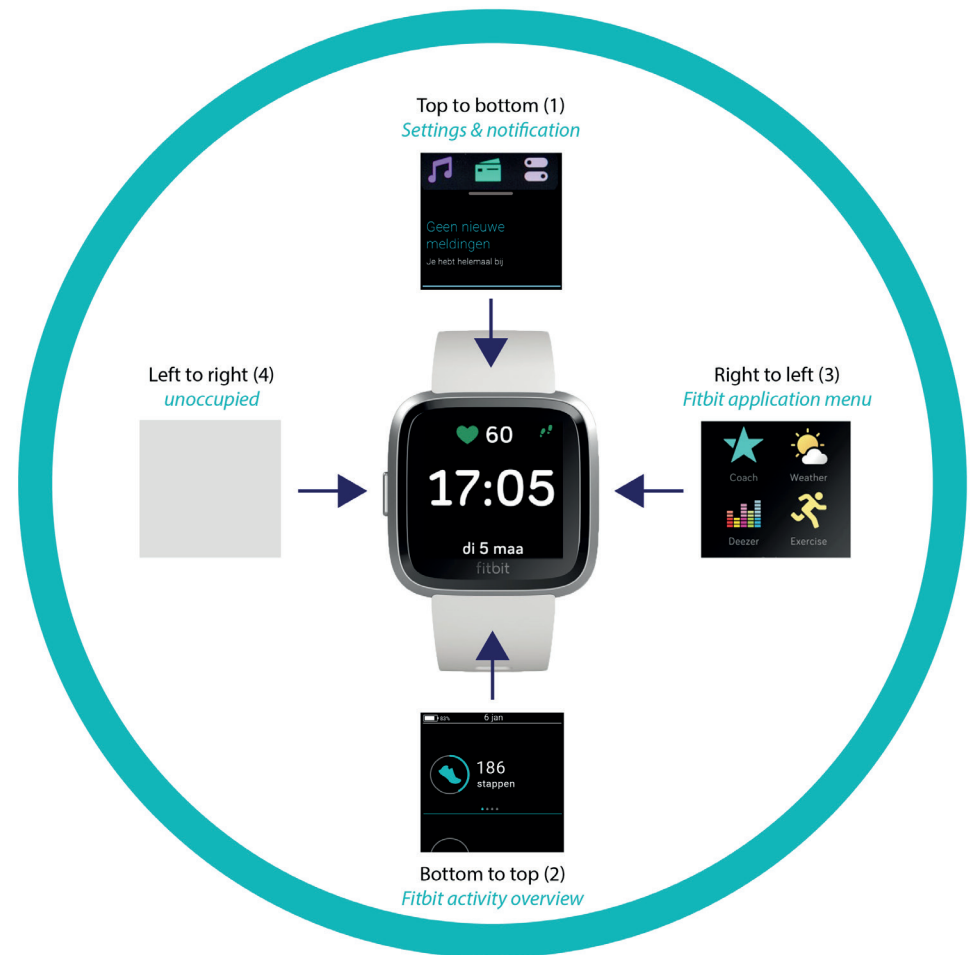

Image 68: Different swipe movements that were explored in order to activate the bad day function in the Emma Activity Coach.

Weekly activity overview

It became clear that the target group likes to compare their activity with previous days. There is an option on the Fitbit Versa 2 to get an overview of the days, but this function was only known by 1 of the interviewed patients. Therefore, the decision was made to implement a week overview screen in the Emma Activity Coach. 4 design ideas were made, which can be viewed in image 69, in order to explore the wishes and needs of the target group further through testing and interviews. An overview of the activity of the patient per day and per week is shown in the designs. The text in the top of the screens tells the user, in all four of the designs, what their average step number is of the previous 6 days. A white vertical line resembles this average number, by which the user can determine how their current step activity is compared to their average amount of steps of the past week. The last bar stands for the current day.

A addition is made in design 1, 3 and 4 of ranking the days according to the traffic light system. This would give the user extra information to determine how they did the previous days and where they are standing now.

Emma Activity Coach weekoverview

Image 69: Four Emma Activity Coach week overview screens that are designed after previous user test interview results.

Motivational notifications

The motivational messages and activity notifications from Fitbit were found a good addition by the target group. They noted that it indeed sparked activity when they lacked some steps or gave them a proud and joyful feeling when they were complimented with achieving the steps that they needed to take. As found out, and described before, it is not desirable that the activity goals and accompanying messages from Fitbit would disturb and entangle with the set goals by the physiotherapist in the Emma system. Therefore, exploration is done in order to implement such motivational and activity notifications in the Emma Activity Coach. Several design ideas are made, which can be seen in image 70, in order to explore the wishes and needs of the target group further on this topic. It is chosen to make several design ideas with text, since Fitbit also uses text to communicate their messages, but also have a design with the use of a thumbs up or down icon in order to explore which way of delivering a message/notification has the preference with the target group.

Differences in portraying a message
Several different types of portraying a message with text are used, such as for instance; *prevent red!* – which is motivational but with a focus on the negative side, *almost in green* – which is motivational but with a focus on the positive side, *take a 5 minute walk* – which is formulated as a tip or *2 hours in green!* – which gives a positive achievement message. This division in messages is done in order to test and explore the thoughts and preferences of the target group.

Motivational notifications

Image 70: A collection of several motivational notifications that are designed to be tested with the target group as a replacement of the Fitbit notification messages.

6.1.1 Iterations user test

The previously discussed iterations were tested with the target group in order to test its validity and explore possible further redesign directions.

Goal

The goal of the interviews with the target group was to test and explore the made iteration that are explained in the previous chapter, as well as gathering additional information on the iteration topics.

Participants and location

5 patients were interviewed at FysioHolland in Zeeland. These patients were also interviewed before during the interviews with 10 COPD patients at FysioHolland Zeeland. This means that the same conditions and setup as in image 56 on page 77 are in place. An overview of the interviewed patients can be seen in image 71.

Method

Several redesign ideas were made before the interviews, which are explained and shown in the previous chapter, which were used as a guideline throughout the interviews. Each image of an iteration was made using Adobe Illustrator and Photoshop and were shown during the interviews on a laptop. These designs were used as a tool to retrieve information about the iterations from the target group. Open questions were asked in order to obtain thorough information from the target group.

Prototype

The iteration on the bad day function, which involves the Emma Activity Coach on a Fitbit Versa 2 and the Emma.6 application on a smartphone, was prototyped and shown on a smartphone with the help of Axure RP 9 in order for the participants to interact and experience the use. Image 72 shows the prototyped bad day function on a smartphone which was used during the interviews. The other made iterations were not action based, therefore a still image without prototyping was sufficient to get the needed information from the interviews.

Patient interview participants

	Age	Gender	Fitbit version	Disease	Use period
P1	76	Female	Versa	COPD	5 months
P2	73	Female	Versa	COPD	5 months
P3	66	Male	Versa 2	COPD	4 month
P4	66	Male	Versa	COPD	4 months
P5	54	Female	Versa	COPD	5 months

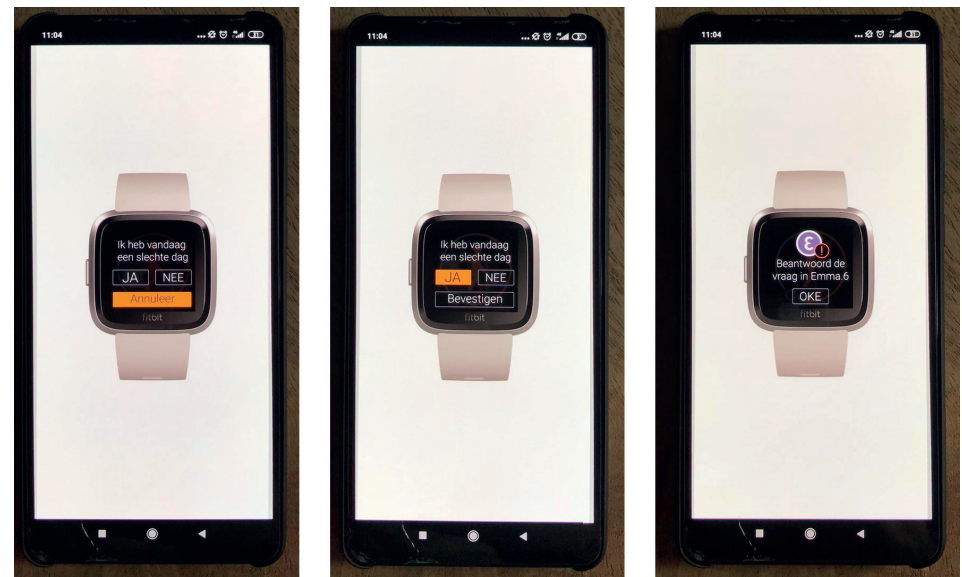*Image 71: Overview of the user test interview participants.*

Image 72: The bad day function iteration prototyped with Axure RP 9 that was shown on a mobile device to the participants during the interviews.

Results

Activity progress visualization

5 out of 5 participants showed their preference for design 1 of image 73. Compared to design 2 and 5, an image of a person walking was found astatically more interesting and fitting to the context of the Emma Activity Coach, P4: *"I find this one really nice, it shows action and movement. It would motivate me to make some steps. It also immediately tells me how I am doing by the color, it is direct".* Although design 6 was found nicely visualized by some, it wasn't immediately clear how the visualization should be read and therefore did not fit the design vision of the project. Design 4 has the same walking illustration as design 1 and 3, but illustrated in white. All participants gave the preference of having the image of the person also colored since it tells them in one glance how they are doing, P3: *"If the person is green as well it strikes more. I am 66 and quite digital illiterate, so I think that these colors make it extra understandable for me".* P5 adds to the latter: *"First I see that the person is red, that already tells me that I don't do enough. Then I see that I am behind my goal".*

Design 1 shows to be fitting to the earlier discussed glanceability in the Smartwatch UX chapter on page 33 according to the responses of the participants. Futhermore, design 1 was preferred above design 3 because of the use of dots instead of the grey circle. **3 out of 5** participants noted that the dots referred to the division of a clockface and was therefore found a fitting visualization on a Fitbit smartwatch. Additionally, P4 noted: *"I like the dots more than the grey circle. The grey circle is sort of filled in already for me, while I think that the dots can be reached and filled in by my own activity".*

Activity progress visualization iterations

Image 73: Six activity progress visualization iterations that are made after the first user test interview results.

Bad day function

5 out of 5 participants found the iteration of the bad day function an improvement compared to the original situation. The use of *yes* and *no* took away the comprehensibility issues that were present before with the cross and checkmark icon, P4 noted: *''This is much clearer than before, I had the idea myself of maybe using the previous check mark only to check a box if you have a bad day, but simple yes and no is even better ''*. P5 added to the latter: *''I always pressed the wrong option before. This is much better with yes and no. I find the cancel option also really good, otherwise I always had to struggle with the side button to return''*.

5 out of 5 participants understood, after explanation, the activation of the bad day function via swiping from left to right. No interaction problems were found when the participants were asked to open the bad day function in the made prototype on a smartphone.

5 out of 5 participants noted that the given options in the Emma.6 application bad day questionnaire were in line with the reasons the patients would give if the would

activate the bad day function, and otherwise they still have the option other (*anders*) if their reason is not present. The addition of the questionnaire design idea was supported by the target group, P4: *''I think the questions are a good addition, since it gives more information for yourself and your surrounding''*. P1 and P2 add that they as well like the idea of their physiotherapist knowing why they have selected the bad day function with the addition of the Emma.6 questionnaire.

0 out of 5 participants noticed the red dot, which indicates the activation of the function, after going through the bad day prototype. When pointing it out to the participants, they told that they did not know what it stands for. An attentive participant noted that the red dot in the right upper corner interferes with the red dots used in some designs of the weekly activity overview, as can be seen in image 75, which could leave confusion.

Image 74: Previous bad day function compared to the made iteration.

Red dot confusion

Image 75: Confusion that occured of the red dot design of the bad day function and the red dots in the weekly step overview screen.

