SMART ENVIRONMENT FOR WELLBEING
WITH DoCHANGE PROJECT

September 2015 - January 2016

PATIENT TO PATIENT SERVICE

COACH
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LIST OF ABBREVIATIONS

CAD	Coronary Artery Diseases
CRN	Cardiac Rehabilitation Nurse
CRP	Cardiac Rehabilitation Program
QA	Question and Answer
TSZ	TweeSteden Ziekenhuis
TUE	Eindhoven University of Technology
UCD	User-Centered Design

01 INTRODUCTION

1.1 PROJECT DESCRIPTION

We are students from the TUE. The TUE provides projects with a duration of one semester, half of a year. We are in the project ‘Do Change’ within the ‘Smart Environment for Wellbeing’ theme.

The core of this project is about creating a smart environment, which is mainly a creation of an interactive and responsive system for people who would like to change their behaviour to live a healthier lifestyle related to their rehabilitation process. In the project Do Change we focus on cardiac patients. Via user research, data analysis and technology people are able to contribute to this big challenge. Aspects like motivational technologies and UCD will help to create valuable solutions via giving freedom, a solid interaction, good communication and last but not least a comfortable experience. The impact this project will have is that patients can get more motivated to act, to live a healthier lifestyle through a smart environment.

1.2 DO CHANGE

Do Change is a 3-year project that focuses on improving the health of cardiac patients by developing a health ecosystem life. Approximately 90% of cardiac rehabilitation patients who need to improve their lifestyle, are unsuccessful. Within the project, experts from over the world (United Kingdom, Belgium, The Netherlands, Spain and Taiwan) come together to create an ecosystem to change patients their behaviour to live healthier (European Commission, 2015).

Do Change is developing personalised health services for cardiac patients. These services are tools that provide data and monitor behaviour. This allows cardiac patients to manage their own disease and health. Currently there are three innovative tools; Krystal that can measure liquid volume, Sal that measure salinity and Horus that can inform users about nutrition (Do Change, About Do Change, 2015).

Do Change is a project that is part of Smart Environment for Welbeing of the TUE. Do Change was within our project our main guideline.

The problem statement is that cardiac patients mostly do not follow the general instructions of their rehabilitation process. Cardiac patients receive a lot of information about their CAD, how to improve their health issues and the procedure of their CAD. They often get so much information that they forget parts of the rules, whereby they can end up in dangerous situations. Another phenomenon is that cardiac patients are not motivated enough to continue to live according to the precepts, causing deterioration of their health.

1.3 TWEESTEDEN ZIEKENHUIS

Do Change is in cooperation with TSZ, TSZ is a hospital for the area Tilburg and Waalwijk. They exchange knowledge and realises certain projects, like ours. TSZ has streamlined care pathways to make a visit to the hospital efficient as possible (Do Change, Tweesteden Ziekenhuis, 2015). Further TSZ has certain priorities, including 'care for patients with cardiovascular and heart diseases. Every year 600-700 patients participate in the CRP (Wetzels, M. H. & Peters P., 2015).
Due to the fact that we were in a project with Do Change, we could get in contact with TSZ. Since we found it very interesting to start a cooperation with one of the stakeholders of our users, we decided to cooperate with TSZ and subsequently received useful information. We obtained knowledge and insight on the hospital, patients their behaviour and the current CRP.

02 VISION

Our vision is to accomplish a behavioral change with cardiac patients. We want to achieve this by improving the CRP and increase the motivation of patients. We want to improve the way patients rehabilitate and therefore build an ecosystem for integrated disease management. This will make it easier for the patients to follow their rehabilitation properly with access to the right information.

Every patient is different and has a specific aspect to improve. Due to this, we want to personalize the rehabilitation program. We think that the rehabilitation is too general for the patients, we want to personalise the rehabilitation experience so cardiac patient can improve what is important for them. Creating more focus on the aspect where they need help the most, will guide them faster through the CRP. Within these specific aspects the patients should follow their rehabilitation properly with access to the right information. A strong point in our vision is that it is your own rehabilitation, but you can go through it together. Because you have a personal CRN that does not mean that you are on your own. We want to connect patients so they can share valuable information and experience to each other. Bringing people together can motivate people more and give them a feeling that there are people with similar problems. We believe this is a very important aspect of creating a system directed to the change of behaviour of cardiac patients.

03 LITERATURE REVIEW AND RESEARCH

3.1 INTRODUCTION

For this project a UCD-approach became very important. To strengthen our findings we use the three books “User-Centered Design” by Travis Lowdermilk (Lowdermilk, T., 2013), the book “Living With complexity” by Don Norman (Norman, D., 2011) and the book “The design of everyday things” by Don Norman (Norman, D., 2013). This was useful as guidelines for our project progression. We did research about the field we were operating in so what CAD are there? What are the risk factors? What is the best lifestyle and what the most important factors are which contribute to change people’s behaviour. From this literature review and research a better view of the user developed, with what they have to deal with all day.
The goal of UCD is that the user is placed in the center of the design process. By using this approach, we can discover what the users really need. These became more understandable and created new ways to operate with a product or system and to eventually improve our product value. UCD is not subjective, it is based on observation and getting informed via related people with the right questions.

Although as a designer you should not blindly follow your customer/user. From the book “Living With complexity” by Don Norman we got that:

“Design thinking, which means, among other things, to start by first determining what the real problem is. I often explain it this way: Never solve a problem the client has ask you to solve. Why? Because the client is usually responding to the symptoms. The first job of the designer, sometimes the hardest part of the entire task is to discover what the underlying problem is, what problem really needs to be solved.” (Norman, D., 2011, p. 148)

So as a designer you should always check if the provided problem is the real problem or if the given problem is a consequence of another problem. We wanted to discover if the given problem is the equal problem through our research and interview, because if the problem definition is not correct we can never solve the real problem.

Picture 3.1. Doing research related to cardiac diseases .

3.2 CORONARY ARTERY DISEASES

When the project description was clear, we figured out the main goal of Do Change. We commenced the project with understanding the diseases of the cardiac patients. Do change focuses on coronary artery diseases and heart failures. We did research about three consequences; Arrhythmia, Atherosclerosis and Myocardial Infarction. In order to talk to experts, nurses and patients for the project we had to obtain the basic of knowledge of the diseases and the procedures for them (For the complete research see Appendix A).

The heart has an important function for the body. First the heart gets deoxygenated blood, this is pumped through the lungs, as a result the blood gets oxygenated. The heart pumps the oxygenated blood and nutrients to the organs. In order to make the organs work, they use the oxygen and nutrition. Due to this fact the organs deliver deoxygenated blood back to the heart, where the cycle starts again (National Institute of Health, How the heart works, 2011) There is a possibility that the heart has a failure and a CAD arises. CAD could be genetic transferred, however smoking, bad diet, stress and not exercising increase the risk of CAD (National Institute of Health, To Prevent and Control Coronary Heart Disease Risk Factors, 2011).

ARRHYTHMIA

Arrhythmia means that the heart beats irregularly. A good working heart beats 60 till 70 times a minute, but with arrhythmia the heart can beat too slow, too fast or have an abnormal rhythm. For the organs this could be a problem because the heart could not pump enough blood to the rest of the body. Often this causes dizziness, tired and lightheaded. In the worst case organs could be damaged or stop working (American Heart Association, 2014).

If arrhythmia causes the patients too much trouble they could get a pacemaker, which takes over the rhythm if the heart fails (Chen, M.A., 2014).

ATHEROSCLEROSIS

The procedure of a plaque (cholesterol in the vein) becoming bigger, and the vessel wall becoming smaller, is called atherosclerosis. If the artery wall narrows or is been blocked, the blood pressure decreases and makes it hard for blood to flow. As a result an organ could not get oxygenated blood, first this causes pain eventually the organ could stop working.

This is a big risk for your heart; you could get a stroke or other health problems (University Surgical Vascular, 2016) To help this problem you can get the Balloon Angioplasty
treatment. With this treatment they use catheter, which has a little balloon at the end. The balloon is pumped up for a short time, due to this the vein widens and the blood can flood again (University Surgical Vascular, 2016)(Texas Heart Institute, 2015).

MYOCARDIAL INFARCTION

Myocardial infarction is another name for heart attack. One of the heart arteries becomes blocked. Like atherosclerosis the artery has a plaque. A heart attack often occurs when a blood clot cannot flow further and it blocks the transport of the blood (Beckerman, J., 2014). After a couple of minutes the part of the heart, which these arteries lead to, are starved, they cannot get any oxygenated blood. If the certain heart tissue is too long without oxygenated blood this part could die (Beckerman, J., 2015) When the diagnosis of myocardial infarction is confirmed, there will be a procedure of trying to get the blood flow smoothly again. This could happen through angioplasty or clot-busting medicine. These medicines can dissolve blood clots (National Heart, Lung and Blood institute, 2015).

3.3 PATIENT PRECEPTS

To get more insight of rehabilitation period of the patients we got eight small booklets (Elisabeth-Tweesteden Ziekenhuis, 2015) from TweeSteden Ziekenhuis(see Chapter Tweesteden Ziekenhuis). The patients receive these books after their operation and start their rehabilitation. These booklets contain precepts and advice for a healthier lifestyle. For every disease there were different booklets, however the content was mainly the same.

This information about the rehabilitation was handy, because we knew what rules the patient must follow and we could imagine how a patient must feel in that kind position a lot better. Patients often lose their trust in their bodies and find it hard to exercise. They think exercising would be too much for the heart to handle, while it would be for the best if the heart gets used to work harder.

3.4 COMMUNICATION TO PATIENTS

DOCTOR-PATIENT COMMUNICATION

Communication between a doctor and a patient is an important aspect of the process in health care. The unique powerful position of the doctor has to be very respectful, because it may influence the health of the patients. A good relationship can increase job satisfaction of the doctor and improve communication with patients via motivation, empathy and support.Doctors, who are better skilled in communication will face problems of patients earlier, cause lower costs of care and create greater patient understanding of health issues (Ochsner, J., 2010).
Mainly most of the patients do not want to be labeled as a sick person. Someone who loses the ability to live by himself/herself. So with communication to patients, the emotions of patients need to be taken into account, because it is almost the most important thing.

UNDERSTANDING AND HONESTY

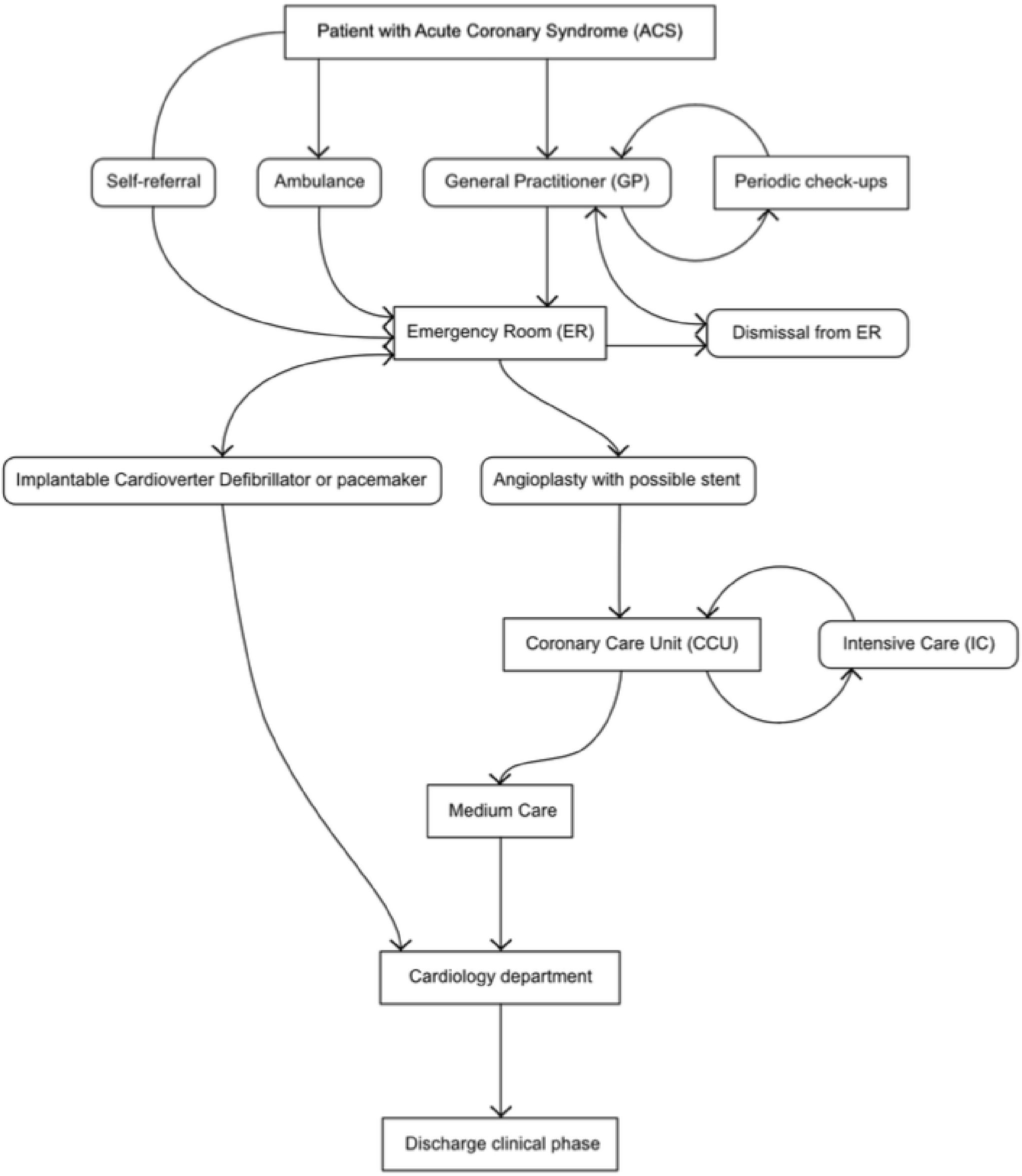
Patients and their relatives are all suffering which can make them vulnerable and lose motivation to positively change their behaviour. By showing empathy to patients and be honest all the time, the connection with the patients will increase a lot. So, patients have to be encouraged and helped to take care of themselves. Since they must change their behaviour in the way experts told them to do, in order to live healthier and prevent more heart failure. Important not to forget is nonverbal communication, since this is a continuous process. Eye contact, facial expression, movement, actually your whole presentation contributes to the perception of the message from the doctor.