Weekly activity overview

5 out of 5 participants noted that they aren't interested that much in their average taken steps, which is shown in the designs of image 76, but they instead would like to see how they did compared to their set activity goal. This means that the vertical white line should represent their activity stepgoal instead of their average taken steps, P4:*"I want the white line to represent my goal, that would be my 0-line. That is what you do it for. The average steps don't tell me that much to be honest. If you make the reference line represent your goal, you can immediately see how you are doing each day"*. P3 adds to the latter by addressing the design of Fitbit's week overview: *"The Fitbit overview takes a few steps to find and activate. It only tells me that I've done 2K steps. That tells me nothing. I now check what my best day has been, and that is what I aim my bars at. But, I want to see what I've done compared to my goal. That is something I miss in the Fitbit overview"*.

Design 1, 3 and 4 have the addition of showing the user how they did previous days compared to their goal with the use of the traffic light system. **4 out of 5** participants preferred design 4; P4: *"I like the addition of the colored dots, they tell me how my previous days were. I like the highlighted bars even more, that tells me direct what days were good"*, P3: *"I prefer the dots over the stripes, the dots are more clear since with the stripes you have to check manually which bars are reaching where while the dots immediately tell you if it is good or bad"*. It was found that it took some time for the participants to understand design 4, although it was prefered.

An additional question was about the order in which the different Emma Activity Coach screens were placed. **5 out of 5** participants noted that they found the current order of the screens: 1.*homepage – 2. activity progress – 3. activity goal and step overview*, logic and useful. The addition of a weekly activity overview would be preferred by the participants as the final screen of the Emma Activity Coach, at place 4, since it was found logical to the participants to first get information on their current day in the application and conclude with information about their past week.

Emma Activity Coach weekoverview

Image 76: Four Emma Activity Coach week overview screens that are designed after previous user test interview results.

Motivational notifications

5 out of 5 participants noted that they preferred positive notifications that are simple and direct such as the green thumbs up and the *goed bezig* (nice job) message from image 77. A red thumbs down was not desired by **5 out of 5** participants since as P4 states: *"If you are in red, you know by the color already that it is not good. I would not like to get a negative thumbs down as an extra."* When asking the patient why he liked a thumbs up when he was in the green zone, while he than also knows that green means that he is doing good, he noted that in that case it gives extra positive feedback which is desired during use instead of extra negative feedback such as a red thumbs down.

The text messages from image 78 were not found interesting by **4 out of 5** participants. They noted that such messages would not give any impact to change their activity behaviour, since they were too vague, P2: *"I am not interested if I am 2 or 3 hours in green, that does not tell me anything. I like the notifications to be simple and direct like the thumbs up or just saying nice job".*

Although the patients noted during this interview and the previous one that the 250 steps per hour from Fitbit were motivating, P3 noted the following: *"It gives a sign that I need to get activity, but it is shown per hour, that is off course useful but it can sometimes be a bit too much too be honest".* As discussed earlier, the principle of Medicine Men is to notify the target group as minimal as possible in order for them not to be reminded of their condition all the time. Notifying the patient every hour with the Fitbit 250 step notification is not desired due to the principle of Medicine Men. But, since the method of Fitbit does show interesting motivation and activity improvents, the idea is thought of adding a similar method as the 250 steps from Fitbit in the Emma Activity Coach but it only sends a notification if the patient is 250 steps below one of their bandwitdh stepgoals instead of every hour. This would minimize disturbing the target group, but does give them a motivational message when needed.

Prefered notification design

Image 77: Direct and clear notification designs are prefered

Motivational text notifications

Image 78: The text messages were not found a needed notification.

Conclusion

Activity progress visualization

The activity progress visualization from image 79 was preferred by all participants. It meets the set design vision of the patient getting clear feedback on their activity according to the interviewed target group patients. Therefore, the decision is made to use the visualization as the final redesign for the Emma Activity Coach.

Bad day function

The redesign of the bad day function in the Emma Activity Coach Fitbit application took away all the comprehensibility problems that were present before. The design will be used as the final design of the bad day function of the Emma Activity Coach on the Fitbit Versa 2.

The iteration of a red dot, instead of a negative red smiley in the upper right corner, to indicate the activation of the bad day function did not give the desired outcome for the target group. An additional user test will be done in order to test iterations of the bad day function activation indicator.

Weekly activity overview

The prefered design from image 79, wasn't clear right away for all the participants. Therefore, iterations will be made in order to comply to the whish of the target group to have a clear and glanceable overview of their week performance.

Motivational notifications

The interviewed target group showed a preference for glanceable notifications that are clear and direct.The green thumbs up design from image 79 was seen as a positive addition to the use of the Emma Activity Coach and will be implemented in the final design. Additionally, a design will be made and tested with the target group that notifies the user when they are 100 steps or less below their activity bandwidth goal.

Activity progress visualization

*Prefered by **5 out of 5** user test participants*
- Direct information via colors
- Clear visual
- Logic and nice connection to activity

Motivational notification

*Prefered by **5 out of 5** user test participants*
- Simple and direct
- Positive feedback

Weekly activity overview

*Prefered by **4 out of 5** user test participants*
- Addition of colored dots
- Clear visual

Image 79: *Overview of the prefered designs by the participants of the user test interviews.*

An interview was held with Dr. A. van Buul. She has written a research thesis about the effect of morning symptoms on the activity of COPD patients. A short summary is giving of the main findings of the research thesis before discussing the held interview.

Morning symptoms and activity
It is shown in her thesis that COPD patients have less activity in the morning due to morning symptoms. Morning symptoms are for instance an increase in sputum, shortness of breath, chest tightness and wheezing (Van Buul, 2019). These morning symptoms cause a decrease in the health status of the patient, an increase in exacerbations, decrease in the patients sleep quality and higher anxiety and depression levels according to Van Buul (2019).

The research thesis of Van Buul uses the PRO morning COPD Symptoms Questionnaire to explore the connection between morning symptoms and activity for COPD patients. This questionnaire consists out of six questions regarding patients dyspnea, sputum production, chest tightness, wheezing and coughing (Van Buul, 2019). An increase was found in the morning in one or more of these morning symptoms for patients with COPD which resulted in less activity in the morning. These literature findings are in line with the findings of the held user test interviews from chapther 5.2. Almost every participant noted that they are in the red zone in the morning with their Emma Activity Coach since they have troubles getting started with their day due to the morning symptoms.

Goal
The aim of the interview was to explore the symptoms that case a decrease in activity for patients with COPD and explore their connection to the bad day function of the Emma Activity Coach. Additionally, the redesign of the bad day function was shown to Dr. A van Buul in order to receive feedback on the design from her research background.

Method
The reserach thesis from Dr. A. van Buul; '*New insights in morning symptoms and physical activity*', was read and analysed for interesting insights with regard to this project. A list of questions was set up to be asked during the interview. These questions can be found in appendix P.

Location
The entrance lobby at Reinier de Graaf Gasthuis in Delft.

Prototype
The same prototypes of chapter 6.1.1 were used to show Van Buul the made designs, which are the bad day function in the Emma Activity Coach and the Emma.6 smartphone application questionnaire. Image 80 shows these prototypes that were made with Axure RP 9 and shown on a smartphone during the interview.
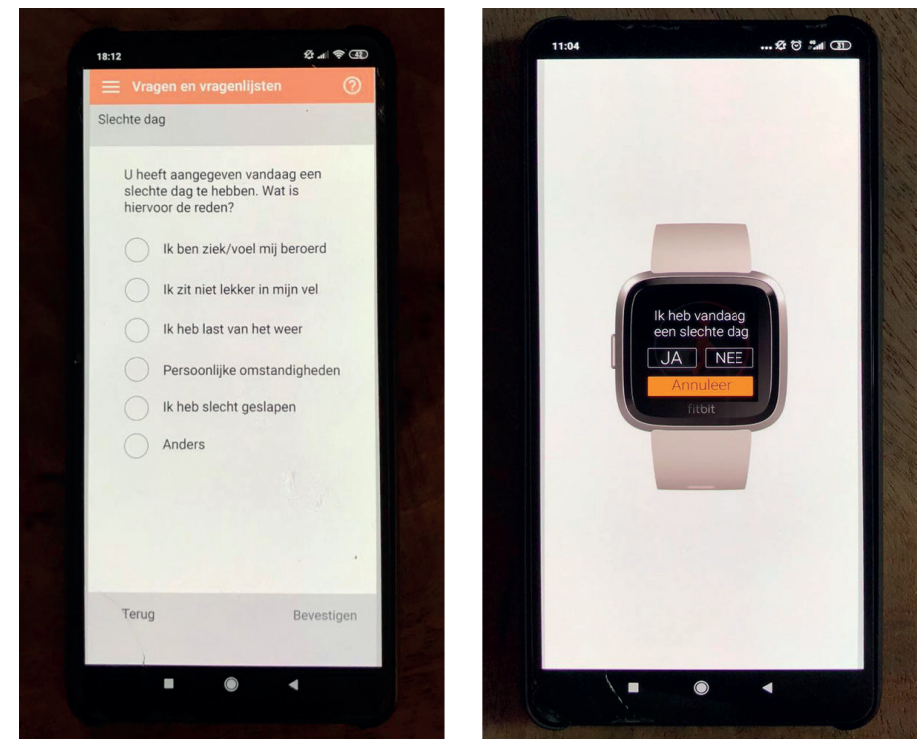

Image 80: Emma.6 application prototype made with Axure RP 9.

Interview results
Bad day function
Van Buul was shown the original bad day function of the Emma Activity Coach and the redesign prototype, from image 80, with the combination of the questionnaire in the Emma.6 application. The redesign was seen as a good and interesting improvement due to the clear and informative design and the addition of the Emma.6 application. The latest test results with the target group showed that still a problem in the redesign of the bad day function was present in the form of the activation notification. Together with van Buul some idea generation was preformed during the interview of what should be a fitting activation notification of the bad day function. The suggestion by Van Buul was that the activation notification has to link with what the function does in order for the user to understand and notify it. The activation of the bad day function reduces the step goal of the patient with a certain percentage which is set by the physiotherapist. At the moment, this is not communicated to the user when activating the function, which could leave them puzzled at what happened and what the function is for.

Emma.6 question
The reasons for having a bad day out of which the patient can choose in the Emma.6 app were discussed with Van Buul. The reason: '*Weersomstandigheden*' was seen as too vague and cryptic for the target group by Van Buul and was suggested to be changed into '*Ik heb last van het weer*'. In addition, a sixth reason was proposed by Van Buul in the shape of '*Ik heb slecht geslapen*'. Van Buul noted that her research showed that many patients of the target group have trouble with getting enough sleep or a healthy sleep pattern which results into a lack of energy and therefore activity during the day.

Conclusion
The next step in the redesign of the bad day function will be making sure that the patient knows what happens when they activate the bad day function and in addition communicate this by showing an understandable activation notification in the Emma Activity Coach.

The suggested bad day reason descriptions iterations by Van Buul will be translated in the design of the Emma.6.

6.3 Emma Activity Coach iterations 2.0

The conclusion of chapter 6.1.1 showed three aspects of the Emma Activity Coach that had to be iterated and tested before including them in the final design, these aspects are; a weekoverview, a notification of the bad day function activation and a notification message is the user is close to reaching the next activity zone. The iterations and designs will be discussed in this chapter.

Weekly activity overview
Image 81 shows five redesigns for a weekly activity overview screen that would be included in the Emma Activity coach design. Each design shows on top in text and number the daily step goal of the user, instead of the earlier shown average step count per day. This change was done according to the response of the participants on the earlier shown designs. Three different ways of visualising the step goal data of that week are made; design 1 and 2 are

bar graphs that shown the users steps compared to the line (white in design 1 and green in design 2) which represends their daily step goal. The bars are marked with the trafficlight color system depending on how far the are removed from the set activity goals. Design 3 uses a column plot with the daily step goal as a starting point. In addition, the bars are just as in design 1 colored according to the trafficlight system depending on how far the step count is removed from the set activity goals. Design 4 and 5 are

based on scatter graphs that show the green activity zone of the patient and markings where the patients activity was on the days of the week compared to their green activity zone. Design 4 makes use of dots with trafficlight color indications whereas design 5 has arrows that point to the green activity zone in order to communicate to the patient which direction their activity needed to go that day in order to reach the green activity zone.

Weekly activity overview iterations

Image 81: Five weekly activity overview iterations made to test further with the particpants of the target group.

Bad day function activation notification

It became clear out of the previous user test with the target group and the interview with van Buul that it was needed to make an iteration in the bad day function that gave the patient information about what the function did, as well as designing an activation notification of the function that also shows a connection to what the function does in order for the patient to understand the notification.

Image 82 shows, from left to right, 4 iterations of the bad day function activation notification in the A row. One of these iterations will be added in the bad day function design on the place of the letter A in the visual lay-out of the bad day function. This screen will be shown after the patient has activated the bad day function and tells them what is happening. The B row shows the activity progress visualization screen with in the top right corner the designs for the bad day function activation notification. One of these iterations will be added in the bad day function design on the place of the letter B in the visual lay-out of the bad day function.

Two icons where designed that would notify the user about the activation of the bad day function and inform them on the effect of the activation. One of these two icons is repeated in the iterations 1, 2 and 3 but in three different colors. This icon shows footsteps with an arrow pointing down. The second icon is used in iteration 4 and consists out of a percentage sign with an arrow pointing down. The design decision is made to shown the activation notification icon already in the text screen of A in order to make it more noticable in the end at screen B since previous interview results with the target group showed that not all of them understood the previous negative red smiley in the top right corner at screen B.

A red icon is made in iteration 1 since it is an alarming color and would therefore be notified more easy by the target group, as was found in previous user tests.

Iteration 2 shows the icon in salmon pink. This color is the on of the portfolio colors of Emma. Additionally, this color is used on the Emma dashboard to indicate the use

Bad day function activation notification

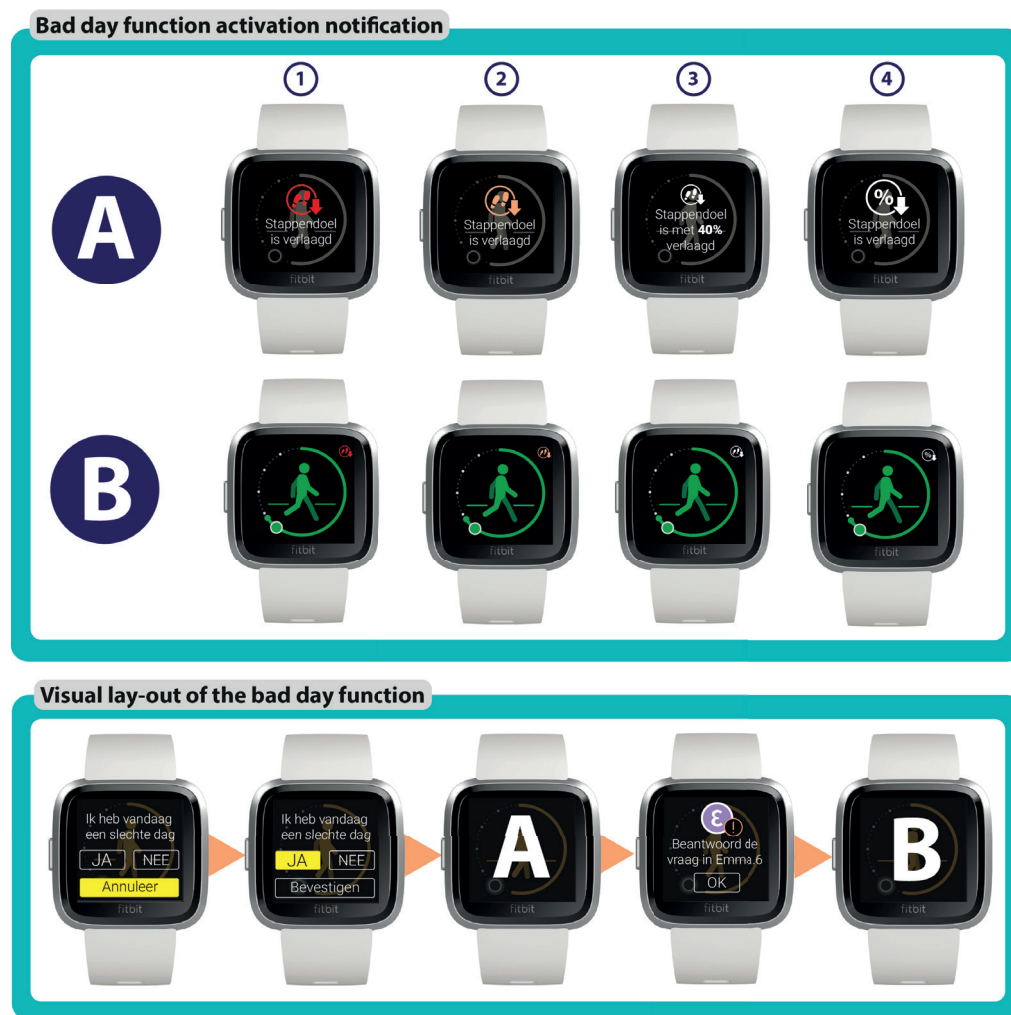**Visual lay-out of the bad day function**

Image 82: Iterations of the bad day function activation.

the bad day function in the activity graphs, as can be seen in image 67 on page 89. Therefore, it is expected that the patient would link this color with the bad day function. In addition, it is a less alarming and negative color as red.

Iteration 3 shows the icon in white in order to explore if the target group would like a neutral color without any additional meaning. Iteration 3 has the addition of formulating the percentage of reduction (40% in this case) in the text. This was done in order to test the preference of the patient of how much information they would like to recieve on the effect of the activation of the bad day function.

Iteration 4 shows the icon with a percentage shown in order to test which icon has the preference and is most understandable.

Stepcount motivational notification
Image 83 visualizes the design of the Emma Activity Coach stepcount notification design, the activation flowchart and the explanation of two walkthrough situations that will be tested with the target group.

The patient will get a notification message in the Emma Activity Coach that shows the amount of steps the patient needs to take, if they are within 250 steps till their next activity zone and according to the flowchart of image 83, before reaching the next activity zone.

Two situations are designed, A and B of image 83, and will be tested with the target group. The first four screens are the same for each situation; the patients getting close to reaching the green activity zone and according to the flowchart a stepcount notifcication message is send that they have 168 steps left till the green activity zone. The patient continues was they are doing and doesn't look on their Fitbit again. After getting a bit of activity, they look again at their Fitbit to see their progress.

Situation A is based on the principle that the stepcount keeps counting down until the patient reaches their next activity zone. As can be seen in image 83, the patient sees that they have 53 steps left before reaching the green activity zone when looking again at their fitbit. They can see this number getting lower depending on their activity followed by a green thumbs up notification when they have reached the green activity zone.

Situation B does not keep showing the count down of steps needed to reach the green activity zone. The patient will be notified with for instance the stepcount message of 168 steps to go from image 83 only once, in case of meeting the flowchart settings. When checking the Emma Activity Coach again, they will just see their activity progress visualization. Eventually they will also recieve a notification of a green thumbs up when they have reached the green activity zone.

These two situation will be prototyped and shown to the target group of this project in order to test their preference in information retrieving.

Emma Activity Coach stepcount notification design

1

173 stappen tot oranje

The patient will get a notification message when they are within 250 steps from their next bandwidth goal. A short vibration will notify the user. The notification will be shown for 10 seconds.

2

168 stappen tot groen

The same occurs when the patient is within 250 steps from their green bandwidth goal when they are in the orange activity zone. A short vibration will notify the user. The notification will be shown for 10 seconds.

3

A green thumbs up icon is shown for 20 seconds when the patient reaches the green activity zone. A short vibration will notify the user. The notification will be shown for 10 seconds.

Stepcount notification flowchart

Past hour less than 250 steps
— Yes → Step notification

Yes

≤ 250 steps removed from bandwidth goal

No

No notification

No

168 stappen tot groen

Two situations for the stepcount notification interaction lay-out

Activity progress visualization

168 stappen tot groen
Stepcount motivation notification

The user has Fitbit OFF for a period of time

♥ 60 **17:05** di 5 maa
The user turns Fitbit on: Emma Activity Coach watchface

Situation A

53 stappen tot groen
Activity progress visualization with updated stepcount motivation notification

The user has Fitbit OFF for a period of time

A green thumbs up notification is shown when the user reaches the green activity zone
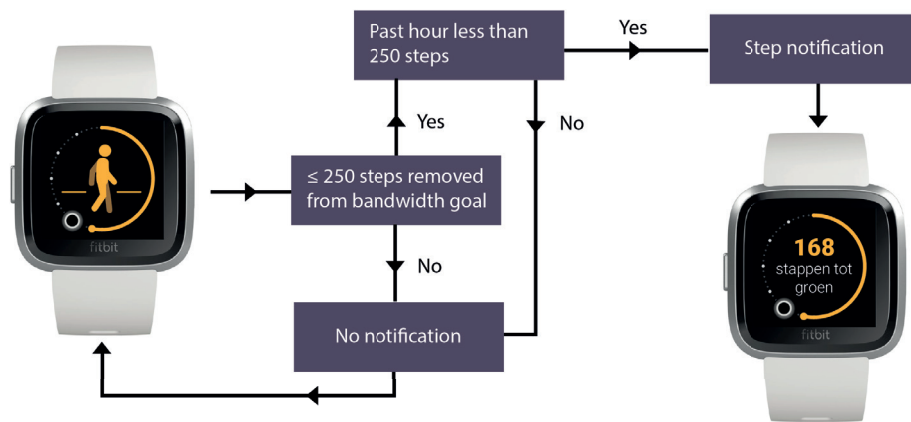
Situation B

Activity progress visualization

The user has Fitbit OFF for a period of time

A green thumbs up notification is shown when the user reaches the green activity zone

104 *Image 83: Emma Activity Coach stepcount notification design and user interaction flowchart. Two user interactions are designs to be tested with the participants.*

6.3.1 Iterations user test 2.0

The previously discussed iterations are tested with the target group in order to explore the preference of the target group for the design of the Emma Activity Coach.

Goal

The goal of the interviews with the target group was to test and explore the made iteration from chapter 6.3 and find out the preference of the target group for each design aspect of the Emma Activity Coach in order to come up with the final design.

Participants and location

7 patients were interviewed at FysioHolland in Zeeland. These patients were also interviewed at the previous two interview session at FysioHolland Zeeland from chapter 5.2 and 6.1.1. The same conditions and setup as in image 56 are in place. An overview of the interviewed participants can be seen in image 84.

Method

The explained iterations from the previous chapter 6.3 were shown to the 7 target group participants. The weekly overview iterations from image 81 were shown and asked which design stood out for them and was in a glance understandable. Followed by asking for each screen what they thought of it.

The activation notification iterations of the bad day function from image 82 were tested with the participants. They were asked what kind of information they prefered as being sufficient about the function activation. Followed by asking if they understood the icon, if it was fitting to the context and their preference of icon and color use.

The stepcount notification design was prototyped in Axure RP 9 in order to show and explain to the participants the interaction and screen lay-out of the two different situations mentioned in image 83. Image 85 shows the stepcount notification design which was shown to the participants prototyped on a mobile phone. The participant was asked after the explanation which situation had their preference and what their thought was of the design and idea in general.