Furthermore the doctor have to show understanding of the concerns of the patients. With a small recap or summary a doctor can show that he or she heard what the patient has to say. By using open-end questions you give the patient the chance to add something or confirm that you have heard it correctly. Next to this, it will also help to prevent creating a defense reaction of the patient. Due to giving delicate feedback or by just using feedback strategies more results will follow. This will all help the patients to feel more comfort (Fam Pract Manag., 2011).

3.5 CLINICAL PATHWAY

Analyzing the clinical pathway the patients of TSZ go through, seemed a logical step to be able to understand our users better. We tried to evaluate the clinical path in order to determine relevant stakeholders. It also gave us more insight in the hospital system. This was useful for the interview with TSZ, because we could ask more relevant questions and got more into depth. This pathway became visible through a documentation of our project coach M.H. Wetzels (Wetzels, M. H. & Peters P. , 2015).

There are three ways for a patient with an acute coronary syndrome to enter the hospital system. The patient first goes to the emergency room and this can happen in three ways namely with the ambulance, self-referral or via a general practitioner.
When patients are in the emergency room they can get dismissal from the emergency room and when that happens the patient goes to the general practitioner and gets periodic check-ups.
Next to that are two other paths that the patient can take. They can go the coronary care unit after they get an angioplasty with possible stent. From the coronary care unit they go to the intensive care. If the patient is doing better he or she goes to the medium care. After the medium care the patient goes to the cardiology department where the patient is fully controlled by the cardiologist. If there is no need to hold the patient in the hospital any longer, the patient can be discharged from the clinical phase by the cardiologist.
The third path the patient could have gone through was that the patient went from the emergency room directly to the cardiology department, after the patient got an implantable cardioverter or pacemaker. From there the patient can be discharged from the clinical phase if the patient gets the green light from the cardiologist.

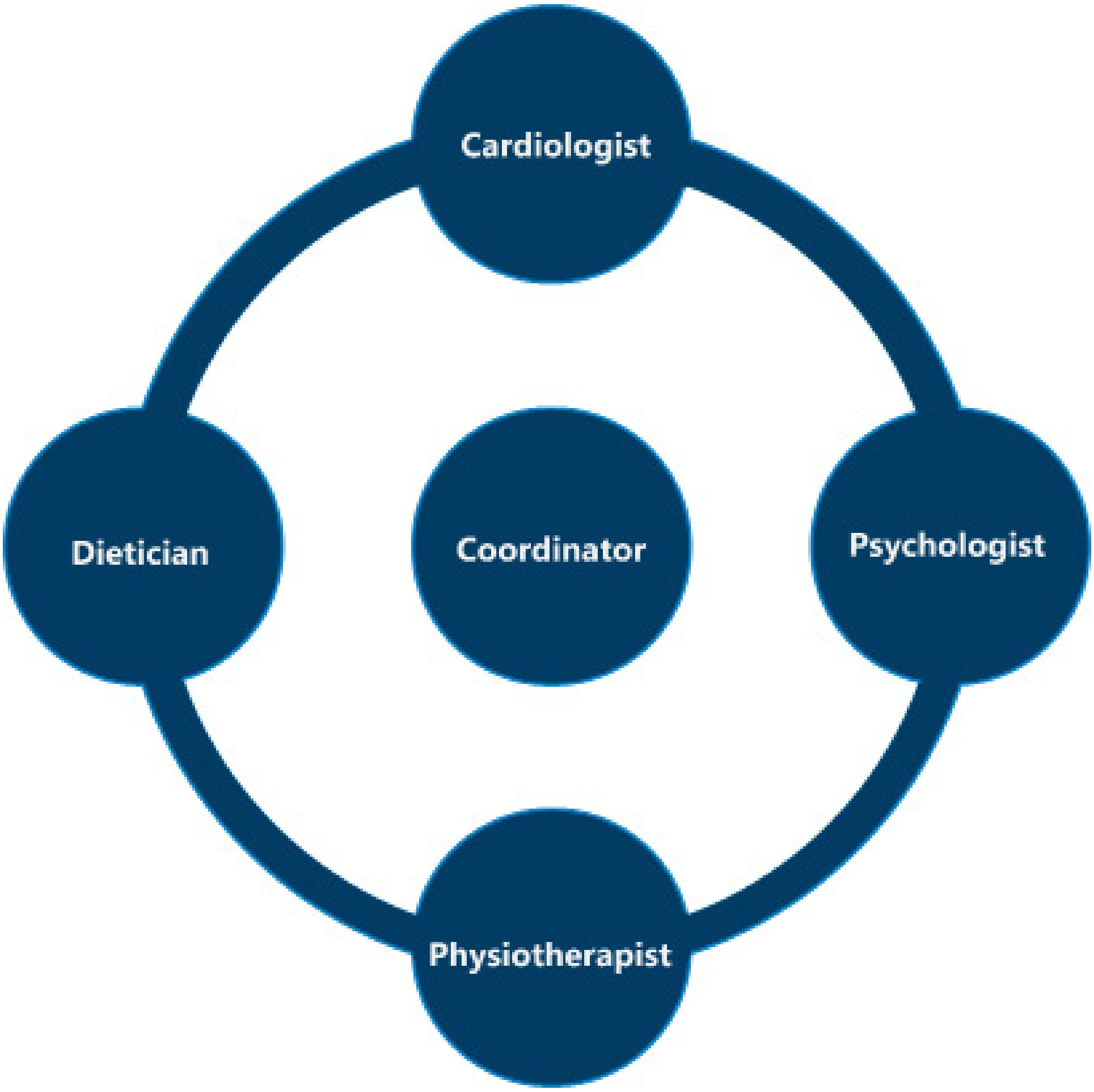


Picture 3.5.1. Visualization of the clinical pathway (Wetzels, M. H. & Peters P. , 2015).

From this we got a general overview of the clinical path of the patients. We focus on the rehabilitation of the patient and because of that we take a deeper look at the cardiology department and can also determine relevant stakeholders there. We made a visualization of it after we did the interview which you can read under ‘Cardiac Rehabilitation Nurse Interview‘

Relevant stakeholders in the cardiology department:
1. The cardiologist
2. The coordinator or rehabilitation nurse
3. The dietician
4. The physiotherapist
5. The psychologist

In picture 3.5.2. you can see that the coordinator is the spill-figure in the cardiology department. We have arranged an interview with the coordinator the get a better understanding of our users and we try to discover what they really need. Because the coordinator is the spill-figure we can ask in-depth questions about the relations between different departments and how they operate towards each other to understand the cardiology department better as a whole system. We try to learn how they operate and evaluate that. In this way we can discover if there are design opportunities.



Picture 3.5.2. Visualization of the stakeholders in the cardiology department.

04 IDEATION

4.1 BRAINSTORM

4.1.1 INTRODUCTION

After formulating the project group goals within the project description and a lot of research, the main preference arose. A project in which we would develop a physical product. In order to start the brainstorm sessions some first ideas had to be produced in order to gain the insights of the field. After that we had to specify our area in which we generated ideas or improve/adapt ideas. To produce in a effective way we used a few different brainstorm methods.

There had been thoughts about analysing tools to help the cardiac patients change their lifestyle to a more healthy one. These thoughts/ideas entered an idealist and were there to find their shortcomings and finally to be reshaped. Such a personal lifestyle coach could be very interesting, therefore new concepts were developed.

4.1.2 METHODOLOGY

The way there had been brainstormed was organised with intended brainstorm methods. The ideas mainly commenced during analysing existing problems and empathising with the cardiac patients themselves. By using personas and scenarios we intensively imagined how we, as user, would act upon the given situation. This empathy increased a lot during the patient research.

A side-brainstorm example is, summarising the most common objects patients carry around and especially which the user actually want to carry around.

Picture 4.1.2. We are brainstorming as a group to generate ideas .

4.1.3 RESULTS

There had been thoughts about analysing tools to help the cardiac patients change their lifestyle to a more healthy one. These thoughts/ideas entered an idealist and were there to find their shortcomings and finally to be reshaped. There are three ideas generated from this brainstorm as you can read below.

THE CARE VISUALIZER

This is a cylinder device that has buttons on the top. These are divided in different tasks like eating, emotional support, medical care, sport and it also tells you which one you need the most. A line on the side of the cylinder that is located under one of the topics, for example sport and it indicates how much you still need to do to reach the amount that should be preferable for your rehabilitation. This visualizes your health situation day by day. It helps you indicating which of the rehabilitation aspects you need the most.

THE TRACKER

This is a cylinder device that has buttons on the top. These are divided in different tasks like sleep, sport, medicines and when you eat what. This will be connected to a website which gives you concrete information day after day. It tells you what you really need as a patient and keeps track of your lifestyle. This will be shared with the hospitals who can evaluate on it and can give feedback through the service.

THE MOTIVATION TRACKER

This concept is the two concepts combined. But then on the top is the first concept on the bottom the second. This concept comes with an extra function and that is turning the cylinder to measure time so the time you sleep, the time you sport, the time you work, etc. These concepts combined gives you the best personalized information with our service. It gives the best indication of your current health situation. It measures the way you live and visualises it so making a change becomes easier. In this way the nurses and doctors have very specific information so they can precisely do what is best for you as a patient personally.

This concept comes also with a side device. This is a small flat device that you have to place in your back pocket, it tracks the time you sit and the amount of steps you take during each day. For example if you sit to much, it will be visualised so the line shrinks. In this way you know you need to do some exercise.

4.1.4 CONCLUSION

Such a personal lifestyle coach could be very interesting, but the overload of those lifestyle coach products in the current market was enormous as found during the period of research.

We planned an interview with a rehabilitation nurse and we wanted to discuss these raw ideas to see if there is potential or get a discussing going which heads in another direction where we can learn and reflect upon.

4.2 CARDIAC REHABILITATION NURSE INTERVIEW

4.2.1 INTRODUCTION

To understand the needs of patients and clinical staff, we conducted an interview with a CRN. On Friday 16th of October we had a meeting with one of the CRN's: Ank Brekelmans at TSZ, a Dutch hospital in the city of Tilburg. In the interview, we asked questions about the connection between patients and the hospital, we proposed three personas and the stakeholder map to clarify the assumption from early research.

4.2.2 METHODOLOGY

The intention of the interview is to obtain insights from the perspectives of clinical staff in the CRP and identify the experience flow of patients with help from a CRN. The interview is conducted as semi-structured with proposal of personas and stakeholder map, while leaving room for discussion based on the proceeding of the interview to explore opportunities to provide better support for the patients.

4.2.3 PERSONAS

From the book “User-Centered Design” by Travis Lowdermilk (Lowdermilk, T., 2013) we learned that we could create personas to increase our understanding of the user. The goal of the personas is to set lists of information in order to represent multiple different users. We created very different types of personas to get a wide range of possible users. These imagined users could improve our concepts a lot due to the drain of knowledge and more awareness about how to coordinate our project well.

In order to set these personas we had to set a list of interesting topics. The elements we focused on while making the personas were: patient his/her name, age, country, family status, occupation, hobbies and favourite items, needs, frustrations, medical background (our personas are available in Appendix B).

4.2.4 SCENARIOS

When we got our personas, we imagined what can occur in different scenarios. After some discussions we developed a few different scenarios for our personas who are cardiac patients. With this we also wanted to create awareness and boundaries for our project to operate in. This eventually could result in a more valuable product or service. A few examples of scenarios, from the perspective of the user, are summed up below.

1. You are sitting at home in the evening all by yourself. You get it difficult. What can/will you do?

2. When you need help with the rehabilitation and your family members visit, are you going to talk about your health situation and possible problems?

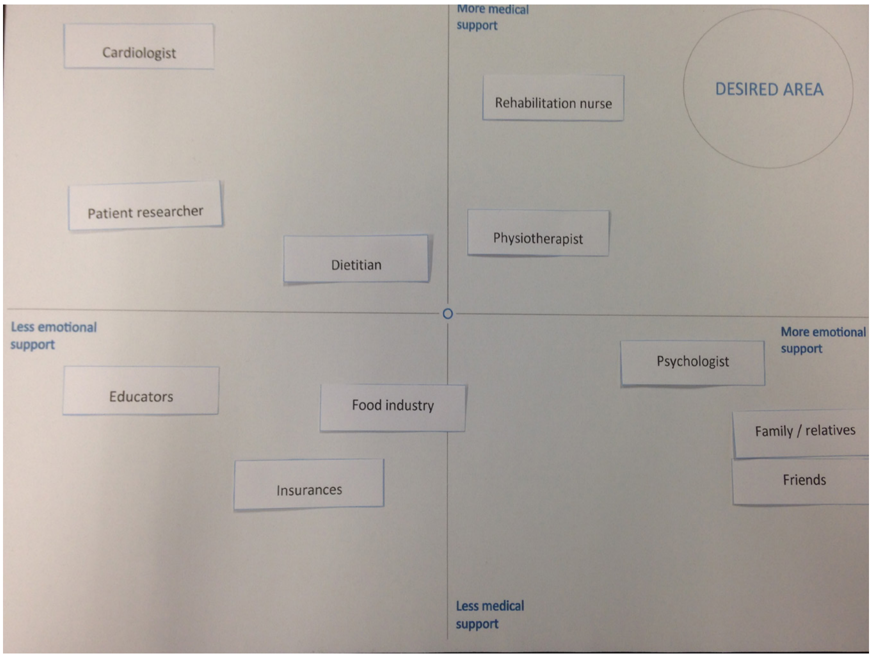
3. Since you are not able to go to the store anymore, how do you get the right food every day? And how can you make sure that you still do exercises every day?

4. If you are not able to care for yourself anymore, how would you make sure that your will get the right treatment?

4.2.5 STAKEHOLDER MAP

Something we added to the interview was a stakeholder map. In this map a clear view of the involved stakeholders in the clinical pathway of the patient would become visual. A goal besides, was that we wanted to make a comparison of our vision on the stakeholders involved and the one of the CRN's we spoke, to see if there were differences.

At first an own map was made to see how it differed with the one from the rehabilitation nurse at the hospital (see picture 4.2.5.). This interviewed person was, of course, a lot more integrated in the area of stakeholders and could provide us an improved vision. The map was separating emotional and medical support to see what the impact of each involved person on the patient actually was. Within this map, the most interesting part was the corner in which stakeholders were placed to be very supporting as medical as emotional. An assumption we, for example, had was that cardiologists are always busy and do not have enough time to support the patients a lot.



Picture 4.2.5. Our interpretation of the stakeholder map at first.

4.2.6 THE INTERVIEW

After research about the user and their environment, we could discuss about what we still wanted to learn even more and determine what we did not know so far. We reviewed all the research information, the personas, the scenarios and the report of our coach (Wetzels, M. H. & Peters P. , 2015) to prepare questions for a well structured valuable interview.

There are three different types of interviews; structured, unstructured and contextual interviews (Lowdermilk, T., 2013). A structured interview, with a clear starting- and endpoint. An unstructured interview without begin or end point, no specific order in which you ask questions. The last type, is the contextual interview. This type of interview is a combination of both other. There is freedom to ask more about what you could not foresee beforehand, but what you discover at the moment itself. We decided to use this type of interview at the hospital, because we wanted this freedom to gain knowledge about subjects we did not foresee (See Appendix C).

Picture 4.2.6. Interview with the CRN at TSZ. (16-10-2015)

We structured our positioning in the interview, to get the best results . We had three roles; the story teller, the listener and the observer. The storyteller told what we did with our project, what our vision was about, what we discovered and what we wanted to know and also how the interview was going to work. The listener had to listen and absorb for the information that had been said and asked questions for more clarity. The observer made sure we reached our goal and checked if everything was covered during the interview. We wanted to explain our concept towards the rehabilitation nurse and got feedback on it at the end . We did not talk about it earlier in the interview, because we wanted to get as much information as possible before we showed our very early 'solution'. Due to the preparations we consider our results from this interview to be very sufficient(in the subchapter 'Analysis' the results can be seen).

4.2.7 ANALYSIS

For a sufficient interpretation of the user we wanted to use a couple of personas, therefore we proposed these to the CRN. The CRN gave a couple of improvements and finally gave an approval. Besides we also discussed about what the pitfalls in the rehabilitation process are. Overall, patients find it hard to follow the rules, while it is incredibly important for improving their health. They also find it difficult to continue on their own, after eight weeks of rehabilitation in the hospital. The confrontation towards their old environment is often too big and they do not manage to keep up with their new healthier lifestyle.

Next to this, she indicated the difference of every patient and that every single patient needs a different approach. Patients find it important and more helpful when their feedback is personal.

A tip that the CRN provided us was, that it would motivate the patients more if they could talk to each other (patient to patient). Due to their similar situation it becomes easier to acknowledge your disease and to recover.

4.2.8 FEEDBACK ABOUT CONCEPTS

We presented these ideas towards the CRN at the end of the interview. She judged ‘the tracker’ to be the most interesting one. More specifically the service, that partly developed during the interview, where patients could ask questions and witness their personalized information which the hospital can follow as well. This is also valuable for the hospital, because in this way they can see what people do after they finish the CRP at the hospital. In this way they can make sure that the patients know what they have to do at home, since the real problem occurs when the patients face their old habits.

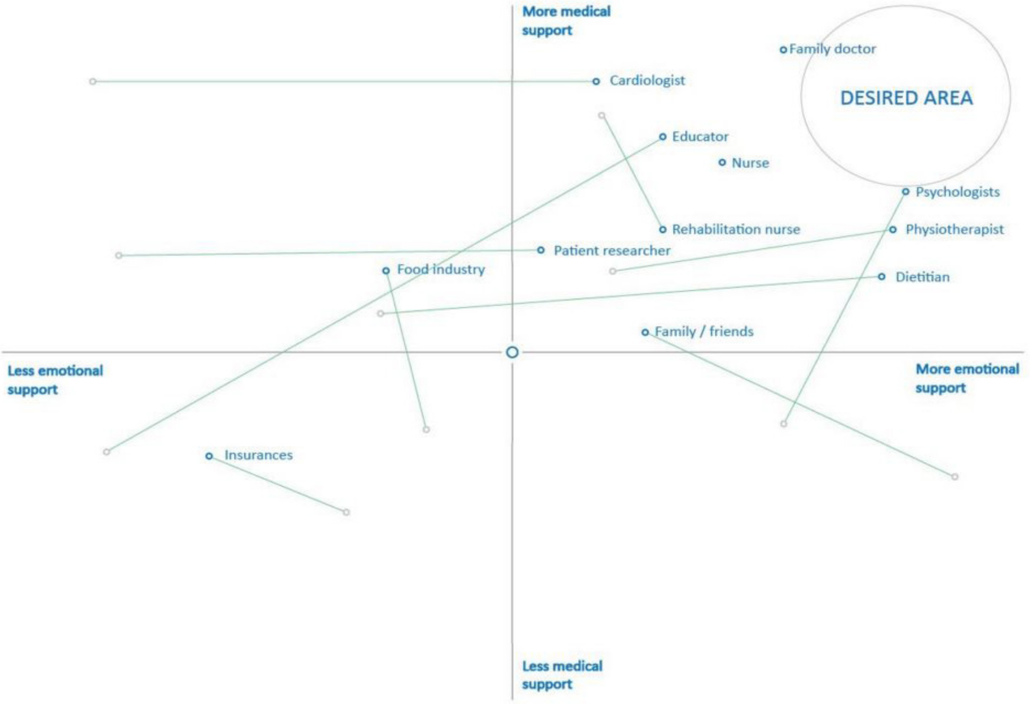
Furthermore, she mentioned that the anxious partner or relative wants the patient to be calm and minimize moving a lot, which is bad. Also the patient itself does not really know what to do anymore and the patient does not have a clear direction. All this information became really valuable when we developed our new concept.

4.2.9 STAKEHOLDER MAP COMPARISON

Comparing our map with hers was very useful, because we estimated a lot of stakeholders incorrectly. Still by surprise, the cardiologist was the most positive stakeholder. Yet cardiologists often provide emotional support next to medical support. Another important aspect that we learned from this stakeholder map was that family has one of the biggest impacts on the patient their rehabilitation process at home.

Based on our interpretation of the stakeholder map we also saw opportunities to offer a service or product to change the position of certain stakeholders in the map. A CRN assists with medical care, but if they also can be more supportive as a friend, it pleases the patients more and that will appease them on an emotional level too. Therefore the goal emerges to give the cardiac nurses more time with their patients, which probably make the patient feel better. Furthermore, it is highly recommended for patients to bring along their family or friends to have a maximum amount of support in both medical and emotional. If we can make a connection between all different opportunities we can surely improve the health of the patient. This will make the recovery easier and will keep him or her on track to live a healthier lifestyle.

Although, a very accurate overview would be visual, eventually not that much results were made. All individual stakeholders have their own unique identity and way they act in their profession. That means that it is very hard to fix a stakeholder at a certain coordinate in the map. A cardiologist could be very emotional supportive, but also could not. As conclusion could be drawn that it still depends on the personality from the stakeholders. Thus the support probably have to be found somewhere else. The support could possibly be found in a product. Or are products/services not always giving a comparative emotional support as human beings?



Picture 4.2.9. The white circles are our interpretations of the stakeholdermap. From there lines are drawn towards the blue circles which are the interpretations of the stakeholder map by the CRN's of TSZ.

4.2.10 DISCUSSION

The interview with the CRN in TSZ provides opportunities and direction for developing concept in the project. Due to the limitation of patients their privacy protection, interviewing with cardiac patients was not allowed. Yet we obtained many valuable insights of the need of the patients and clarified the user requirements with the help of the CRN.

The observations from the interview are translated into functional requirements below, which are delivered through the next concepts.

Users their information need to be private.

Users have to get only the information that they want except from the information that is necessary will always be provided.

The information has to change together with the patient over time.

Users must have fast access to the system otherwise they will not use it. Users have to be able to ask questions and get fast feedback on that question. Hospitals have to be able to manage all the data from the users of our service to come to new insides and follow up patients better and also get and better understanding.

Users have to be able to compare between different patients of the same kind anonymously so they can avoid future risk factors that similar patients experience in a later stadium.

The service has to be easy to use and synoptic.

User-friendly Interface. The user must be reminded about changes that happen so our users always has the best and newest information to work with.

05 CONCEPTUALIZATION

5.1 THE MIDTERM CONCEPT

We were also focusing on a physical product, but we skipped 'the tracker' idea, because there are already a lot of tracking devices. Therefore we wanted to build a smart environment that gives information or guidelines about the things you have to follow during your rehabilitation . We wanted to build an intelligent network as after-care where a connection of all sort of trackers becomes possible.

This is how it works, when you do a rehabilitation you have to do it every day and you only need support on the moment you do something related to your rehabilitation . When do we have to provide information to the patients? Where and how is the best way to provide them these information? The solution we found, is to provide information at the exact moment itself when they perform an action related to their rehabilitation . For example, when they leave the hospital they cannot drive a car for the first weeks. When the person gets in his or her car and then our service will provide them a reminder to prevent driving for a period of time. In short, when the user performs an action related to their rehabilitation they get immediate feedback on what would be the best. The same will happen with other scenarios like in the topics exercise, diet, sleep etc. In this way a complete environment of sensors in your living environment would be integrated, to give feedback on a physical device and possibly on a service online.

A cluster system is used to get these users in a certain group and ask for help and support from other patients. This is mainly the peer-to-peer support we tried to include on the web service. Thus the combination of a sensor network located at selected spots and a peer to peer support on a service online, was our intermediate concept.

06 INTERMEDIATE EVALUATION

6.1 MIDTERM DEMO DAY

Halfway the semester the TUE organises a midterm demo day. This demo day is intended as a intermediate evaluation and moment to get a lot of feedback. After presenting your current concept and design process, we evaluated the concept with different project coaches to gain new insights.
The first elaborated smart environment concept was worth to get feedback on. The expectation of us beforehand was primarily focused on feedback about the range/amount of work the project would demand. The concept was still very broad and we actually still wanted to narrow it down. The goal of this approach was to highlight the most appreciated values of the concept by the experts during the demonstration.

Picture 6.1.1. Midterm concept visualisation.

Picture 6.1.2. Presenting at the midterm demoday.

6.2 FEEDBACK

The feedback acquired was indeed mostly about the too expanded size of the demonstrated concept. We were thinking to big. The main focus of the experts was to continue with only one part of the complete concept. In order to accomplish this, for instance, a target group has to be set to design for. The more detailed feedback about the different aspects was interesting and useful as well. During the presentation, we unfortunately had no physical objects to show.
The experts advised us to increase the amount of visualizing and to build a physical prototype, something tangible, in an earlier stage. Furthermore, they highlighted that technological understanding of our target group had to be clarified more.
They were most enthusiastic about the peer-to-peer feedback tool used in the concept. It was stated as very interesting to continue with. Although they mentioned that the answer to a few why-questions had to be stated more definite. Why could this contribute and be valuable to our target group?
We saw that our strongest part was our extra service, because the service on itself is very good and, according to us, it connects a lot of Do Change products in a meaningful way.
Therefore we decided to elaborate a similar service and proceed it as our final concept. Our final concept is called patient to patient service.

07 PATIENT TO PATIENT SERVICE

7.1 SUMMARY

As we discovered during the research, an absence of after-care for cardiac patients was one of most crucial causes to get CAD more than once. Patients judge it as difficult to adapt their lifestyle and obey their disease-related rules. Therefore the following online ‘patient to patient service’ is developed.

We maintained elements of ‘The tracker’-concept and specifically the service that was part of it. We discovered that a lot of Do Change products are tracking something about the patients their intake and/or their medical state. We judged these products to be not really connected towards each other and saw an opportunity to build a common platform/website for these products in order to make them become even stronger. The core of the concept is the service on the website. In this service you can find a data collection on a personal dashboard, a peer to peer support (forum) and a collection of articles as source of information. We can use data for our dashboard from Do Change products to collect daily data about different activities. Via these products you get feedback on what you do during the day(salt intake, exercise, sleep etc.). The forum, possibly our strongest aspect, will give people the opportunity to help other patients with their rehabilitation by sharing knowledge and experience. To be sure that patients will participate actively, the service has a lot of elements which can help to achieve that. For instance the opportunity to add other patients on your friends list to create better relations and to probably get more detailed help (more information can be seen in the subchapter ‘Social media design’). To engage a patient to use the service at their smart device, we added a trigger device. This hand-size engagement tool sends notifications via light to trigger the patient to, for instance, check their new posted answer to their question(more information can be seen in the subchapter ‘Trigger device’). (A visualization of the system’s data flow between stakeholders can be found in appendix F).

7.2 CONCEPT ELEMENTS

We discovered that when you can personalise a patient his/her profile you immediately feel more comfort at the service. From the book “Living with complexity” by Don Norman we got:

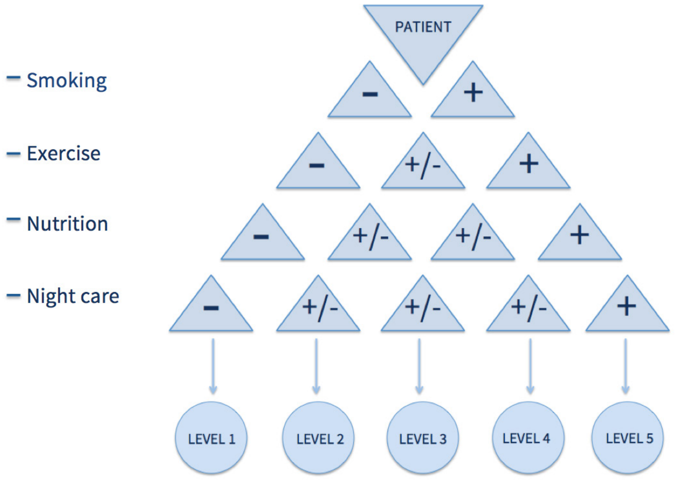
“Website’s count as services. There may be millions of people using a website, with diverse needs and understandings of the offerings. Somehow, the site has to be able to cater to everyone, but without diminishing the experience.”(Norman, D., 2011, p. 161)

Based on these information we added an interest button. In this way you can interest different topics for example exercise as a topic or a specific question in it. When you interest it, it appears on your interest page and you are updated when changes occur so you can follow the newest things. In this way you can personalise your personal rehabilitation experience on our server to work on what you think you need the most.

We want our concept to be trustworthy for the patients in order to guarantee that the content is definitely supporting their health. Therefore we introduce a function for the cardiologist to verify answers given by the users. With this method others can know for sure that they can trust the given information. We wanted to manage this correctly otherwise it would be too much to handle for the cardiologist. The question that has the most interests from patients, appears at the top of the cardiologist his/her screen so he or she can deal the questions with the highest priority. In this way we hope that the cardiologist can help more people in less time.

Since we learned that larger groups have more problems to materialize their common interest than smaller groups (Matzat, U., 2009), we wanted to avoid large groups. Therefore we tried to cluster our users in a meaningful way. We cluster them by giving them a survey at the login page which they only have to fill in once. This survey was based on the book "User-Centered Design " by Travis Lowdermilk (Lowdermilk, T., 2013). At this moment we cluster people based on four topics namely sleep, smoking, exercise and diet. We also have questions about their interests, so people immediately get a couple of things in their interest list, which they can optionally remove if wanted.