Patient interview participants

	Age	Gender	Fitbit version	Disease	Use period
P1	76	Female	Versa	COPD	5 months
P2	73	Female	Versa	COPD	5 months
P3	66	Male	Versa 2	COPD	4 months
P4	62	Female	Versa 2	COPD	1 month
P5	76	Male	Versa	COPD	5 months
P6	75	Male	Versa 2	COPD	3 months
P7	73	Female	Versa 2	COPD	3 months

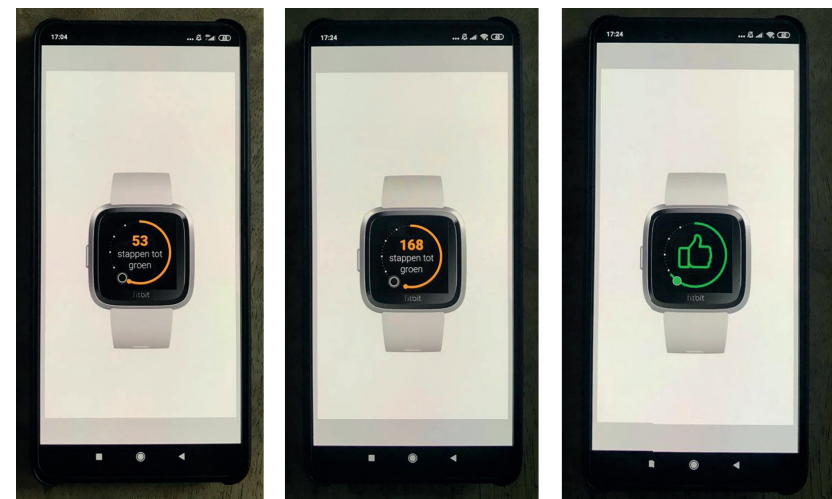*Image 84: Overview of the user test interview participants.*

Image 85: Iteration prototypes that are made with Axure RP 9 and shown a mobile phone to the participants.

Results

Weekly activity overview

7 out of 7 participants showed a clear preference for week overview design 1 from image 81. The design decision to color the bars completely is prefered by the target group since it adds to the glanceability of the design, P1: '*Number one 1 is my favorit, I know what I see there and the colored bars can be seen and understood right away. I don't understand design 4 and 5...*'. Although desgin 3 was also understood by several participants, the visuals where less prefered due to smaller bars which made it harder to see the difference between the days, P3: "*Design 3 has too small bars for me. I need to watch more detailed at it in order to see what is what. Design 1 is in that case clear at first glance and more screen filling which I like.*"

The color blue used for the bar on the right, which represent the current day and thus an activity measurement in progress, was not totally clear for all participants. They found it to be to much deviating from the traffic light colors. When asking what they would wish to see in replace, they noted that they would prefer filling it in with one of the traffic light colors already,

depending on the activity level, but the color to be a bit more toned down (lower opacity) to indicate it is not final yet. An iteration will be made her for the final design of the weekly activity overview.

Bad day function activation notification

7 out of 7 choose the bad day activation notification icon from image 86, since it was a clear and understandable icon for them; P6: '*It is very clear to me. I understand that it has to do with lowering my stepgoal, whereas the other icon with the percentage sign could also implement something with my battery percentage of my Fitbit maybe...*'

3 out of 7 participants gave preference to the red icon color and **3 out of 7** to the salmon pink icon color. P1 an P2 noted that they were used to seeing a red red activation notification icon (the red negative smiley) and therefore were most drawn to red again. P3 showed a preference for the salmon pink color, as he noted: "*It is a less alarming color as red but more noticable than the white design. It tells me that something has happend.*" The physiotherapist was also asked

the question of color preference. She choose pink salmon because in her view red was too negative and alarming, while this would not be desired for the bad day function according to her. Additionally she liked the connection it made with the bad day function indication in the graphs on the Emma dashboard since the same color is used. The input of the physiotherapist made the decision of going for the salmon pink color for the activition indication of the bad day function.

5 out of 7 participants prefered the text *'stepgoal is reduced (stappendoel is verlaagd)'* above *'Stepgoal is reduced with 40% (stappendoel is met 40% verlaagd)'*. The message that their stepgoal is reduced when activating the bad day function is enough information for the patient. The addition of *40%* was too much unneeded detail for 6 out of 7 particitpants.

Stepcount motivational notification

5 out of 7 participants prefered situation A from image 85 in which the stepcount notification would keep counting down until reaching the next activity zone. P7 noted: "*Seeing how*

many steps I have left en how many I have done motivates me to get into green. I also like the thumps up. That gives me a pat on the back and tells me he you did good!". The overal principle of reviecing a notification when they are close to reaching the next activity zone was also found an improvement compared to the 250 step notification they get now every hour from Fitbit, since several participants noted that they only wanted to get a notification when it mattered, when being close of reaching the next activity zone in this case.

106

Conclusion

Image 86 shows the choosen designs for each discussed aspect of the Emma Activity Coach together with the main argumentation summarized. Although all participants choose design number 1 from the weekly activity overview design from image 81, not all understood the blue colored bar on the right which represented the current day with the ongoing activity measurement. Image 86 shows the final iteration with the current day bar on the right colored in the traffic light colors depending on the activity level, but slightly toned down to indicate it is not final yet. This iteration was suggested by the test participants.

Weekly activity overview

Prefered by **7 out of 7** *user test participants*
- Good glanceability
- Direct and understandable

Bad day function activation notification

Icon prefered by **7 out of 7** *user test participants*
- Connection to the context

Icon color prefered by **3 out of 7** *ser test participants*
- Less alarming than red and Emma dashboard connection

'Stepgoal is reduced (stappendoel is verlaagd)' prefered by **5 out of 7**
- Sufficient information without making it complicated

Emma Activity Coach stepcount notification design

Prefered by **5 out of 7** *user test participants*
- Motivational
- Reachable
- Notification when it matters

Image 86: Overview of the prefered designs by the participants of the user test interviews.

7. Emma dashboard

This chapter discusses the exploration and iteration of the Emma dashboard. The focus is on the dashboard of the HCP since they monitor the patients data with it and use their dashboard version to discusse results during consults with their patients. The Emma dashboard of the HCP is further explored by interviewing physiotherapists who have made use of the system or still have.

The previous chapters discussed concepts and test results of the Emma Activity Coach on the Fitbit Versa 2, together with some design ideas that take place in the Emma.6 application. A third element of the Emma platform is, as discussed in the research phase, the Emma dashboard.

The physiotherapist will monitor the patients Emma Activity Coach use and data via the Emma dashboard. This chapter explores the Emma dashboard for the HCP. Interviews with the target group patients showed that not all of them look on the Emma dashboard to watch their data. Most of them noted they watch their data via the Fitbit mobile application since this was found to be more easy to access. Nevertheless, all patients watch their data on the Emma dashboard during meetings with their physiotherapist on the desktop and Emma dashboard of the physiotherapist. Therefore, it was decided that the Emma dashboard of the HCP was the most important dashboard to focus the exploration and iteration process on instead of that of the patient.

Goal

The aim was to explore the user experience and interaction of the physiotherapists with the Emma dashboard. The findings would be evaluated and translated into a suggestion of a redesign of the Emma HCP dashboard.

Method

Research questions were set up in order to find out the user experience of the physiotherapists with the Emma dashboard. These research questions were send out to 4 physiotherapists, each working at a different practice, via e-mail. These physiotherapist were selected and contacted since they had used the Emma system before to monitor their patients who used the Emma Activity Coach.

Research questions

The following research questions are used in order to explore the user experience of the physiotherapists with the Emma dashboard:

1. *What is/was your general experience with the use of the Emma dashboard? What were the plus or minuses and if you had the possibility, what would u change about?*

2. *On average, how many times a week did you watch patients data on the Emma dashboard?*

3. *When did you watch the data of a patient on the dashboard? For instance, together with the patient during consult or also throughout the week on your own initiative.*

4. *Which information/data was/is most interesting for you on the Emma dashboard?*

5. *Do you still use the Emma platform? Why (not)?*

6. *(In case of not using the Emma system anymore) How long did you use the Emma platform?*

Results

Image 87 shows the answers of the interviewed physiotherapists on research question 2, 3, 5 and 6. The answers on research question 1 and 4 are discussed further in this chapter.

Emma dashboard general experience

4 out of 4 physiotherapists noted that they in general find the Emma dashboard clear and easy to use. The ability to monitor the patient together with gaining insight about their activity, for as well the physiotherapist as the patient himself, is seen as a very useful aspect of the Emma dashboard.

Pt4 notes that a struggle with the Emma dashboard is the amount of steps that need to be taken before she gets to see the information she wants. Image 88 shows the current Emma HCP dashboard and the steps that the HCP has to go through before seeing the patients data. Additionally she noted, that these steps from image 88 need to be taken for each patient in order to check if their data is synchronised from their Fitbit with the Fitbit Cloud. This takes up a lot of time with the 30 patients in the pilot. She therefore notes that a change she would like to see is to have a clear homepage overview per patient that directly shows the most interesting information to your liking instead of having to navigate to it via different tabs.

Physiotherapist Emma dashboard

	A	B	C	D	E
Pt1	No	10 months	Once a week	Before + during patient visit	1
Pt2	Yes	11 months	Once a week	Before + during patient visit	1
Pt3	No	6 months	Once a month	Before + during patient visit	3
Pt4	Yes	6 months	≈ 3 times a week	Throughout the week + during patient visit	30

A: Still using the Emma dashboard?
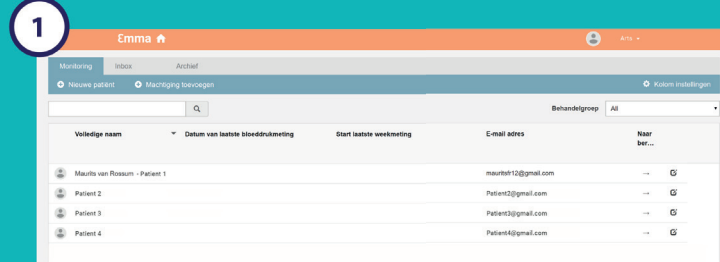B: How long does/did the physiotherapist use the Emma dashboard?
C: How many times does/did the physiotherapist look at the Emma dashboard?
D: When did the physiotherapist take a look at the Emma dashboard?
E: How many patients were monitored with the Emma system?

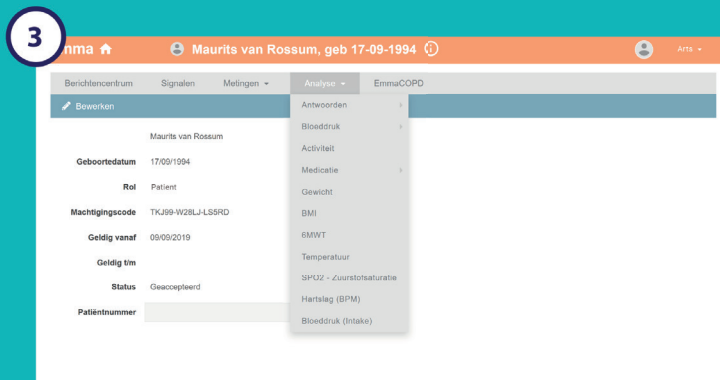*Image 87: Physiotherapist information and answer to RQ 2,3,5 and 6.*

HCP patient data view steps

Homepage with an overview of the patients that are under the care of the HCP. The HCP clicks on a patient to go to page 2.

Overview page with the patients general information.

From page 2, the HCP goes to the Analyse tab to select the patient data they want to view.

Image 88: Steps that the physiotherapist has to take on the Emma dashboard to get the information they want to see.

Pt1 and Pt2 had only monitored 1 patient with the Emma dashboard and Pt3 3, they therefore did not have the problem of Pt4 of losing time by navigating through different tabs of different patients.

More specific problems with the Emma dashboard were noted by Pt1 and Pt3 about not being able to fill in results of the 6 Minute Walk Test (6MWT) and connecting the patients Emma data to the patients medical file. These problems are about specific functionalities of the Emma dashboard which fall outside of the scope of this project.

Emma dashboard usage
It turned out that **3 out of 4** physiotherapists only watch(ed) the data of the patient on the Emma dashbord just before the patient would come in for a visit and during the patients visit in order to briefly discuss their progress. Pt2 notes: "*I watch the data of my patient before she visits. In case of particularities, we look at it together, and otherwise I just briefly discuss it.*" Pt1 to Pt3 noted that they did not have enough time to monitor the data of the patient on the Emma dashboard troughout the week.