The goal of this clustering system is to cluster people together with people at the same level in their rehabilitation . Depended on the age of the patient, these differences in levels are used. For example a 40-year old, on average, has to sport more to some extent than a 70-year old person. The illustration of how we cluster can be seen below. With this clustering system you will get a variety of people in the same group as you can become with people with all different strengths and weaknesses. In this way people might use their own strengths to help each other. We also cluster them depending on which CAD they have in order to get even smaller groups. This is one of our features that we implemented to avoid passive usage. Other aspects are discussed in the subchapter 'Social media design'.



Picture 7.2. This shows how we cluster patients in different groups.

As our last feature we wanted the data of all patients to be available for the hospitals. In this way the hospital can check whether a patient is behaving well after the CRP in the hospital and contact them if needed. It is also useful when a particular patient meets at the hospital, because then they can already analyze the data beforehand and talk more with the patients their feelings. In this way patients get more emotional support and have an increased amount of time to discuss their issues. This in the end will benefit both the patient and the hospital.

7.2.1 WEB SERVICE

The first prototype of the website is online and possible to see (online since December 2015). The aim of this first prototype was to be able to show how we would structure it and how you could navigate through the website. The link of the website is:

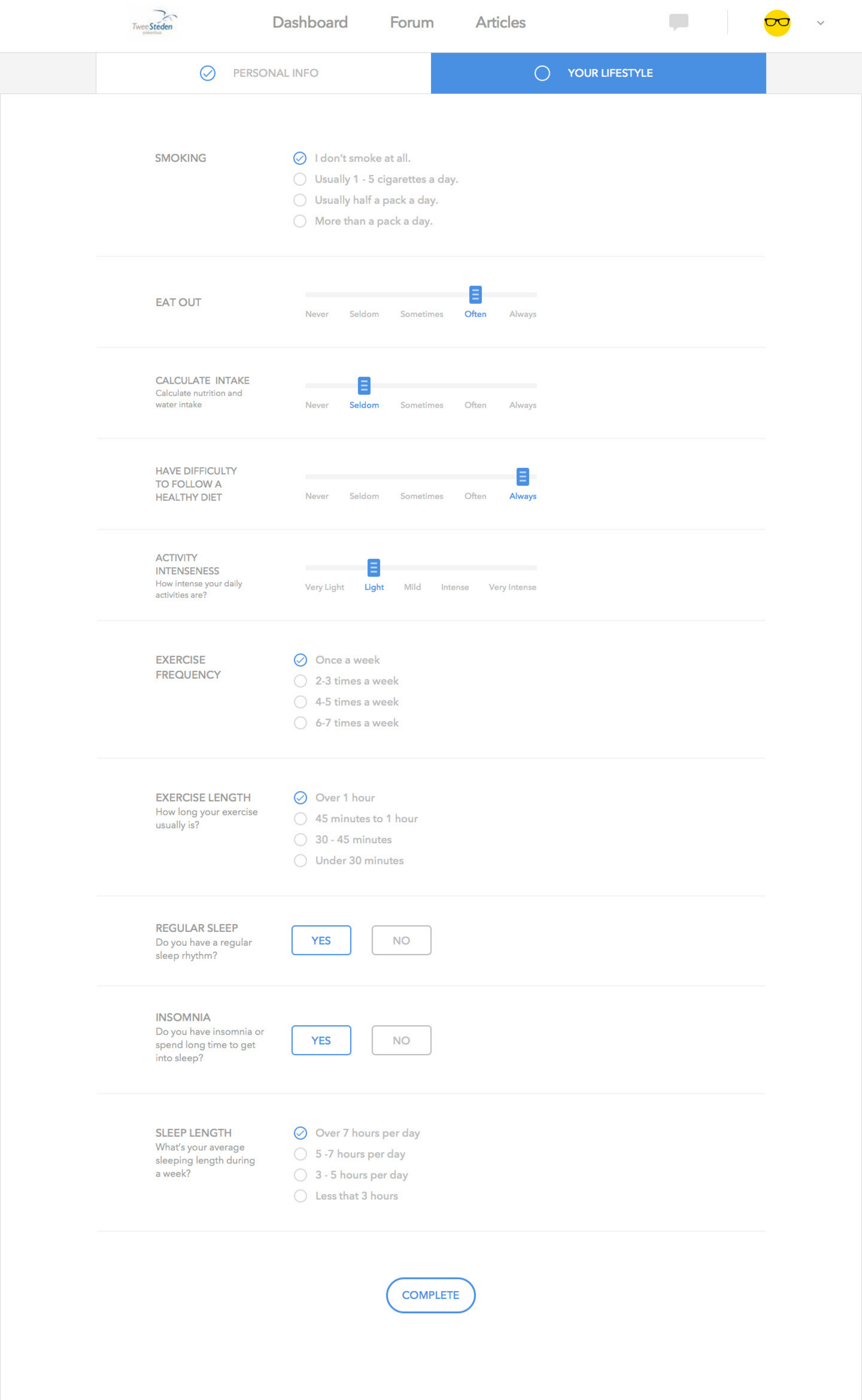
http://patientservice.oliviervanduuren.nl/index.html

When opening the link above, you could log in by inserting random content in both text areas to see the remaining content of the website. You are free to discover how we intended it and please experience it yourself.

Via a forum within this service, patients could ask for any sort of support from other patients. With its open database, users, are able to see the collection of all the questions asked before. If a new question is asked and another user is interested in the answer, he is able to follow the question to get notifications if the answer has been given. By giving a valid answer yourself you can collect points to get awards when achieved a next level.

Points will be given, when the asker of the question judges the answer as valid. The higher the amount of points the patient had been collected, the higher the reputation of the patient on the forum and the higher the trust in that person his/her answers. Next to this forum system, the service is completely personalised through surveys and with possibilities to personalise through connecting lifestyle analyzers(gadgets). All data of the analyzers becomes visual for the patient and his/her relatives(if approved) at the personal dashboard. The service itself will respond to how well the patient has been behaving during that day and will give feedback on that. When a patient did not do what was expected, he or she possibly could drop down a group. This will just operating as delicate feedback.
Next to these two tools a large collection of articles is coupled to your profile to find all the information collected in one assemblage.

The webservice, as online community, had to be presented and structured very well to influence the patients to participate according to the community goals. By getting a very clear and persuasive detailed structure around the three main tools, these tools become a lot more effective. All the added extra elements are making the entire service operate well. A few of these elements are a registration page, a friends list, a score indicator, a level indicator. This will be addressed in the next subchapter ‘Social media design’.



SMOKING

- ☑ I don't smoke at all.
- ○ Usually 1 - 5 cigarettes a day.
- ○ Usually half a pack a day.
- ○ More than a pack a day.

EAT OUT

Never Seldom Sometimes [✓ Often] Always

CALCULATE INTAKE
Calculate nutrition and water intake

Never [✓ Seldom] Sometimes Often Always

HAVE DIFFICULTY TO FOLLOW A HEALTHY DIET

Never Seldom Sometimes Often [✓ Always]

ACTIVITY INTENSENESS
How intense your daily activities are?

Very Light [✓ Light] Mild Intense Very Intense

EXERCISE FREQUENCY

- ☑ Once a week
- ○ 2-3 times a week
- ○ 4-5 times a week
- ○ 6-7 times a week

EXERCISE LENGTH
How long your exercise usually is?

- ☑ Over 1 hour
- ○ 45 minutes to 1 hour
- ○ 30 - 45 minutes
- ○ Under 30 minutes

REGULAR SLEEP
Do you have a regular sleep rhythm?

[✓ YES] NO

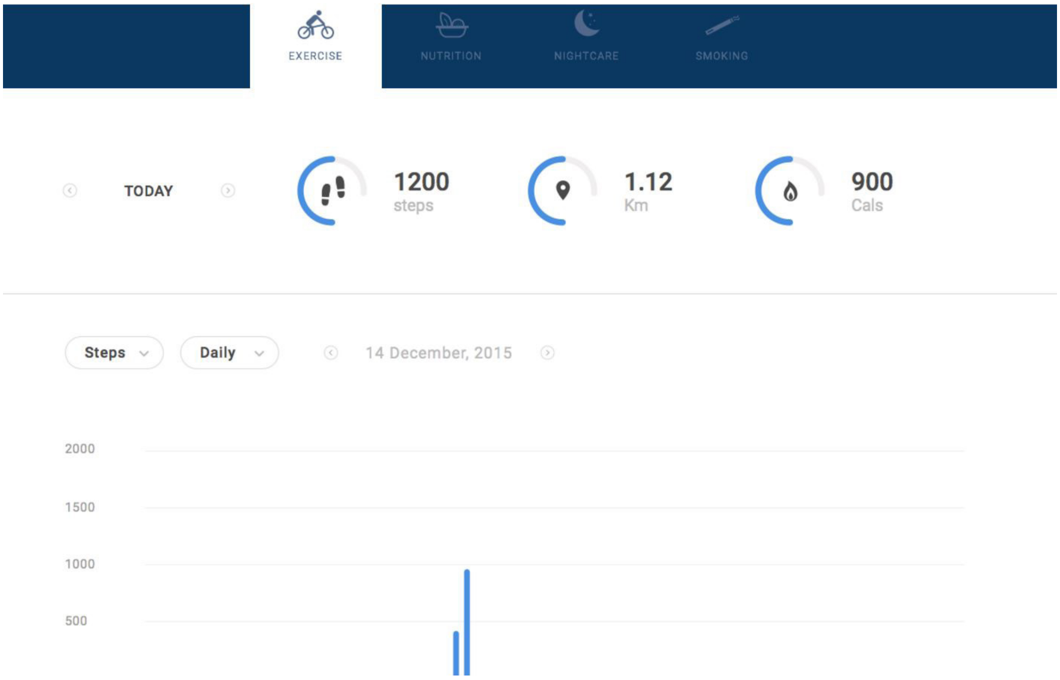
INSOMNIA
Do you have insomnia or spend long time to get into sleep?

[✓ YES] NO

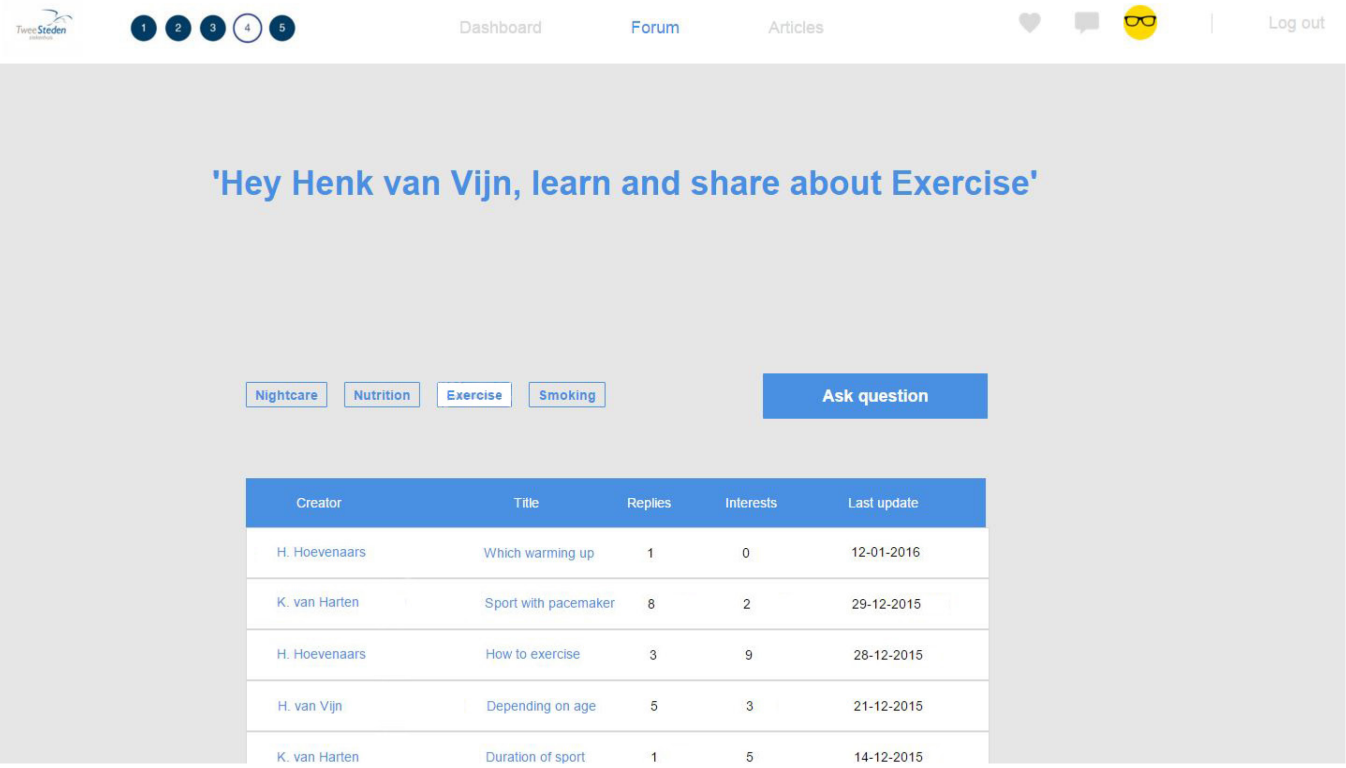
SLEEP LENGTH
What's your average sleeping length during a week?

- ☑ Over 7 hours per day
- ○ 5 -7 hours per day
- ○ 3 - 5 hours per day
- ○ Less that 3 hours

Picture 7.2.1.1. Survey to cluster patients into different groups.