The questionnaire results from Pt4 differ from the other interviewed physiotherapists in terms of how many times a week they watch the patients data and when, as can be seen in image 87. Pt4 is the earlier interviewed and discussed physiotherapist who runs a pilot with the Emma Activity Coach with 30 COPD patients. She monitors the patients multiple times througouth the week due to her pilot research with the Emma system. A footnote should therefore be made that she does not truly represent the average physiotherapist who uses the Emma system, just as the results from image 87 already show. Nevertheless, her intensive use of the Emma system is interesting to explore and will be discussed later on in this chapter.

Emma dashboard information interest
4 out of 4 physiotherapist noted that they are most interested in the activity and step count data of the patient. Additionally, two physiotherapists noted that they watch the answers that are given by the patients on the questionnaires and connect them with the activity data, Pt4: "*I connect the question lists to the activity week data of the patient. I am curious if in the case of a patient having less activity in a week I could see that back in the answers they gave on the questions.*"

Discussion
The physiotherapists were contacted via e-mail and asked to answer the above 5/6 questions. The decision was made to use this method since it turned out from earlier experience in the project that making an interview appointment with a HCP could take several weeks of planning before finding a free hour in their agenda to hold an interview in person or via telephone/skype. Therefore, the most efficient way to get the needed information was found to be sending the questions via e-mail. It is understood that sending out a questionnaire instead of an interview might give less thorough information, but this was tried to overcome by sending follow-up questions via e-mail if needed, at which the physiotherapist answered in return.

Conclusion
The decision is made to further explore the Emma dashboard usage with the physiotherapist of FysioHolland Zeeland (Pt4). This physiotherapist works with the Emma dashboard since September 2019 and has included and monitors 30 COPD patients during the pilot that she is running with the Emma platform. Therefore, she can offer more interesting and thorough user insights of the Emma HCP dashboard as an intensive and real time user with multiple patients connected to the system.

Emma HCP dashboard

The main frustration of the interviewed physiotherapist is the amount of clicks it takes before getting to the needed patient information on the Emma dashboard. An iteration is made and tested with the physiotherapist of FysioHolland Zeeland.

Goal

The goal was to test the made iteration of the Emma dashboard with the physiotherapist and explore if it would solve the discussed problems.

Method

An iteration is made based on the idea of a modular homepage in which the HCP can compose and arrange their Emma dashboard to their own needs and wishes. The iteration is shown and discussed in image 89.
The patient overview page is kept the same, but with the addition of showing behind each patient the last time the patient has synchronised their Fitbit data to the Fitbit Cloud. The HCP can now directly see which patients are synchronised or not in one clear overview.

Widget homepage

The patient information page on the Emma dashboard, screen 2 from image 89, has been altered compared to the original version which only stated the personal information of the patient. The Emma dashboard homepage from the patient was taken as a base of the HCP Emma dashboard iteration since it showed aspects that were in line with the wishes and needs of the HCP and the idea of a modular design. Each tab on the iterated HCP page will be a widget that can be added, replaced or moved by the HCP in order to create an Emma dashboard that is tailored to the needs and wishes of the HCP.

Each iterated page of image 89 was shown fullscreen to the physiotherapist via screen sharing on Skype. The physiotherapist was asked if the iteration was found an improvement compared to the original design.

Prototype

The iteration was made by making a screenshot of the current Emma dashboard and alter it with the help of Adobe Photoshop.

Results

The made iteration of image 89 showed to be an improvement of the original Emma dashboard of the HCP. The physiotherapist noted that she could imagine that the new design would save her time since she had al the information she needed in an overview on the first two pages.

In addition, she noted that she found the iteration fitting to Medicine Men since they offer different modules such as EmmaHBPM (blood pressure monitoring) and EmmaCOPD. This means that different HCPs from different background are using the Emma system with different health focusses. The modular Emma system iteration makes sure that each HCP can get the information they are interested in directly on their patient homepage with the use of the widgets.
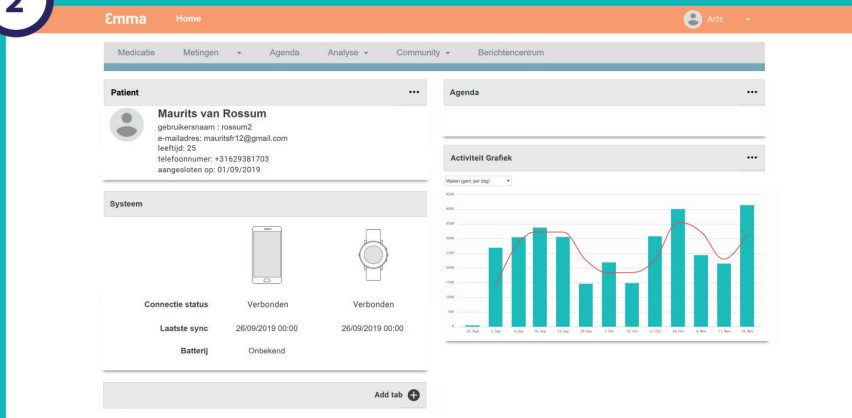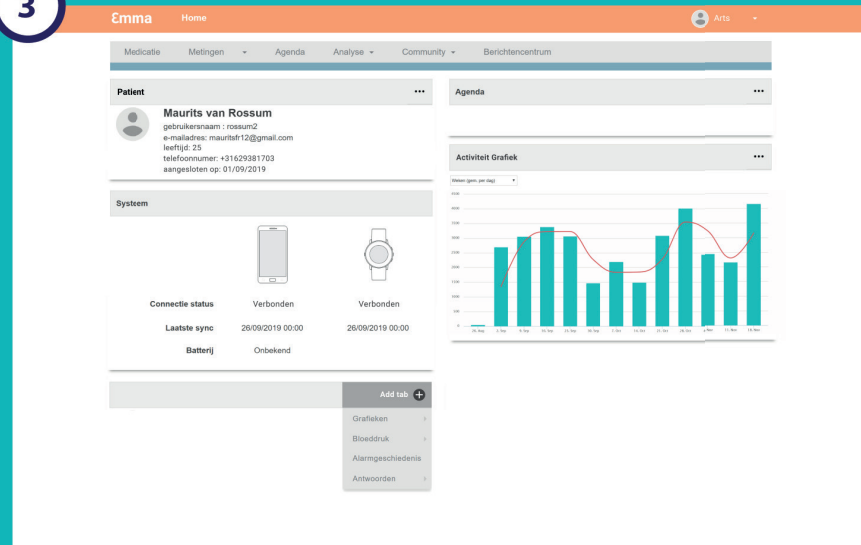
Emma HCP dashboard iteration

1
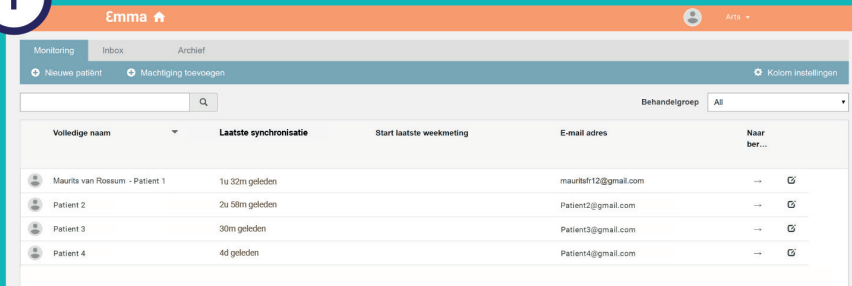
Homepage with an overview of the patients that are under the care of the HCP. The HCP can view the last synchronisation of the patients in one view. The HCP clicks on a patient to go to page 2.

2

3

4

New patient overview page with the patients general information and the selected, by the HCP, patient data. Image 3 and 4 show the homepage interaction. The homepage is made modular, with the use of widget tabs, this way the HCP can add, replace or move tabs to their liking and create an Emma dashboard that is tailored to their needs and wishes.
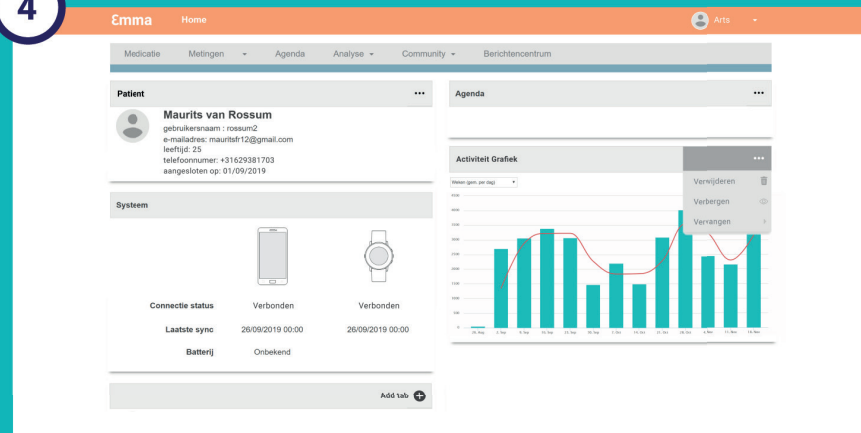
Image 89: Emma HCP dashboard iteration; a widget based dashboard that solves the problem of going through different tabs per patient to get to the needed information.

8. Final design

The results of the iteration tests from the previous chapter are concluded in a final design involving all aspects of the Emma product-service system. The final design is evaluated according the previous setup design vision and target group needs and wishes. A final test is done with the target group in order to validate the final design. The chapter finishes with a conclusion of the results of the final design target group test, together with further recommendations.

The final design of Emma Activity Coach, together with the Emma.6 application, are discussed in this chapter.

General Emma Activity Coach design

Image 90 shows the visual lay-out interaction of the Emma Activity Coach. The watchface is kept te same as the original design. The next screen is the redesigned activity progress visualization is. Below are the three different activity zone designs; red, orange and green shown. The third screen is the stepgoal overview screen which is also kept the same as the original design. The final screen is an addition to the original Emma Activity Coach design. This screen contains a week overview of the patients steps compared to their daily stepgoal. The days of the previous week are marked red, orange or green depending on how the patient preformed that day.

Emma Activity Coach visual lay-out of the interface

1 2 3 4

Watchface that shows the time, date, heartbeat of the patient and activity progress indicator.

Activity progress visualization of the patient.

Set stepgoal overview and the current steps of the patient.

A week overview shows the last 6 and current day results compared to the daily stepgoal.

The three activity progress visualization designs

Image 90: Final design of the Emma Activity Coach interaction lay-out interface and the activity progress vizualization

115

Bad day function

Image 91 shows the final design of the Bad day function on the Emma Activity Coach together with the use flowchart. The patient has two options in screen for canceling the bad day function activation. This design decision is made to prevend mistakes and great a clear design. Observations with the target group showed that patients are often on accident in the wrong screen and don't know how to get out of it. Additionally, if only the option *yes* would be given, the likelyhood is there that most of them would just press *yes* although they might not have a bad day but do it because it was the only option they are given.

Deactivation bad day function
After activation, the bad day function will be deactivated automatically at 00:00 when the next day begins. Another option to deactivate is to open the activation screen and select *no* and *confirm*. When a patient has activated the bad day function and deactivates later that day, because they might be feeling better, the HCP can still see the activation notification in the activity graph of the patient on the Emma dashboard and act upon it.
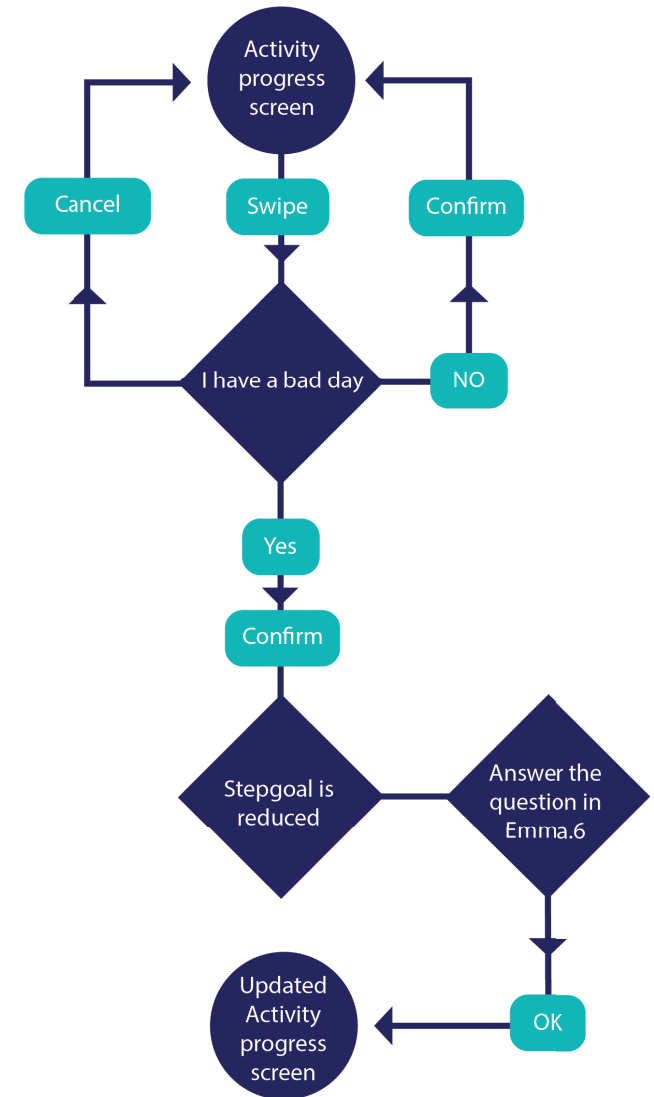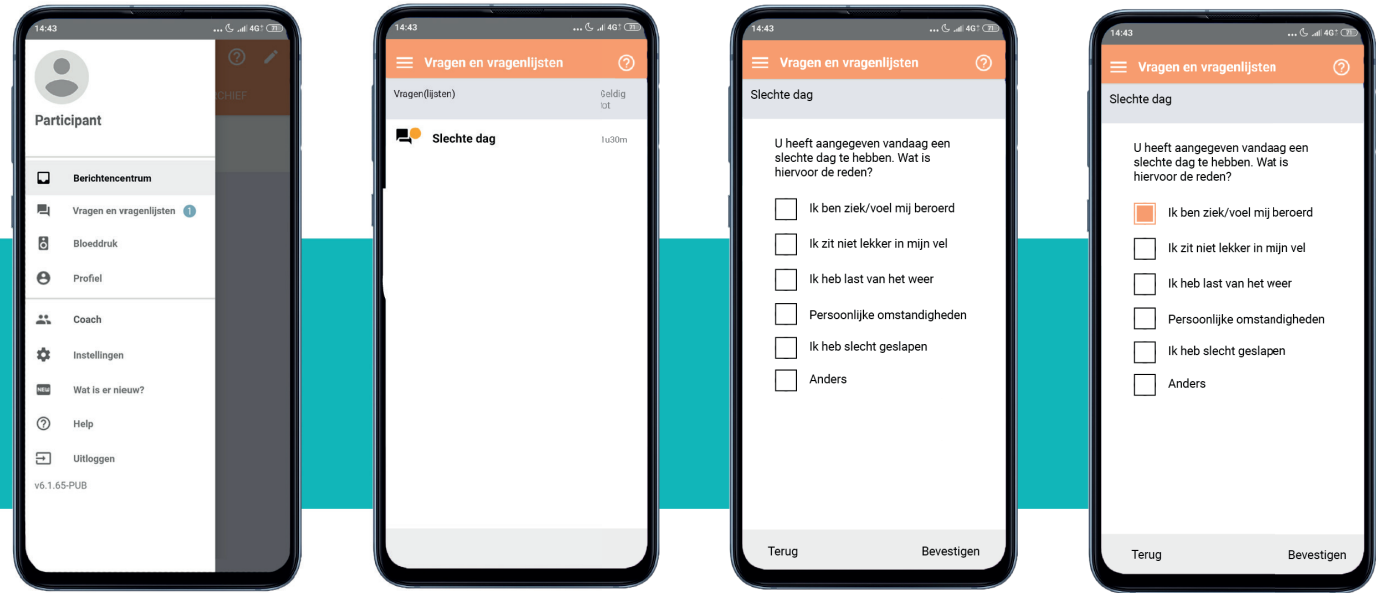
Bad day function final design

1

The patient has a bad day and swipes from left to right to bring up the bad day function menu.

Swipe

2

Ik heb vandaag een slechte dag
JA NEE
Annuleer

The sentence: 'I have a bad day" comes up and the patient can select yes, no or cancel.

3

Ik heb vandaag een slechte dag
JA NEE
Bevestigen

If the patient selects yes, it gets highlighted. The cancel button is transformed into a confirmation button in order to confirm the choice

4

Stappendoel is verlaagd

After activation, an notification is shown for 10 seconds that tells the patient what is happening.

5

Beantwoord de vraag in Emma.6
OK

A second notification is shown which tells the patient to answer a question in the Emma.6 application. The patient presses OK.

6

The activity progress screen is shown in which the step goals are reduced with a certain percentage. The activation notification icon from screen 4 is shown in the top right corner to indicatie activation of the function.

Use flowchart

Activity progress screen

Cancel   Swipe   Confirm

I have a bad day   NO

Yes

Confirm

Stepgoal is reduced   Answer the question in Emma.6

Updated Activity progress screen   OK

Image 91: Final design of the bad day function together with the use flowchart.
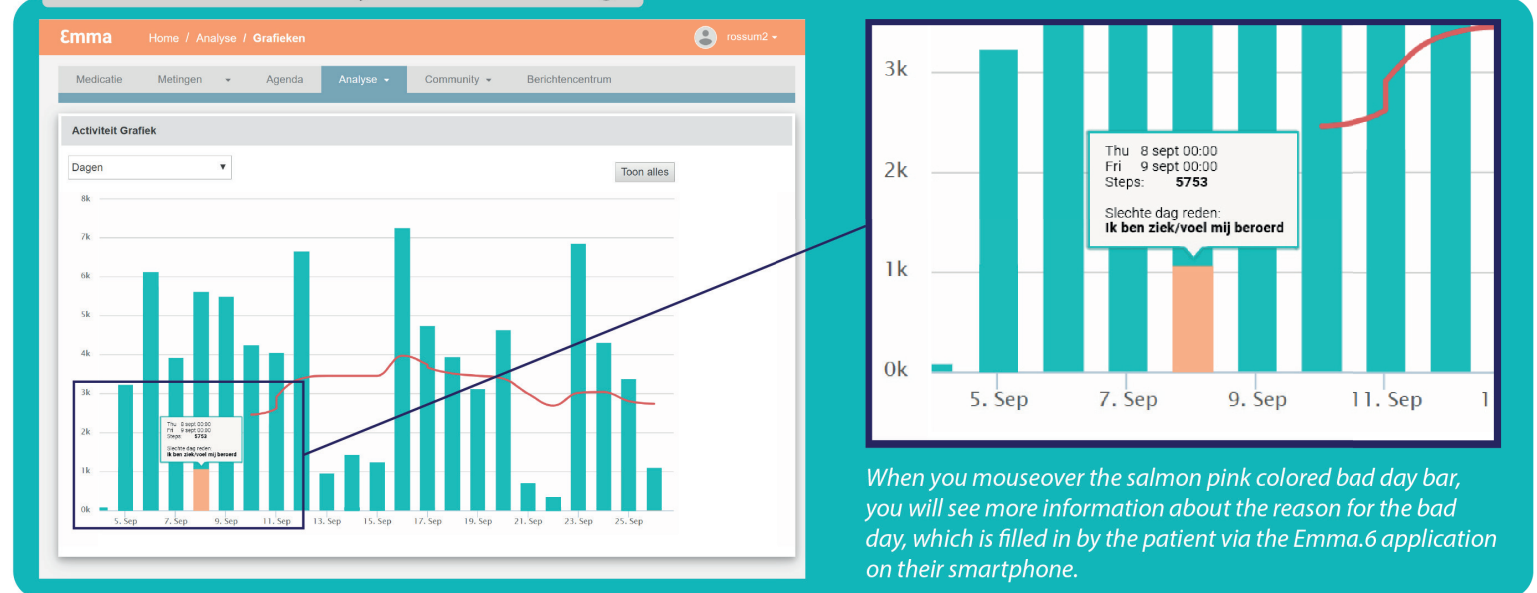
Emma.6 bad day function

Image 92 shows the final design of the bad day function aspect in the Emma.6 smartphone application. The patient will recieve a question on their Emma.6 app after they have selected the bad day function in the Emma Activity Coach application on their Fitbit smartwacht. The question is about the reason of activating the bad day function. The filled in answer is added to the bad day function activation indication on the Emma dashboard activity graph. The HCP and patient get extra information and insights about the connection between the physical and mental condition of the patient due to this design addition.

Checkboxes are used when answering the question in the Emma.6 app since the patient might experience multiple reasons for heaving a bad day.

When you mouseover the salmon pink colored bad day bar, you will see more information about the reason for the bad day, which is filled in by the patient via the Emma.6 application on their smartphone.

Image 92: Final design of the bad day function on the Emma.6 application and the Emma dashboard.

Stepcount notification

Image 93 shows the final design for the stepcount notification in the Emma Activity Coach. The stepcount notification message is shown according to the flowchart of image 93.

Emma Activity Coach stepcount notification

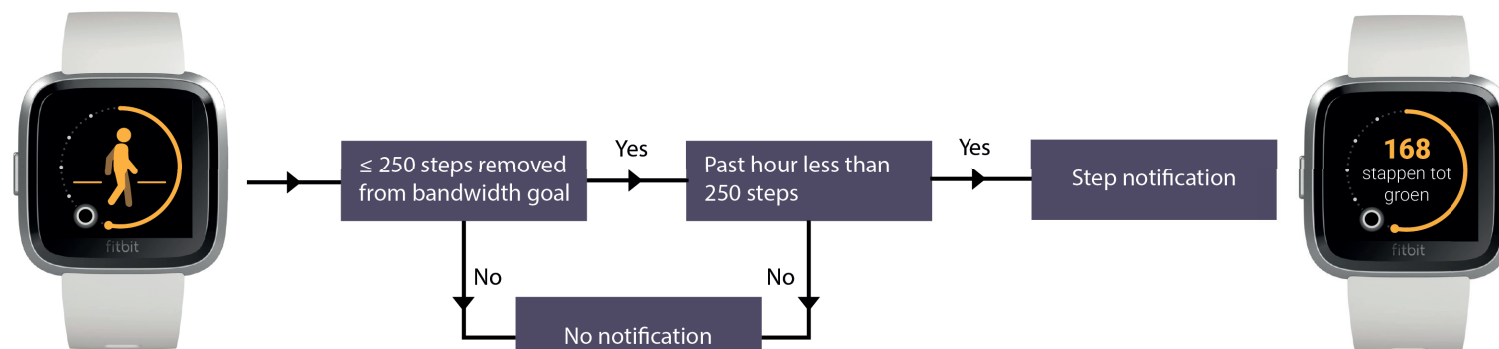The patient is in the orange zone and close to getting to the green activity zone.

The patient will get a notification message and a short vibration of the Fitbit if they are 250 steps removed from the green activity zone (according to the flowchart below). The notification will be shown for 10 seconds.

The patient will see the steps going down, if they are active, the next time they check their activity progress.

A green thumbs up icon is shown for 10 seconds when the patient reaches the green activity zone. A short vibration will notify the user.

The same situation goes from getting to the red zone into the orange zone. The only exception is that the patient won't recieve a thumbs up when reaching the orange zone.

Step notification flowchart

Image 93: Final design of the stepcount notification with the activiation flowchart.

Each aspect of the Emma Activity Coach is designed, iterated and tested with the target group. This chapter discusses the evaluation of the proposed final design. The evaluation of the proposed final design is done according to each aspect of the final design.

Goal

The goal was to evaluate the proposed final design of the Emma Activity Coach compared to the design vision of this project and the original design of the Emma Activity Coach.

Participants and location

The same particpants as the iteration session from 6.3.1 were used to evaluate the proposed final design with at FysioHolland Zeeland. An overview of the information of these 7 participants is given in image 94. The session was held in one of the physiotherapy practice rooms of FysioHolland Zeeland. The setup can be seen in image 95.