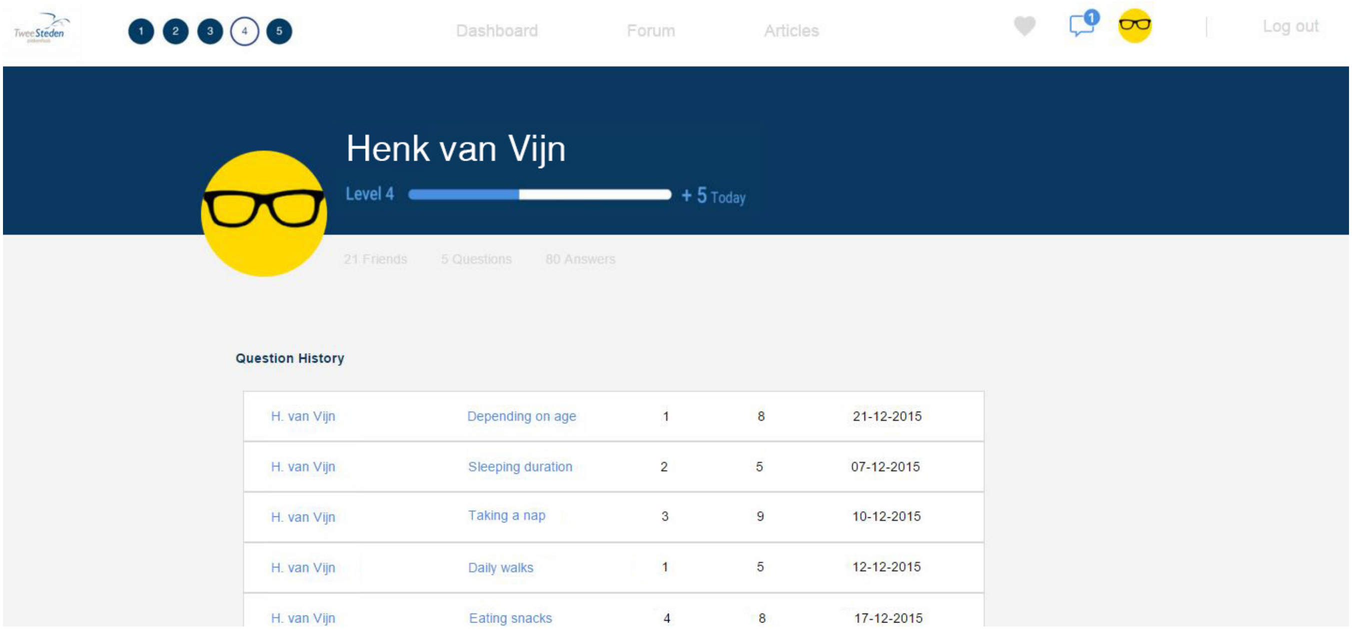
Picture 7.2.1.2. This is the main page of our service. You can also see the data that Do Change products track to follow up your daily progress.



'Hey Henk van Vijn, learn and share about Exercise'

Creator	Title	Replies	Interests	Last update
H. Hoevenaars	Which warming up	1	0	12-01-2016
K. van Harten	Sport with pacemaker	8	2	29-12-2015
H. Hoevenaars	How to exercise	3	9	28-12-2015
H. van Vijn	Depending on age	5	3	21-12-2015
K. van Harten	Duration of sport	1	5	14-12-2015

Picture 7.2.1.3. This is the exercise forum. You can see the questions that were asked with their amount of replies and interests.

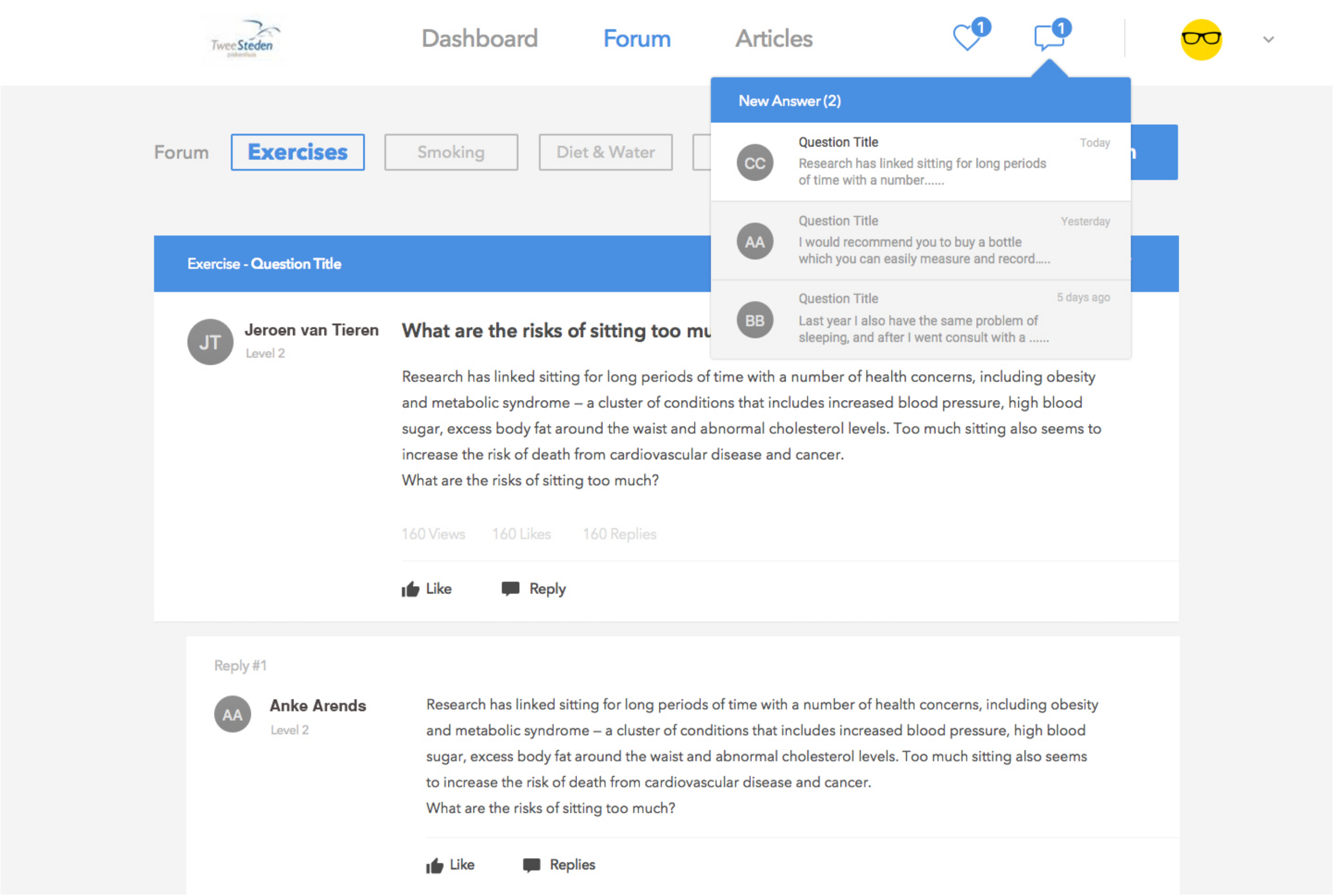


Henk van Vijn

Question History

H. van Vijn	Depending on age	1	8	21-12-2015
H. van Vijn	Sleeping duration	2	5	07-12-2015
H. van Vijn	Taking a nap	3	9	10-12-2015
H. van Vijn	Daily walks	1	5	12-12-2015
H. van Vijn	Eating snacks	4	8	17-12-2015

Picture 7.2.1.4. This is your personal page where you find all your activities on the forum. Your interests are also listed here.



New Answer (2)

Question Title — Today
Research has linked sitting for long periods of time with a number......

Question Title — Yesterday
I would recommend you to buy a bottle which you can easily measure and record.....

Question Title — 5 days ago
Last year I also have the same problem of sleeping, and after I went consult with a ......

Exercise - Question Title

Jeroen van Tieren
Level 2

What are the risks of sitting too mu

Research has linked sitting for long periods of time with a number of health concerns, including obesity and metabolic syndrome – a cluster of conditions that includes increased blood pressure, high blood sugar, excess body fat around the waist and abnormal cholesterol levels. Too much sitting also seems to increase the risk of death from cardiovascular disease and cancer.
What are the risks of sitting too much?

160 Views 160 Likes 160 Replies

Reply #1

Anke Arends
Level 2

Research has linked sitting for long periods of time with a number of health concerns, including obesity and metabolic syndrome – a cluster of conditions that includes increased blood pressure, high blood sugar, excess body fat around the waist and abnormal cholesterol levels. Too much sitting also seems to increase the risk of death from cardiovascular disease and cancer.
What are the risks of sitting too much?

Picture 7.2.1.5. This is how the chat and reply of our forum is visualized on our service.

7.2.2 SOCIAL MEDIA DESIGN

To improve our forum we have done research about what the important aspects are to make a good working online community. In this subchapter the entire documentation is based on lectures of Uwe Matzat at the TUE and his documentation about relational signal in online groups (Matzat, U., 2009). We purvey a service, however we must deliver such a service that the patient will use it as where we designed it for. Our group goal is to be supportive for the other individual cardiac patient, so in short: we desire to give the opportunity to help each other to change behaviour to achieve a healthy lifestyle. There are several methods to increase certainty about active participation of the patients. Thus they do not only read and use but also give input at the forum themselves.

RECIPROCITY

With reciprocity we want to prevent free riding. The free-riding problem will occur when members within our community gain advantages of any collective good without bearing the costs. To prevent free-riding we, for instance, can set the conflicting individual goals more to the background and the general group goal more to the foreground. That is what we try to do with creating a system in which patient do share their knowledge and experience. The reciprocity is created for the patients through the forum. If patients put a lot of effort in helping other patients, they expect that other patients also will put effort in helping them. Patients are more likely to keep on helping when they get something in return or a reward.

Then you will get a reward when scored at least an amount of points, generated by means of answering a question. In this way you can get some extra features for free. By implementing a ranking system, users can build a reputation. If patients see an answer from another patient with a high reputation then they will get a feeling that they can rely on it.
The individual goal is important, but the goal of the group is the main focus. A couple of methods for high reciprocity are; identifiability, long term relations and embeddedness.

IDENTIFIABILITY

An important aspect of reciprocity is identifiability. It is important for a web service that patients have a name and can be recognized. If patients are numbered, they are anonymous and it is too difficult to create a trustworthy connection. It is important that patients feel that they are talking to a real person, otherwise it becomes hard to believe an answer. If a patient does not want to use his/her real name, a pseudonym can be a solution. We offer an own online account for every user. These accounts can be visible for other users, however the information that is provided for others are limited.

LONG TERM RELATIONS

A second aspect that we want to foster, is long-term relations. With long-term relations you know what you can ask from other people and other people know what they can expect from you. It creates more efficiency, when you want to ask a question. This can be encouraged by creating friends lists, which makes it easier to find people that could help you and create relations with them.

EMBEDDEDNESS

Another aspect is embeddedness, which means offline relations with people you know from the online community. For example, if they could meet physically, it would be easier to exercise together and give specific tips. Another advantage of embeddedness is that people are less likely to give fake answers. If the chance exists that you could run into each other, the level of trust increases. You might not want to see each other in real-life, after you gave certain ridiculous answers. We implement this in our forum by giving the location of the patients or realise special peer groups based on location.

UPWARDS-SOCIAL COMPARISON

Another aspect to increase patients their motivation, is upward-social comparison. The ranking system could also be used with upwards-social comparison. It is proven that if users can compare themselves with people that are better than them, the growth is relatively bigger, than when you compare yourself with someone worse than you. The ranking list can give motivation for helping other people and have a healthier lifestyle.

7.3 TRIGGER DEVICE

To remind patients of our service, we designed a small device. This device is meant to trigger the patients to look at our web service. We considered that the biggest percentage of cardiac patients is between 50 and 80 years old, and are mostly not used to go on the computer, they most of the times have to be reminded to see how they are exactly doing. By using the trigger the patients probably get engaged more with our service and become a more active user. The device is a hanger to attach to your bunch of keys, so it is easy to carry with you. It has three different coloured LED's. The different colour signals are there to recognize different notifications in an easy way.(selection of colours is not yet based on scientific research). The trigger will give a light signal when something happened on the the service that is related to you. When someone has answered your question you get a purple light. When someone answered a question where you are interested in, a LED will turn white. When you make positive progress so if you went a group higher the LED will turn blue, and if you went a group lower the LED will turn red. The position of the LED is not fixed based on the relation with the colour. So it is ordered according to the time of occurring. When a LED turned on it will be on permanently. There is an option to rotate the LED's circle. This is a convenient function to hide a burning LED. For example if you do not want to be distracted you can make them invisible. Thereby you let know that you saw the message and will return to the web service as soon as possible. When you log in at the web service and check your notifications, all the LED's will turn off automatically. The notifications will pop up in the forum and you can continue at the website. The trigger has the size of a car key and fits comfortably in an average adult hand.

We wanted to make a separate device and not an app, because we want the trigger to be noticeable and not a message on your phone that you slide away and forget easily. The trigger is an object that you can carry around always, and the LED's will only disappear when you logged in and checked the notifications.
For this system we made a wireless electronic circuit of the lights, a 3D model in the program 'Fusion360' and eventually made a 3D-print. We 3D printed two prototypes; one version in a bigger scale in order to fit in all the electronics and one version for the actual intended size. This was important, in order to visualize the trigger system. We could see and feel it, as we had the prototype in mind.

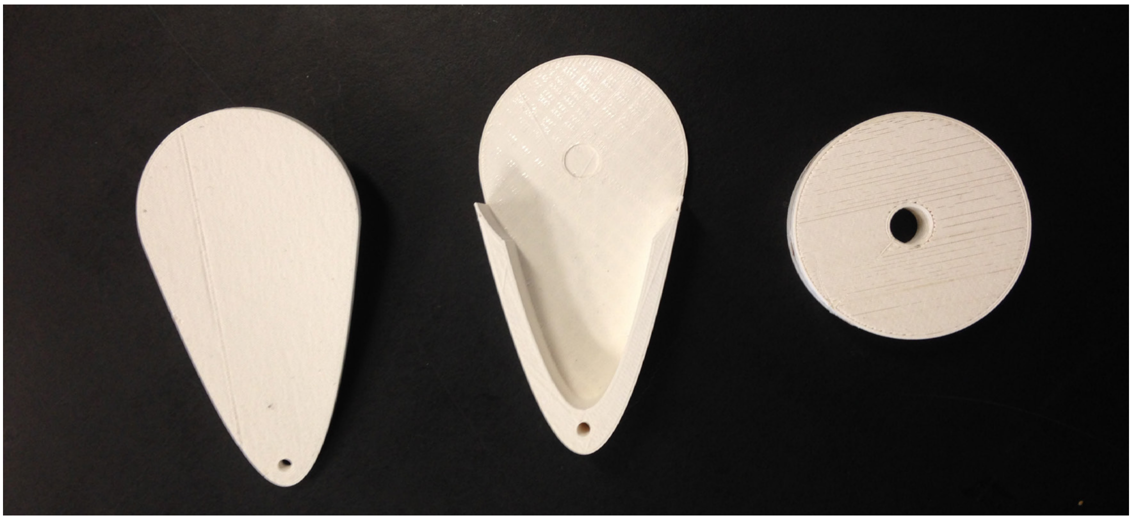
Picture 7.3. 3D-print of our trigger device with its intended scale.

7.4 TECHNOLOGICAL PART

7.4.1 PHOTON

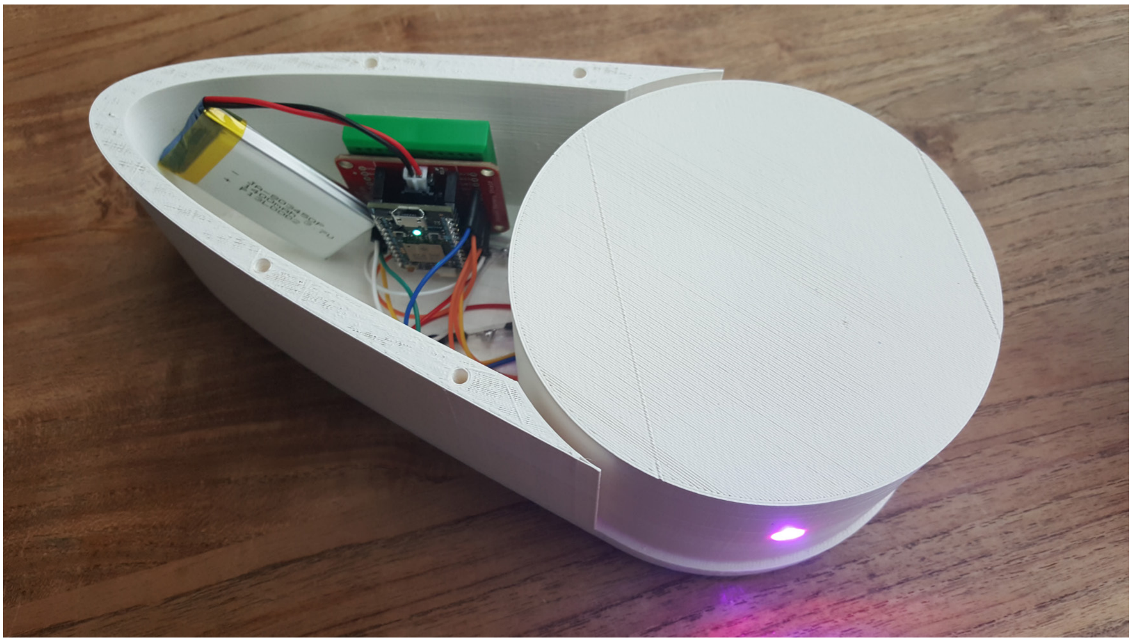
To make our ideas technological realisable we used a 'Particle Photon'(Photon, 2015). This is a programmable wifi-module, in this way we can send and receive data over the WIFI-network. We used our trigger as the receiver so when something happens on the service(sender) it will influence the way our trigger reacts.
We used the particle build software to code the photon and let it behave like we explained under the topic 'trigger' (Placona, M., 2015).

We use a 3.7V battery to power the photon. This happens through the battery shield, the photon automatically converts it into 3.3V. We used RGB-LED's to indicate changes on the service. RGB-LED's have 4 pins, the ground, red LED, green LED and blue LED. The red LED only works at 2V and the other LED's at 3.3V. All the LED's work at a current of 20mA. Because our photon uses 3.3V we have to put a 65 ohm resistor before the red LED of the RGB-LED based on this calculation $R= (3.3V-2.0V)/0.020A = 65$ ohm. We use 1 ohm resistors for the other LED's, because they can handle the voltage they do not need a resistor. That is why we use the smallest resistor possible just for prevent damaging the leds. Because we have eight digital pins on the photon, we decided to attach the green pin of all our leds to the analog pins and make them behave like digital pins. In this way we were able to manage and use nine digital pins. Below you can see the circuit, the black lines are the grounds, and the other lines are coloured the same colour as the LED's pins that they enter. To program the photon we used our own code (See Appendix D). The electrical circuit is visualized digitally (See Appendix E).



Picture 7.4.1.1. 3D-printed case for the technology. This has a bigger scale as we intended.

Picture 7.4.1.2. 3D-render model. Made with Fusion360.



Picture 7.4.1.3. Technology inside the 3D-printed case.

7.4.2 WEBSITE

As second topic of our technological part, we had to build the complete service on a website. To be able to build all the features we wanted to integrate in the service, languages as jQuery, Javascript, PHP, mySQL-database, HTML and CSS are used. In order to use these, we had to collect information from fellow students at the TUE, but especially on the internet.

First, we integrated the most important part, in our opinion; the forum. In order to do so we used an example chat box with database (Coyier, C., 2011). When this was working a database was already working and forum messages could be saved and seen at other times. Then we tried to make a registration option, but because of some higher priorities we only used a login page and skipped that part for then. The start of the service was made.

Secondly, a lot of elements had to be added to make the service operate better. So as a dashboard with data, profile pages and other elements. Mainly PHP was used to get more personal sentences in order to provide meaningful feedback.

Then, the layout had to be designed in order to get all of it very clear and easy to use. It has to appear very delicate and beautiful to give the patient a nice-looking environment.

Last but not least, the connection with the physical object was necessary to be able to experience that interaction. To connect the website and the photon in the trigger device, we used another service online. In the code of the website we had to use for our ‘Particle Photon’ we had to make the connection. When this connection was made a complicated access token was put in the code to actually create the interaction. When this connection was made, we designed the buttons on the website itself, to trigger the device and eventually the user.

08

VALIDATION TWEESTEDEN ZIEKENHUIS

On the 5th of January 2016 we arranged a Skype-meeting with two CRN's: Ank Brekelmans and Lonneke Stolman. We had an interview with Ank Brekelmans earlier in the project development and we wanted to show our progression and first prototype. We asked them relevant questions about the concept we integrated in our service as well as clarity and functionality it has for the patients as for the hospital.

The CRN's found the construction of the website very clear and clear. It is easy to use, due to the fact that the tools from Do Change would upload data from the patient automatically. With this function the CRN's find it very functional for the patients, because they do not have to fill in and track the data by themselves. Another positive aspect of the web service is that it is accessible for everyone, because it is a web based service which was a positive aspect for the CRN's. We thought that a website would be a risk for elderly to use, however the CRN's did not see this as an obstacle. Furthermore, if patients see the benefits of our service, the patients have no problem to carry the trigger device we made as a reminder of what happens on the service around the CRN's mention. Although they commented that maybe the trigger need some extra functionality to be able to deliver a greater value towards our users, for example the trigger can contribute to tracking data for the patients.

In the first interview with Ank Brekelmans we discovered that patients often find it hard to live a healthier lifestyle, right after the eight weeks of cardiac rehabilitation program from the hospital.
The CRN's found it wonderful that we created a product that could not only help these eight weeks, but for the rest of their lives. It is a great valuable addition to the patient, because just like in the hospital people are connected in a meaningful way to help and motivate each other with their rehabilitation process. They appreciated that our service is an extension of what happens during the CRP in the hospital and that patients can communicate with each other in a meaningful way.
With the friends list on the website, patients can add each other to keep in contact. The CRN's thought this was a great advantage, because it will increase the fun and embeddedness in the forum and can stimulate people to do activities together in their spare time.
Something what was really promising for the CRN's was that the hospital would be able to check the data of their patients after they left the hospital. In this way they can sharpen their CRP and prepare patients better before they go back home. Also the implementation of the cardiologist in the forum to communicate and verify answers was a very important and nice addition for them. They said that in this way they could stay in contact with the patients and verify answers given by patients on our service to make it more trustworthy which is a very important aspect for them. They also say that the patient can feel closer connected to the hospital in this way, what is very important for a hospital to create a good reputation and connection with their patients on a medical support level as well as on a emotional level.

A few comments were that the site must be written in the mother language of the patient. The reason for this is to be an active user, because patients probably want the easiest way of understanding and replying. Furthermore, they gave an option to replace the verification of the cardiologist with the physiotherapists, the dietician and/or other people working in the CRP. The cardiologist often has too less time to spend on the forum, while these other stakeholders would be equally to a cardiologist in their specific field. For example, we could ascribe the dietician to verify answers on the diet forum. The last thing the CRN's said was that family engagement is an import motivation for the patients. It would be nice to make it part of the forum for the partner and close family so they could easily help and motivate the patient.

So overall they were very satisfied and enthusiastic with the result we could show them. The interview was very valuable due to an efficient conversation. We gathered feedback about our concept, the functionality and the engagement of the hospital in our 'Patient to Patient Service'. We discovered some new future improvements which we can implement in the future. We think this conversation was very helpful as validation from stakeholders with whom our product will operate in a possible near future. That is why we are very delighted with the positive results from the CRN's on our concept and prototype.

09 FUTURE IMPROVEMENTS

9.1 TRIGGER DEVICE

The trigger system has as function to remind and connect the patients to the web service. We did not focus on how the patient will receive all their data, however we could think about how could we make the trigger device more functional.
This device is meant to carry along wherever you go. A good option would be to implement a tracker in the device. It would notice how many steps you did and how active you were. Another function of the trigger could be to track how many cigarettes you smoke a day. On the device we can make a clicker, which you have to press every time you smoke a cigarette. This information will be send to the webservice and automatically uploaded to your own personal data storage.

9.2 DIFFERENT WAYS TO TRIGGER USERS BACK TO THE WEBSITE SERVICE

In this stage, the service has a special trigger designed to give notifications with lighting LED while users get feedback or news from the website service. In this way the users can get connected to the website forum even when they do not have access to computers and also track their health data and questions they asked on the website more often. Instead of using a trigger, the purpose of encouraging users using the service more often may also be achieved by the following ways:

STRENGTHEN SOCIAL COMMUNITY

Like Facebook, Twitter and many other social platforms, using social community to trigger users to go back to the service.

MOBILE-FRIENDLY SERVICE

The trend shows that people nowadays spend more time on their smartphones than their computers (Halleck, T., 2014). Providing a mobile-friendly website or an smartphone application can reduce the limitation for users to get access to the website and also allow them to check the website in daily life.

9.3 MORE THAN MOTIVATION

The service includes a patient to patient forum aiming to build a social community. Users can get help, receive suggestions from other users who are more experienced on managing their lifestyle and also share their own experiences. By interacting with other members, users cannot only solve the problems about health improving but also get social support from the community.
Most of the time people do understand what kind of lifestyle is good for them and realize some bad behaviors can do harm to them. Especially cardiac patients, those who need to be more careful about managing their diet, sleep, exercise etc. However, people might choose to ignore some parts of the suggestions from experts due to many reasons such as laziness, convenience, social factors, and many others. In the next step, some directions might be added to improve the service to more effectively encourage users to 'Do Change' rather than providing information only.

EASY TO CHANGE

Instead of telling a user that he/she need to change their behavior directly, ''How about walking to the station today?" or '' How about walk to the supermarket?"may be a better way to encourage users to take action. Breaking a large mission of changing someone their habit into smaller tasks will ask user to put less effort and time to change and provide instructions to change lifestyle step by step.

HEALTH DATA PRESENTING

Instead of just presenting users health information collected from the portable devices, translating the data to easy-to-read infographic and useful suggestions will help users to understand those figures showed on the website and track their health conditions and the most important thing is to do some changes by following the customized suggestions.

9.4 VERIFICATION CARDIOLOGIST

For the cardiologist there is a verification button for every QA at the forum. The cardiologist can read these QA and if the answers are correct, he can confirm by pressing the verification button. The patients can see that the cardiologist confirmed it and they know the other user is not saying something surreal. However cardiologist are often busy men with a tight schedule. It would take a lot of effort, to spend time on the forum. An option to make this an more effortless process is to not only use the verification of the cardiologist but also to involve physiotherapists, psychiatrist and dieticians. Every specialist could take his own expertise. Thereby the workload of verifiering the QA could be easily decreased.

9.5 INTEGRATE FAMILY TO WEB SERVICE

Family engagement could be an import motivation for the patients. For a majority of the patients it is very hard to live a healthy lifestyle, while your partner or family does not. If the patient wants to stop smoking, but his/her relatives keeps smoking nearby, it could be hard to be disciplined and the step would be bigger to quit. It makes it easier for the patient if their relatives understand what they are going through and how they can live a healthier life. Involving the family in the web service means they can learn about the CAD's. Furthermore it would be handy to make a part of the forum for the partner and close family. They could have there own login account to see the lifestyle improvement of their relative.