Method

The iteration test session of chapter 6.3.1 was concluded with the evaluation of the final design. The design outcome of the iteration session was evaluated by comparing it to the design vision of this project, which is *to make the patient feel in control of their physical and mental health condition, by providing clear feedback on their activity.*

The 7 participants were asked to compare each iterated final design aspect of the Emma Activity coach to the original design of the Emma Activity Coach. These design aspects are: the activity progress visualization, the bad day function, the stepcount notifications and the weekly activity overview.

Two evaluation questions were formulated to be answered per design aspect:

- *Compared to the original Emma Activity Coach, which design will make you feel more in control of your health management?*

- *Compared to the original Emma Activity Coach, which design will give you clearer feedback on your activity?*

Patient interview participants

	Age	Gender	Fitbit version	Disease	Use period
P1	76	Female	Versa	COPD	5 months
P2	73	Female	Versa	COPD	5 months
P3	66	Male	Versa 2	COPD	4 months
P4	62	Female	Versa 2	COPD	1 month
P5	76	Male	Versa	COPD	5 months
P6	75	Male	Versa 2	COPD	3 months
P7	73	Female	Versa 2	COPD	3 months

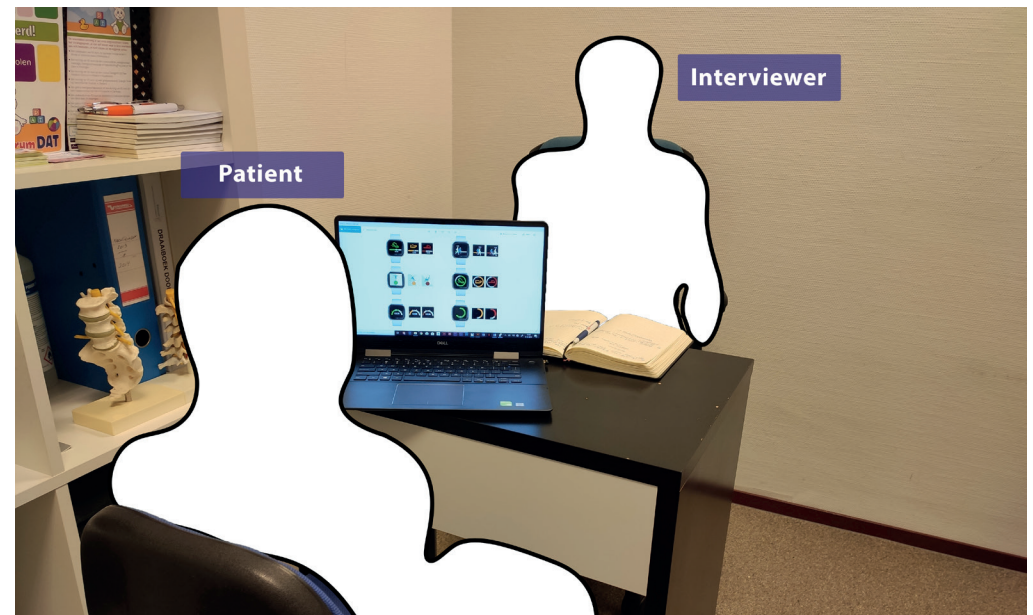*Image 94: Overview of the evaluation nterview participants.*

Image 95: Interview setup; a physiotherapist practice room at FysioHolland Zeeland.

Prototype

The final designs of the activity progress visualization, the bad day function with the addition of the Emma.6 questionnaire, the stepcount notifications and the weekly activity overview are prototype using Axure RP 9 and shown to the participants on a smartphone during the evaluation session. Image 96 shows the made prototypes for each mentioned design aspect of the Emma Activity Coach.
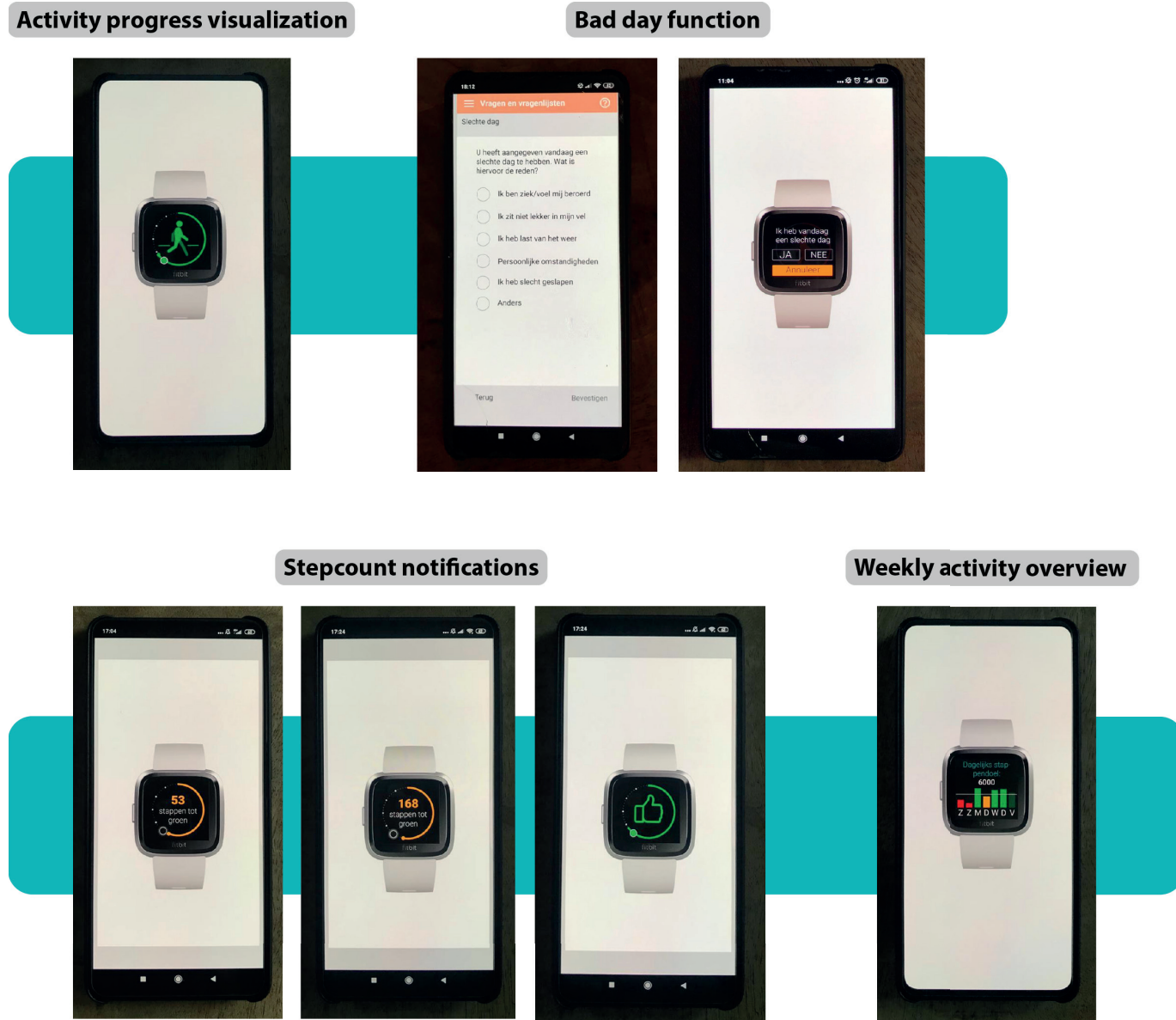

Image 96: Prototypes made per Emma Activity Coach aspect with Axure RP 9 and shown on a mobilephone to the evaluation participants.

Results

The results of the evaluation will be discussed per design aspect of the Emma Activity Coach. An overview is shown in the end of the chapter in image 97.

Activity progress visualization

5 out of 7 participants felt that they would be more in control with the proposed final design of the activity progression visualization, than with the original design. Previous user tests showed that the original activity progress visualization of a battery was troublesome for some patients since it made them confused with the actual battery status of the Fitbit smartwatch. In addition, the participants found the battery visualization astatically unattractive and unfitting to the context of activity.

2 out of 7 participants, P1 and P4, had a neutral opinion on the question which design would make her feel more in control of their health management. P1 was an elderly lady who is new and uncertain with technology. She noted that she only watches the colors in activity progress visualization. She found that both designs showed the colors good and

therefore no preference was given. P4 had just started using the Emma Activity coach and noted that she could not give an opinion yet in terms of being in contral since she had not experienced any impact of the use of the original Emma Activity Coach yet.

6 out of 7 partipants believed to receive clearer feedback with the proposed final design. Participants noted that the proposed final design gives them a clear and direct overview of their activity progress, which in return contributes to the design criteria of empowerment and being in control of their health management. The addition of the visualization of a walking person added to the design criteria of letting the user feel stimulated. They noted that they were motivated to get it 'in movement' and turn it green when seeing the visualization of a red person standing still.

1 out of 7, P1, prefered the original design since she had trouble with understanding when she reached her goal or had filled the visualization in the proposed final design.

The bad day function

7 out of 7 participants felt that they would be more in control with the proposed final design of the bad day function, than with the original design. The redesign of the bad day function took away the comprehensibility problem that were present before. All participants understood the bad day function final design of the Emma Activity Coach and that they were able to use the function with confidence and knowledge of what they were doing.

7 out of 7 partipants expect to get clearer feedback with the proposed final design of the bad day function. The previous unclarity in the bad day function left patients puzzled what happend after activation of the function, as well as many patients accidentally activating the function. The new design communicated clearly to them what actions they needed to take and what the consequences are for these actions. The addition of the Emma.6 questionnaire design

5 out of 7 participants added that they found it a comforting thought that the reason why they had activated the bad day function

is directly communicated to their physiotherapist and visible in the Emma dashboard activity graphs. This shows that the Emma.6 design with the questionaire about the reason of the bad day function activation made the patient feel supported as well as secured.

Stepcount notifications

The original Emma Activity Coach does not have a stepcount notification system, but the participants thought that the *250 steps per hour* notification by Fitbit was part of the Emma Activity Coach design. The proposed final design is therefore evaluated by comparing it to the Fitbit notifications that the participant gets.

7 out of 7 participants felt that they would be more in control with the proposed final design of the stepcount notifications, than with the Fitbit design. The final design activates the notifications according to the flowchart explained in chapter 6. This was found an improvement by the participants since it only gave them notifications when it mattered and prevents constant notifications that would disturb their daily life, compared to receiving them every

hour as in the Fitbit design.

7 out of 7 partipants expect to get clearer feedback with the proposed final design of the stepcount notifications compared to the Fitbit design since the amount of steps that need to be taken to reach the next activity zone stay present in screen until the next zone is reached. The participants noted that this will stimulated them to get active and reach their activity goals.

Weekly activity overview
5 out of 7 partipants found that the addition of a weekly activity overview in the Emma Activity Coach would make them feel more in control of their health management. They noted that the additional screen would give them insight on how their activity devision and their goal achievement of the past week has been. They could act upon this insight to make changes in their activity management if needed.

2 out of 7 participants responded neutral to the question of feeling more in control of their health management via the weekly activity overview design. They noted that they are not

that interested in looking back at the activity of other days and comparing them. They tried to do their best and reach their goals on the given day and that was enough for them to focus on.

7 out of 7 participants noted that the design of the weekly activity overview provided clear feedback on their activity. The colored bars were direct and easily interpret by the participants. No comprehensibility problems of reading the graph were found.

These comments showed that the bad day function design fulfilled on the design criteria of letting the user feel empowered and secured.

Discussion
A weekly activity overview is not present in the original design of the Emma Activity Coach. The made weekly activity overview of the proposed final design could therefore not be compared with the original design of the Emma Activity Coach. Fitbit does have its own weekly activity overview build in the Fitbit Versa 2 software, but all participants did not know this and had therefore never seen or used it.