10 DESIGN PROCESS

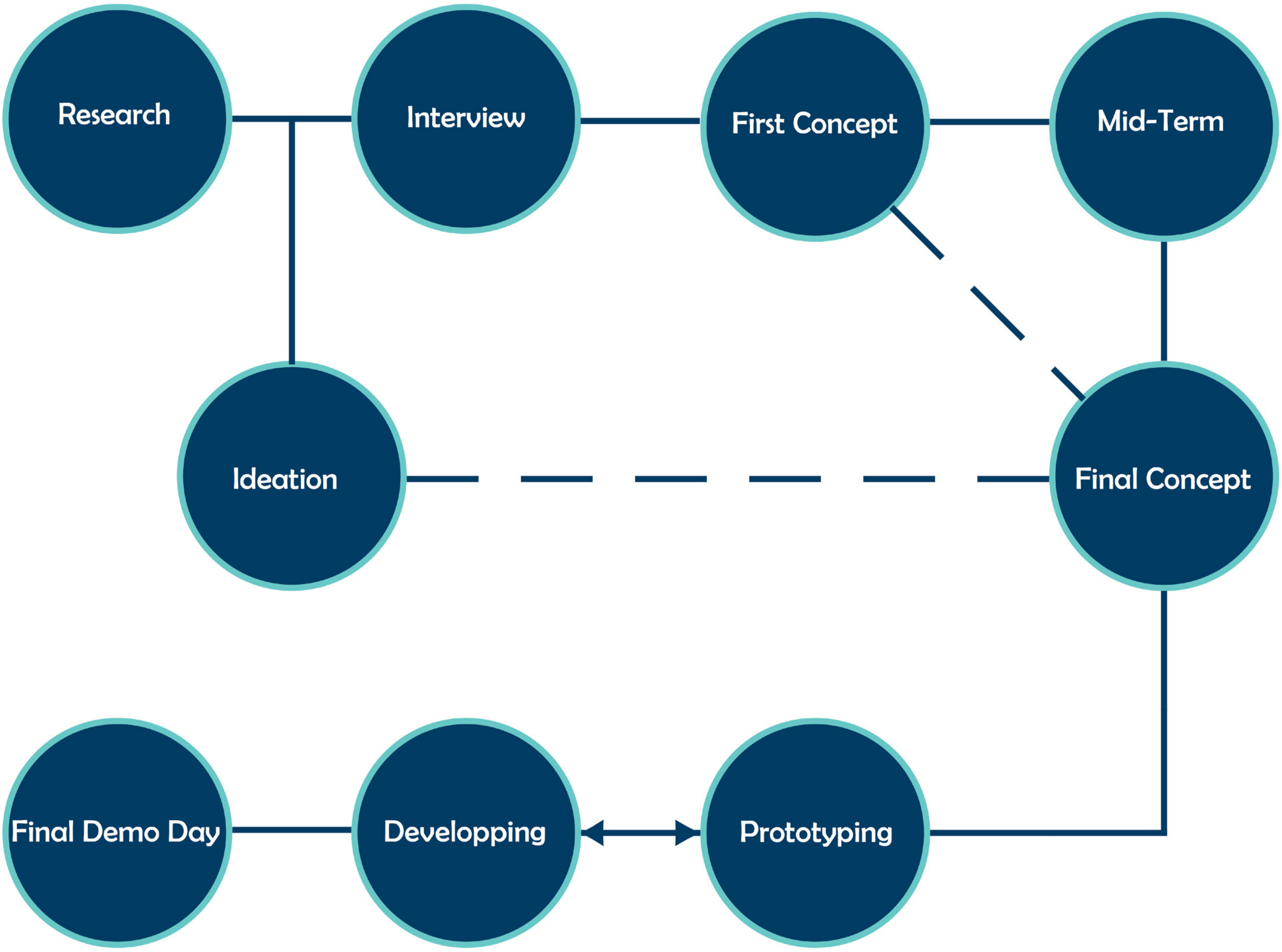
In this chapter we summarize the design process of this project. During a half year we followed a linear design process. Since our project is based on research we wanted to make sure that we covered all essential parts, we did this by continuously reviewing our results. As start of our project we had been doing a lot of research to gain knowledge about cardiac diseases, heart failure and additional aspects. Due to all the period of diversified research we learned where and how we were going to operate. Furthermore we, with the use of this relevant information, learned to understand our users their circumstances.

To gain more inside depth knowledge and experience ourselves we started to prepare an interview. In order to get valuable results during this interview we developed UCD-methods like personas and scenarios. From that perspective we started to generate some early ideas through several brainstorming sessions. The goal of these sessions was to develop our first ideas through gained knowledge of research. We used these ideas to get feedback on our early developed vision, from several different oriented people like fellow students, experts and especially our client: TSZ.

Based on the feedback and information from, for example the interview, we started to develop a first concept. We presented this concept at the midterm demo day and gathered some next feedback from multiple students and experts.

We started to build our final concept mainly based on the results acquired during the midterm demo day. We also integrated some developed strong elements of our research, early ideas and the interview. At the time we clarified our final concept, we started to prototype and continuously developed it towards our final prototype, which we presented at the final demo day.

Finally, after gathering all useful feedback of students and experts at the TUE, we arranged a Skype-meeting with the two CRN's form TSZ to validate our results. This validation turned out to be very useful and valuable for any possible continuation of this half year project.



Picture 10. This is a visualization of our design process.

11 ACKNOWLEDGEMENTS

We would like to acknowledge a few people for their participation in our project the past half year at the TUE. Without these people the project would have developed differently and might not have achieved what we delivered now.

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13 APPENDIXES

A. CORONARY ARTERY DISEASE

Do change focuses on coronary artery diseases and heart failures. The three consequences that we researched are:

1. Arrhythmia
2. Atherosclerosis
3. Myocardial Infarction

1. ARRHYTHMIA

What is the problem?

The heart has an important function for the body. First it gets deoxygenated blood, this is pumped through the lungs, as a result the blood gets oxygenated. The heart pumps the oxygenated blood and nutrients to the organs. In your heart you have a sinoatrial (SA) which gives the heart an electrical pulse, which causes the heartbeat. It could happen that your SA is interrupted or develops an irregular rhythm. A good working heart beats 60 to 70 times a minute, but with arrhythmia the heart can beat too slow, too fast or have an abnormal rhythm (American Heart Association, 2014).

What is the risk?

For the organs this could be a problem because the heart could not pump enough blood to the rest of the body. Often this causes dizziness, tired and lightheaded. In the worst case organs could be damaged or stop working (American Heart Association, 2014).

Procedure

If arrhythmia causes the patients too much trouble they could get a pacemaker. A pacemaker (or ICD, implantable cardioverter-defribillator) has the same working as the SA. If the SA stops working, the pacemaker replaces his function, so the heart can beat at a normal rhythm. The pacemaker consist out two parts, a part with the battery and information to command the rhythm of the heart and the other part that consist out of wires to the heart that give the electrical pulses.The pacemaker is often placed under the skin below the collarbone on the left side. Duration of procedure: 1 hour (Chen, M.A., 2014).

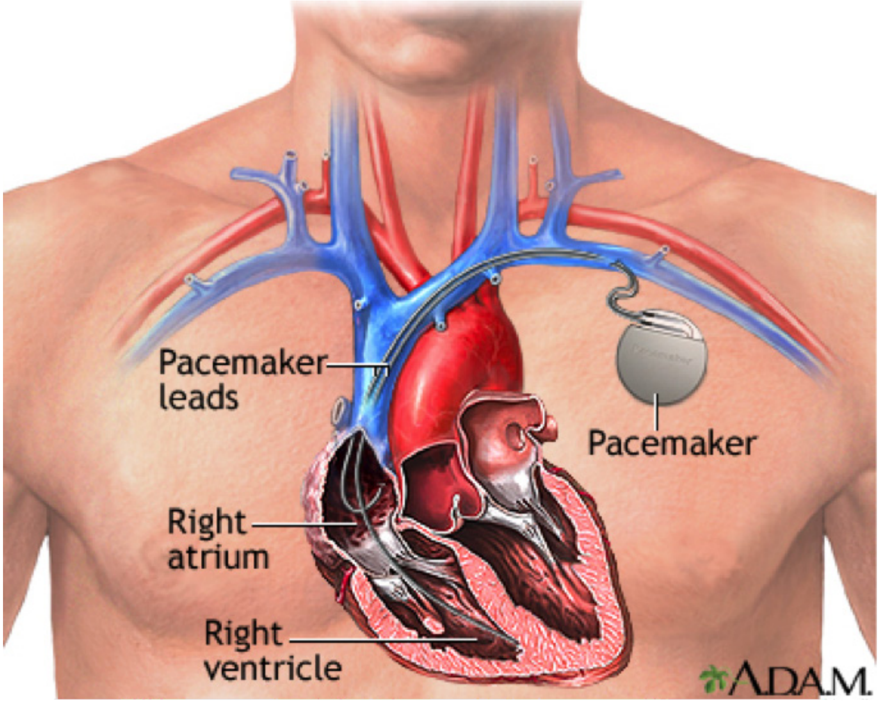

Figure A.1. Pacemaker (Source: Chen, M.A. (2014). Heart Pacemaker. Consulted on 29-09-2015, https://www.nlm.nih.gov/medlineplus/ency/article/007369.htm)

2. ATHEROSCLEROSIS

What is the problem?
Balloon Angioplasty is a procedure to help a blocked or narrowed blood vessel. Vessels could be veins, transport of deoxygenated blood, or arteries, transport of oxygenated blood. Blood clots or plaques can block the vessel (University Surgical Vascular, 2016) (Texas Heart Institute, 2015).

What is the risk?
A plaque is a layer of fat substances that arises on the wall of endothelium. Endothelium is a thin layer of cells in a vessel. This has as function to keep the vessel smooth, what is necessary to keep the blood flowing. A plaque is mostly caused by high cholesterol, high blood pressure or smoking. The procedure of a plaque becoming bigger, and the vessel wall becoming smaller, is called atherosclerosis. If the artery wall narrows or is been blocked, the blood pressure decreases and makes it hard for blood to flow. As a result an organ couldn't get oxygenated blood, first this causes pain eventually the organ could stop working. This is a big risk for your heart; you could get a stroke or other health problems (University Surgical Vascular, 2016).

Procedure

To help this problem you can get the Balloon Angioplasty treatment. With this treatment they use a long thin catheter. The catheter is been pricked in your arm or groin into a vessel, the catheter follows your vessel, till it is at the point where the plaque is located. When the catheter is at place, there is a second catheter placed over the first catheter. This catheter has a little balloon at the end. When the second catheter is at the end of the first catheter. The balloon is pumped up for a short time, due to this the vein widens and the blood can flood again. There is possibility that the doctor places a stent. This prevents that the artery re-narrows. This stent is placed over the balloon, after the balloon is pumped up the stent expands and stays the size of the artery wall. A stent is mesh tube that stays in place while it grows in your endothelium. Blood can flow again, without the risks of getting a heart disease or stroke.
Duration of procedure: 30 minutes - 2,5 hours (Texas Heart Institute, 2015).

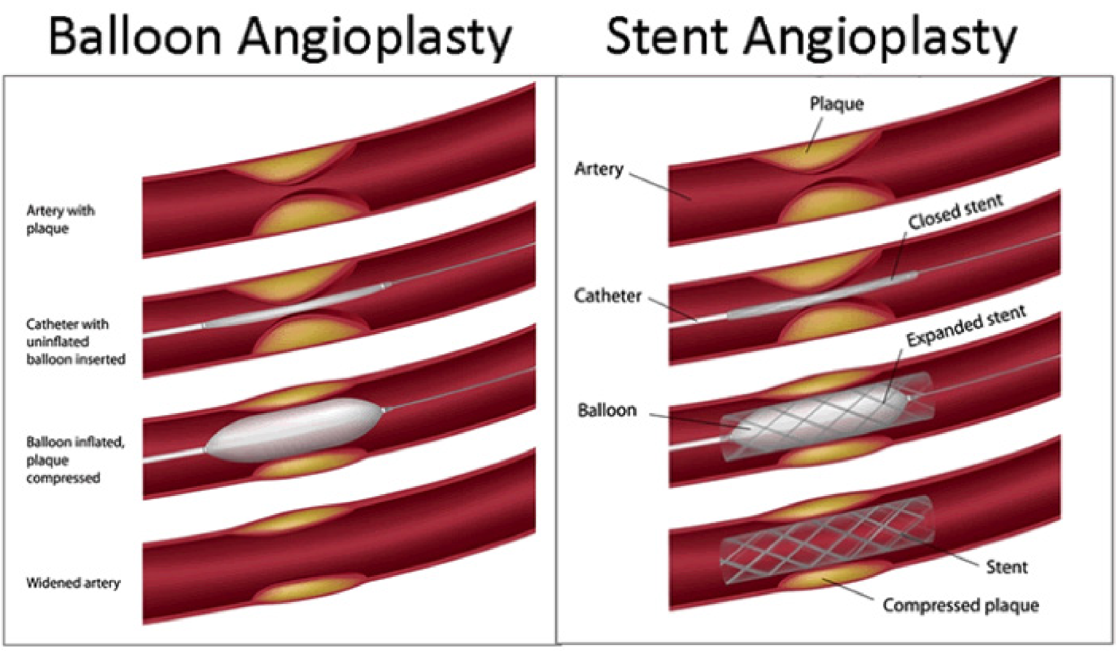

Figure A.2. Balloon/Stent Angioplasty. (Source: University Surgical Vascular (unknown). Angioplasty & Stenting. Consulted on 29-09-2015, http://www.vein-free.com/treatment-options/angioplasty-and-stenting/)

3. MYOCARDIAL INFARCTION

What is the problem?
Myocardial infarction is another name for heart attack. One of the arteries becomes blocked. Like atherosclerosis the artery has a plaque. A heart attack often occurs when a blood clot can't flow further and it blocks the transport of the blood. Symptoms are nausea, faintness, dizziness and shortness of breath. One out of four times it also happens that there are no previous signs of a heart attack. There are several types of a heart attack, from severe to mild. A severe heart attack feels like the heart gets a big clap and squeezes. A mild heart attack feels like a small pain in the heart, one that you could easily forget (Beckerman, J., 2014) (Beckerman, J., 2015).

What is the risk?
After a couple of minutes the part of the heart, which these arteries lead to, are starved, they can't get any oxygenated blood. If the certain heart tissue is too long without oxygenated blood this part could die. The weeks after, this tissue, becomes scar tissue (Beckerman, J., 2015) (Zafari, A. M., 2015).

Procedure
When a heart attack is suspected, they offer you a couple of treatments. Aspirin to prevent further clotting of the blood. To improve blood flow and reduce the workload of your heart they provide Nitro-glycerine. Another option is oxygen therapy, which will provide the body of extra oxygen. When the diagnosis of myocardial infarction is confirmed, there will be a procedure of trying to get the blood flow smoothly again. This could happen through angioplasty or clot-busting medicine. These medicines can dissolve blood clots. If the heart attack is severe and your heart stopped beating, first aid will try to defibrillate. After this they will get to the 'normal' procedure (National Heart, Lung and Blood institute, 2015).

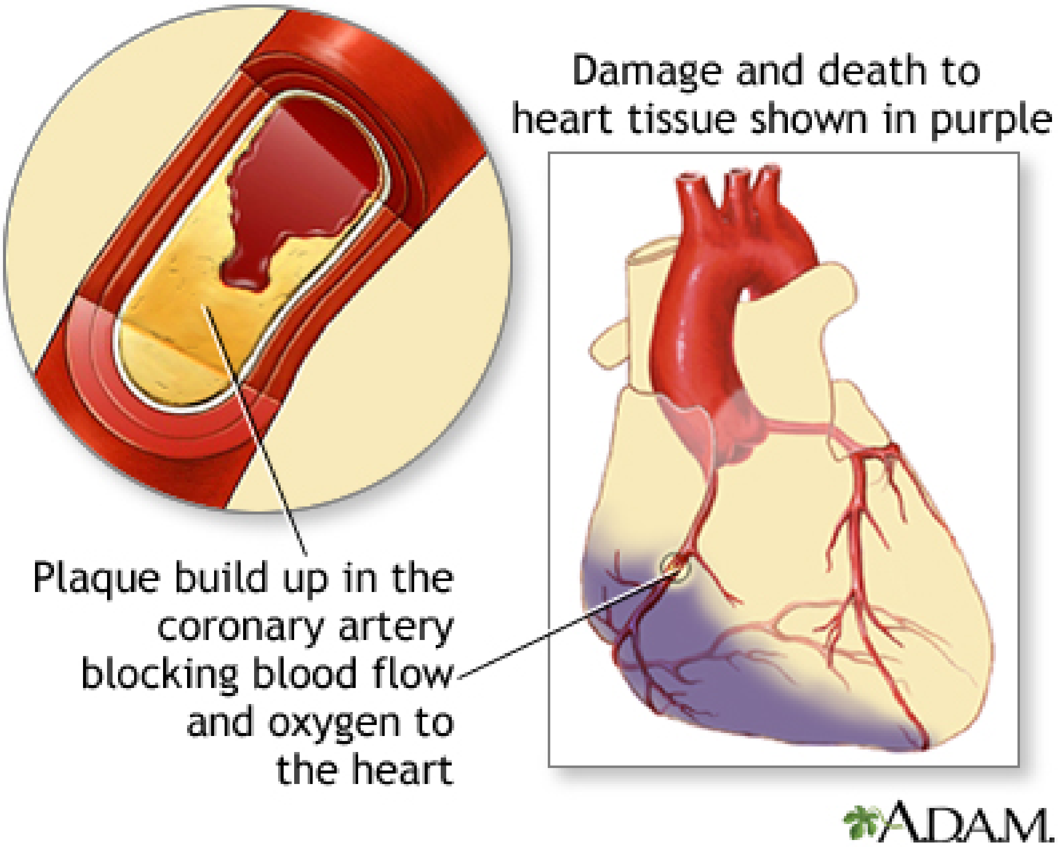

Figure A.3. Plaque blocking blood flow (Source: MedlinePlus.(unknown) Heart Attack. Consulted on 02-10-2015, https://www.nlm.nih.gov/medlineplus/ency/images/ency/fullsize/17004.jpg)

B. PERSONAS

Persona 1 Arrhythmia (pacemaker, ICD)

Basic personal information

Name: Karin van Harten

Gender: Female

Age: 40

Profession: teacher biology

Medical Information

Disease: Pacemaker

Medical history: None

Reason for a pacemaker was because of fluttering (too fast heart beats).

The increased blood pressure was caused by a lot of serious stress about her divorce.

Just arrived home, back from the operation in the hospital.

Medicine: None

Smoke: No

Environment

Living condition: Healthy, not that social, financially fine,

Social life: Divorced, two young children of 11 and 14(girls)

Hobbies: Running, making music, cooking

Sports: Running

Attitudes

Character: very sweet, structured

Dislikes: Depending on others, reading

Needs: She needs emotional attention. She needs something that can give her a comfort feeling, like medical support.

Beliefs: Thinks the world is a better place if everyone gave more attention to a healthy lifestyle. The government has to support health care a lot more

Personal Life Goal: To become 100 years old

Experience Goal: Become aware of how to live with a pacemaker.

Persona 2 Atherosclerosis (plaque, dotter, stent)

Basic personal information

Name: Henk van Vijn
Gender: Male
Age: 78
Profession: Pension

Medical Information

Disease: High cholesterol (plaque), he needs a dotter procedure.
Medical history: 6 weeks ago he got pain in his hart. After a visit to the doctor, he was forwarded to the hospital that highly recommend to has a surgery for a dotter procedure.
Medicine: None
Smoke: Sometimes

Environment

Living condition: small apartment together with is 70 year old wife.
Social life: Once a week he has a day with his 2 grandchildren, one night he play darts with his friends and further daily things with his wife.
Hobbies: Watch soccer and playing darts
Sports: Likes to walk (half an hour) with his grandchildren to the playground.

Attitudes

Character: Helpful but impatient
Dislikes: Being told what to do, smart devices
Needs: Control to take his medicines, control to eat healthy and someone that motivates him to go sporting.
Beliefs: Thinks smart devices are nonsense
Personal Life Goal: To live a happy life for the years he has left and to see his grandchildren grow.
Experience Goal: Get a little bit more healthier with more sporting and eat less salt in his food.

Persona 3 Myocardial infarction (heart attack)

Basic personal information
Name: Linda
Gender: Female
Age: 53
Profession: Housewife

Medical Information
Disease: Myocardial infarction, hypertension, obesity
Medical History: Had first myocardial infarction six months ago.
Medicine: Aspirin as medication for secondary prevention.
Putting pill box in kitchen so she can see it whenever she has meal. Seldom forgets to take medicine.
Smoking: Yes but quit after first myocardial infarction

Environment
Living condition: Living in an apartment with family(Husband, and two children who are college students).
Social life: Family, and a few friends, siblings.
Hobby's: Watching series, chatting, cooking.
Sports: Does not like strenuous exercises but takes walking for 30 minutes at least three times a week.

Attitudes
Character: Discipline, caregiving
Dislikes: Appointments that are been broken
Needs: Emotional support
Beliefs: God and love will make your life complete
Personal life goal: Lives happily with her family and helps other people as much as she can.
Experience goal: Hope to get emotional support and get information about hospital more easily.

Recourses:

Lowdermilk, T. (2013). User-centered design (1st ed.). Sebastopol: O'Reilly Media.

C. REHABILITATION NURSE INTERVIEW

Interview with Ank Brekelmans

According to the process of a patient going through the cardiac rehabilitation program, the timeline is divided into five main parts: explaining the cardiac rehabilitation program, before intake-interview, intake-interview, during the program, after the program. The interview focuses on understanding how nurses lead patients through the process, what tools do they use now, how do they classify different types of patients and how they give advices.

Explaining the cardiac rehabilitation program

1. What do you mention when you explain the program to patients / relatives?
2. What tools do you use while explaining?
3. How do you explain the program to those patients who are not interested in the reha bilitation program?
4. Mostly who are not interested in the program? Elderly?
5. What are the common questions from patients while you explaining the program to them?
6. What do patients worry the most about the program?(Cost? Time? ?)
7. How long does it take to explain the program to a patient?
8. Usually does it take longer while patients come with their relatives?
9. What do the relatives of patients usually ask or say in the meeting?
10. Is there any difficulty to set an intake- interview with patients?
11. What are the reason patients don't want to join the program?
12. Will you contact those patients again? When?

Before intake-interview (After patients agree to join the program)

1. What do you do between the meeting and the first-time intake-interview? Do you need to discuss with doctor or other people?
2. Do you remind patients before the intake-interview?
3. What's the ratio of people canceling the intake-interview? Who are the patients?(Age, disease)
4. If patient doesn't show up in the interview because he/she change his/her mind or under psychological stress, what do you usually do?

Intake-Interview

1. How do you translate the questionnaire and categorize different types of patients?
2. What's the process for you to give advices to patients?
3. What are the things of patients you take into account while giving advices to patients?

During the program

1. How many times the patients should go to the hospital?
2. How do you help the patients who are older, less-mobile to travel to the hospital?
3. Is it often that older patients go to the hospital with their kids?
4. What's the process of every program?
5. How do you encourage patients to talk about his/her health condition?
6. How do you help patient to remember his/her daily life(diet, exercise,...)?
7. How often do you contact with patients(why/when/how/what?)
8. If patients has any problem, how do they contact you? And normally what's their questions?
9. How to give feedback and explanation why and how certain activities or consumables have an impact on patients health who do not have enough comprehension. Is it instant?
10. What are the difficulties of doing this?
11. Do you give any brochure to patients for them to check when they have questions about diet, exercise and disease after they go back home.

After the program

1. How do you give continuous emotional support and health advice after the program?
2. After the program, is there any way for you to track patients health condition and if they change their lifestyle or not?

Resources

Lowdermilk, T. (2013). User-centered design (1st ed.). Sebastopol: O'Reilly Media.

D. CODES

The codes of the web service and the trigger device can be found in the following link:

https://drive.google.com/folderview?id=0B9xojihUno91VDZaS3ozdFBwRmc&usp=sharing

E. TRIGGER ELECTRONIC CIRCUIT

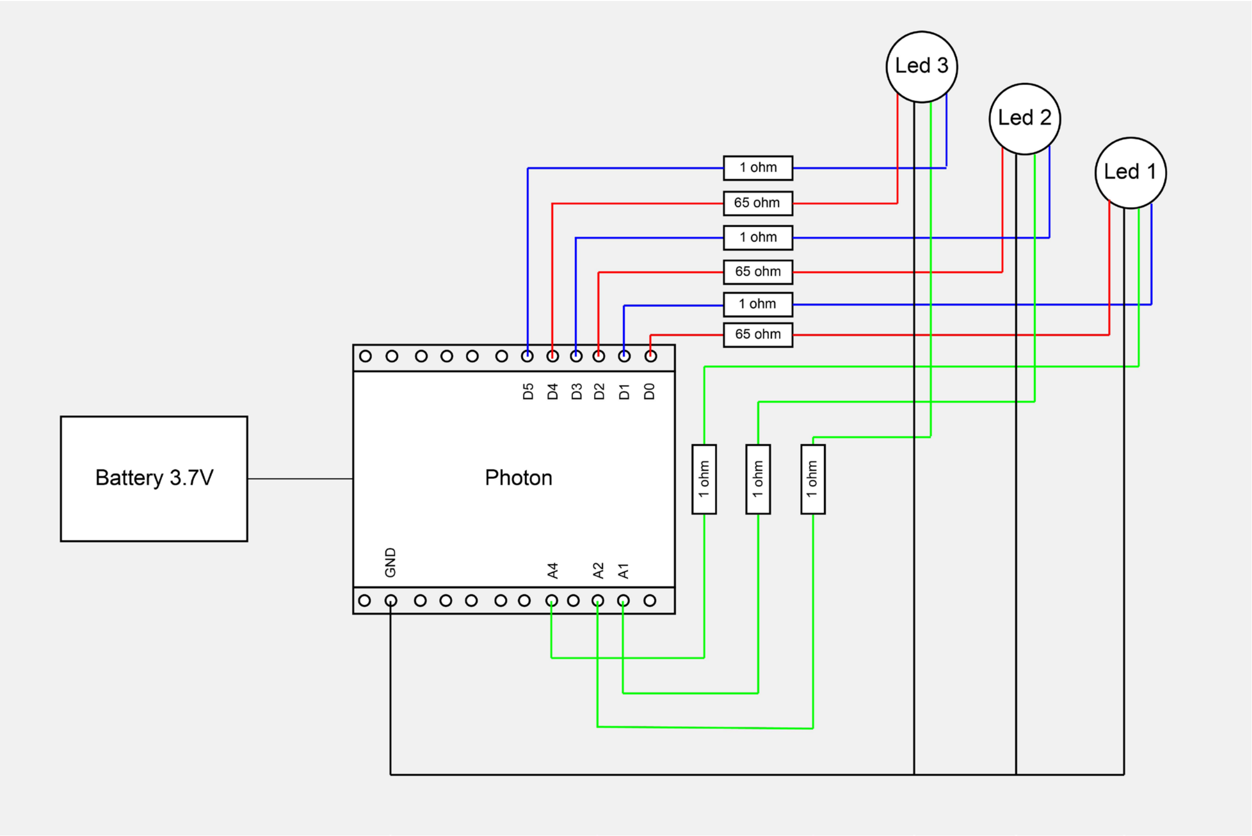

Figure E. This is the circuit we made for our trigger device.

F. SYSTEM DATA FLOW WITH STAKEHOLDERS

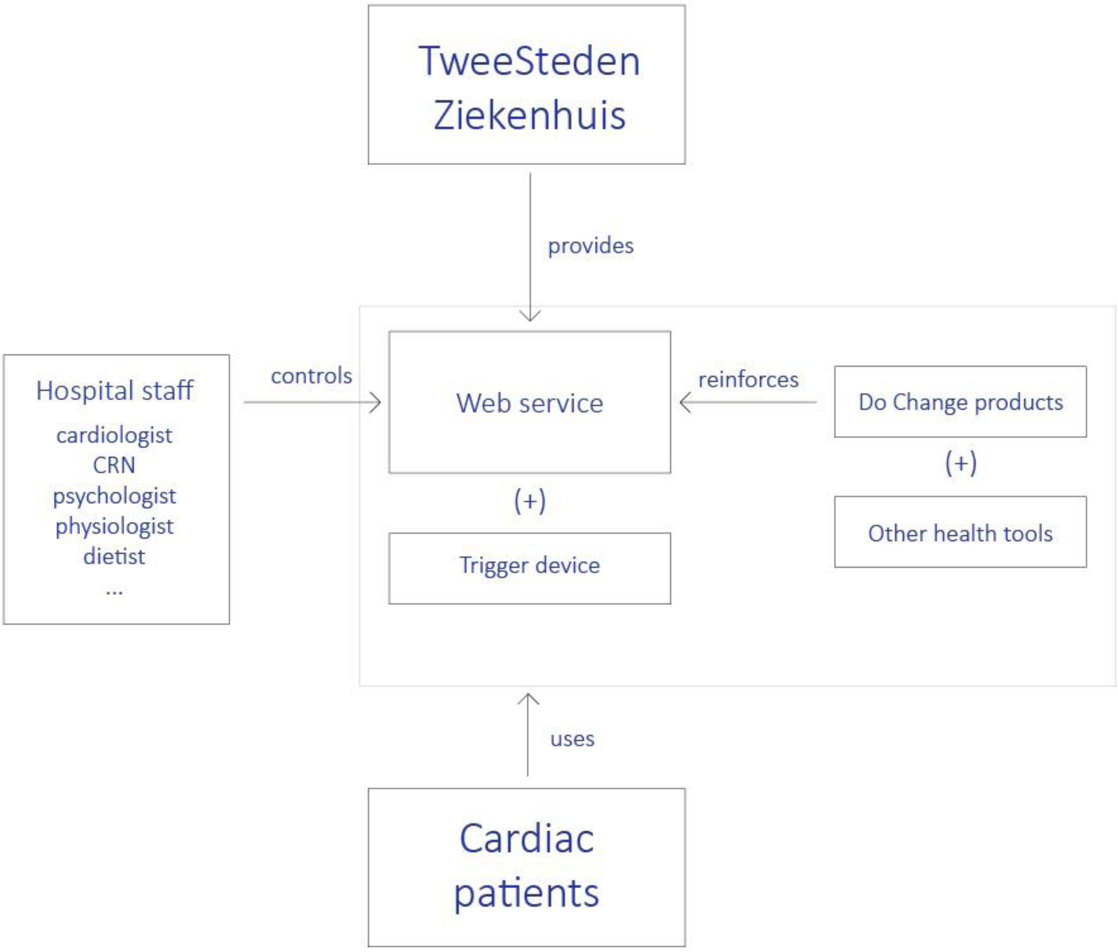

Figure F. This is the system data flow with the stakeholders.

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