The two evaluation questions were rephrased for the weekly activity overview as:
- *Does the addition of the design make you feel more in control of your health management?*

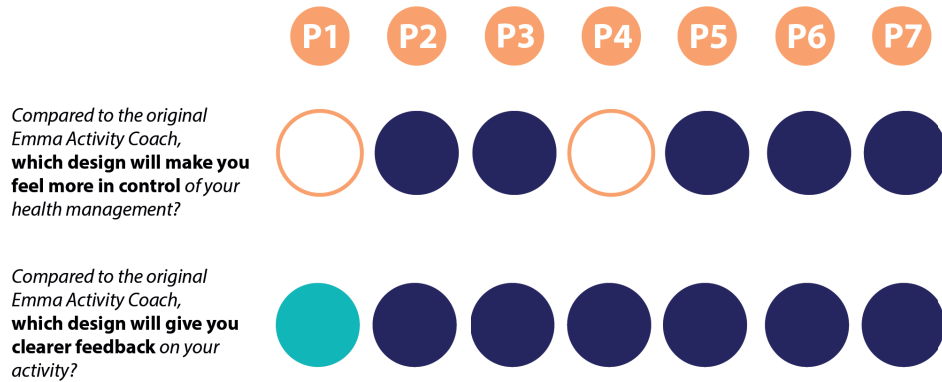- *Does the design provide clear feedback on your activity?*

Conclusion
The evaluation results show that the proposed final design for the majority meets the design vision of the project, which is formulated as *to make the patient feel in control of their physical and mental health condition, by providing clear feedback on their activity.*
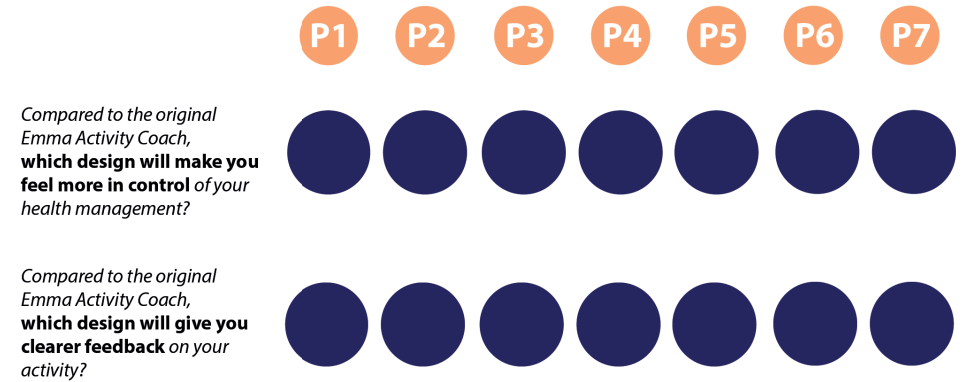
The final design of the Emma Activity Coach, with the addition of the Emma.6 bad day function questionnaire is presented to Medicine Men as a proposed redesign of their product.
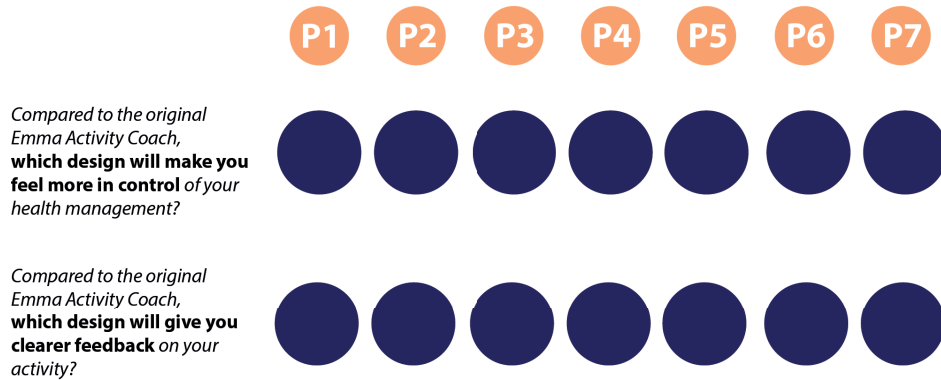
Activity progress visualization

P1 P2 P3 P4 P5 P6 P7

Compared to the original Emma Activity Coach, **which design will make you feel more in control** *of your health management?*

Compared to the original Emma Activity Coach, **which design will give you clearer feedback** *on your activity?*

Bad day function

P1 P2 P3 P4 P5 P6 P7

Compared to the original Emma Activity Coach, **which design will make you feel more in control** *of your health management?*

Compared to the original Emma Activity Coach, **which design will give you clearer feedback** *on your activity?*

Stepcount notifications

P1 P2 P3 P4 P5 P6 P7

Compared to the original Emma Activity Coach, **which design will make you feel more in control** *of your health management?*

Compared to the original Emma Activity Coach, **which design will give you clearer feedback** *on your activity?*

Weekly activity overview

P1 P2 P3 P4 P5 P6 P7

Does the addition of the design **make you feel more in control** *of your health management?*

Yes Yes Yes Yes Yes

Does the design provide **clear feedback** *on your activity?*

Yes Yes Yes Yes Yes Yes Yes

Proposed final design   Original design   Neutral

Image 97: Results of the evaluation research questions per aspect of the Emma Activity Coach.

9. Conclusion & recommendations

The thesis concludes by discussing the main insight that are gathered during the project.

In the end, several recommendations are given for further research and exploration regarding the topic of this thesis.

9.1 Conclusion

The main research question of this thesis was defined in the assignment chapter as; *how can the Emma Activity Coach and the Emma system around it be improved in order to create a better user experience for the patient in which they feel in control of their chronic condition management?*

The target group of the Emma Activity Coach was explored via interviews and observations. The healthcare professional was also involved in the design process to get feedback from both ends of the table. Several iteration rounds with participants who are using the original version of the Emma Activity Coach were held to develop a final proposed improved design of the Emma Activity Coach and the Emma system around it. The final design was evaluated in the end by real usage participants to give answer on the research question.

The qualitative interview and observation approach that was used throughout the project to explore the target group contributed to the development of the final design. The interviews with multiple patients who use an older version or the current version of the Emma Activity Coach,

in combination with the insights given by interviews with healthcare professionals that are active in the projects domain, resulted into a clear overview of the problems and needs of the target group. The target turned out to be defined by three needs; autonomy, security and stimulation, and having trouble with maintaining a healthy balance in activity that fits their condition. These findings were taken as a starting point for the iteration design development to improve the user experience of the Emma Activity Coach.

Each iterated design aspect of the proposed final design showed to be an improvement in the user experience of the product. The participants noted that they would feel more in control of their health management and receive clearer feedback on their activity compared to the original design. This shows that the needs for autonomy and security are fulfilled with the new design. In addition, it was found that the implementation of the motivational stepcount notifications design contributed to the need of stimulation, whereas the addition of the Emma.6 questionnaire for the bad day function made the target group

feel supported by their surrounding and healthcare professional.

This thesis serves as an example of how involving the target group and stakeholders throughout the design process is a valuable aspect in creating meaningful user experience design. Many iterations were developed with and tested by actual patients whose conditions would benefit from a tool such as the Emma Activity Coach. Involving them throughout the entire process showed to be very valuable and made sure iterations could be made and tested fast if needed. The involvement of other stakeholders of the project such as the healthcare professionals resulted in feedback from the other end of the table which could be compared and evaluated which each other to come up with the best fitting results for everyone involved.

9.2 Recommendations

Long-term validation and evaluation

The made iterations and designs were tested via prototypes or images being shown during user tests and evaluation. It is recommended to test and evaluate the proposed final design of the Emma Activity Coach and the Emma system further with patients for a longer period of time of minimal 1 year with real time usage of the final design in order to fully evaluate and validate the design and the intended design effects. This was unfortunately not reachable in the time window of this project.

For now, this report with its research and iterations serves as a base for Medicine Men to implement the proposed final design in practice and conduct further exploration.

Target group usage period

The interviewed COPD patients user test participants had on average used the Emma Activity Coach on a Fitbit for 2,6 months. Although they gave interesting insights and user experiences, it is recommended to look again at this patient group after a minimum of 1 year use in order to explore the user experience over a longer period of usage. It will be interesting to see if the patients still use the Emma Activity Coach. Interesting research topics after a longer period of use are:

- The behaviour change of the patient
- The impact of use on their quality of life of the patient.
- The commitment of the physiotherapist to monitoring their patient with the Emma system who use the Emma Activity Coach.

Exploring these questions with patients who have used the Emma Activity Coach over a longer period of time on the Fitbit would be benefitial for improving the user experience of the Emma system.

Emma.6 smartphone application

A recommandation is made to look further into the possibilities of the Emma.6 smartphone application to incorporate the activity data of the Emma Activity Coach in it without creating confusion and interference with the Fitbit application for the user.

Interview results with users of the Emma system showed that the patients used the Fitbit smartphone application to view their activity data. The question rose if such activity data overview and information should also be implemented, and designed in this project, in the Emma.6 smartphone application in order to let the patients use the Emma.6 application instead of the Fitbit application.

The patients participants in this project found it difficult to distinguish and understand the difference between the Emma software and Fitbits own activity software. The patients thought that everything on the Fitbit smartwatch was part of the Fitbit application, and thus the Emma Activity Coach part of Fitbits activity software. This confusion is suggested to be due to the patient test group being new to the technology and use of a smartwatch and its possibilities and usability in general.

The decision was made during the project to place the focus on the Emma Activity Coach and the Emma dashboard of the HCP since those were found to be the core elements of the Emma system. Improving the core elements of the Emma system was given priority within the timespan of the project in order to make sure that the patient as well as the HCP could use the system in a clear and comprehensible way.

Stepcount notifications

The stepcount notifications in the Emma Activity Coach on the Fitbit is recommended as to be an option that can be selected by the physiotherapist in their Emma dashboard goal setting page of the patient. The interviews that are held with the physiotherapist showed some patients need such extra notification to reach their goals, while others have no trouble reaching their goals without getting extra motivational notifications. The physiotherapist discusses the patients activity problems and goals during the inclusion. As the interviewed rehabilitation physiotherapist noted; *"I know within 5 minutes during a conversation with a patient if they need extra motivation or coaching"*. The physiotherapist assesses the situation and preference of the patient and could select in the goal setting page of their Emma dashboard if the patient would receive the step reminder motivation notification as shown in image 93. A design of how this would look in the Emma dashboard of the physiotherapist is made and can be seen in image 98. In addition to making the decision if a patient needs such extra notifications, the physiotherapist can select at

which amount of steps removed from the patients bandwidth goal the notifications are shown. This design decision is made since as discussed earlier, the amount of steps that are shown in the notification should be reachable for the patient in order to increase the change of the patient actually change their behaviour and take the needed steps. This reachable step amount is different for each person. The physiotherapist determines which amount fits the patient. Each patient also has an

different activity pattern and different segment of the day in which they are active, therefore, the physiotherapist can also fill in a time slot in which the patient receives the notifications. This way, the physiotherapist can tailor the activity experience of the patient and tackle certain moments in the day by sending out extra motivational notifications.

Image 98: Stepcount motivation notification Emma dashboard iteration is which the notifications are tailored to the condition of the patient.

Rehabilitation Emma module

Chapter 5.1.1 shows that a difference in treatment and therefore design direction was found between rehabilitation patients in the third-line care and chronic condition management in the primary care.

A solution to tackle both discussed design directions could be done by making a rehabilitation mode in the Emma system. That way, an Emma Activity Coach rehabilitation application could be selected in the Emma dashboard of the HCP whereby the patient would get an Emma Activity Coach design in the direction of image 99 including the needed coaching throughout the day. If the patient is happy with the results and use of the Emma Activity Coach after their rehabilitation treatment, they could continue using the application and its system. The rehabilitation mode can then be switched off in order to change the Emma Activity Coach design into monitoring instead of intensive learning, which is the goal of the rehabilitation mode.

Image 99 shows an design idea of such a mode in the Emma dashboard of the HCP. As discussed in the conclusion, the focus of the project will be on the management of chronic conditions with the Emma Activity Coach without the use of rehabilitation. Further exploration is therefore recommended in order to explore the possibilities and needs for the proposed design idea of a rehabilitation mode.

Image 99: Emma dashboard rehabilitation module iteration design.

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