Contextual information sharing in patient referrals

Facilitating implicit information exchange in interdisciplinary communication.

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Executive summary

Introduction

This Strategic Product Design master thesis aims to find a solution to the problem of ill fitting care trajectories that result in overtreatment, higher costs and negatively impacted health outcomes. This project was created with the recently founded Reinier Haga Orthopedic Center

Literature and Field studies

To understand the problem and identify solutions, research studies were conducted.

A literature study identified potentials solutions, tt also provided insights into the condition of knee arthrosis and how healthcare is currently organised.
Two field studies were also done.
The first were interning sessions that provided additional knowledge on the organisation of the healthcare.
The second were interviews with patients and treatment providers which, resulted in an understanding of what patients and medical professionals miss in the organisation of the care trajectory.

Design goal

From the literature and field studies came that a cause for the problem is the interaction between stakeholders. Information exchange between the medical professionals was chosen as the design problem. As a lack of information about a patient as a whole explains the ill fitting care trajectories. The missing information was identified as implicit contextual patient information. This often left out of the referral and can not be used when making the treatment decision. Based on the above, a design goal was formulated:
Enabling easier sharing of contextual patient information between the GP and the OS in the initial referral

Creative process

A co-evolutionary creative process was used to create a solution. This was heavily influenced by the COVID-19 outbreak, resulting in more validations with the client rather than large stakeholder sessions.

CICS

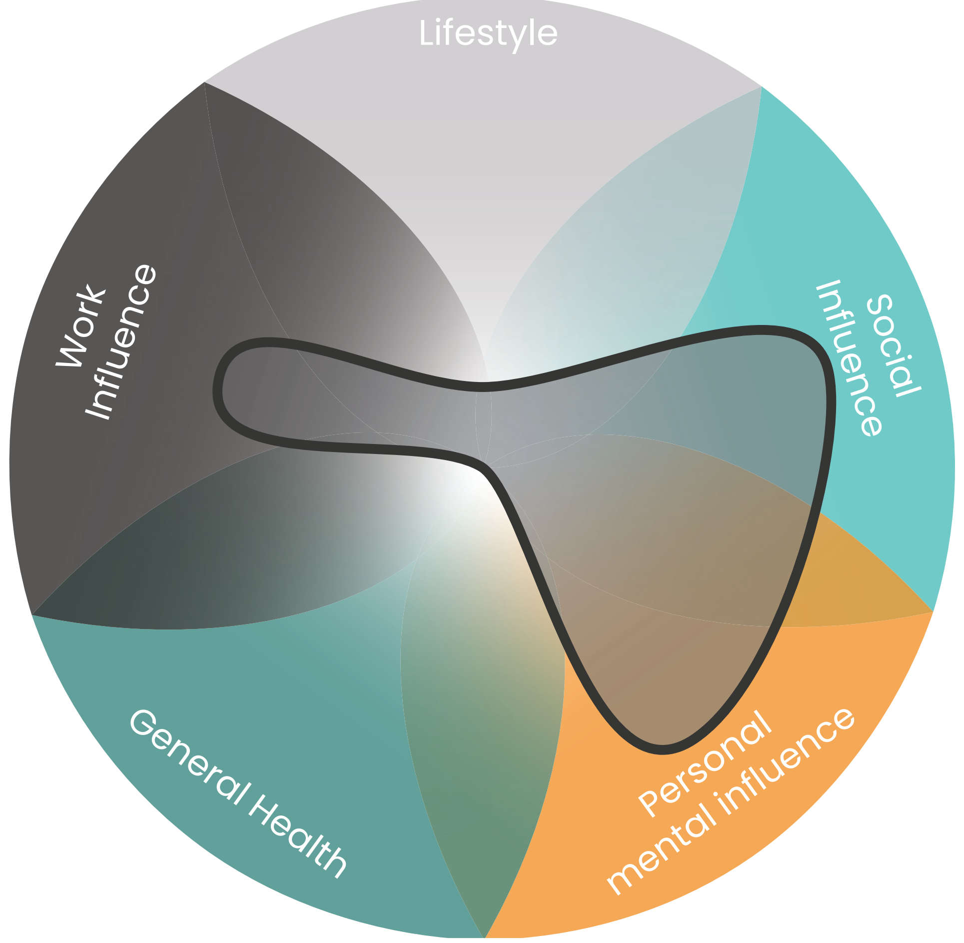
The result is the Contextual Information Communication System (CICS). CICS consists of the Contextual Sharing Tool (CST) and the requirements for its functioning.
The CST is a visual tool that enables fast capture and review of contextual patient information by the GP. The GP uses it by setting 5 points for the respective information rubrics along an axis that indicates the significance of that rubric for a patient.
This CST gets shared with the orthopedic surgeon, together with the textual referral. It does not provide him with the detailed information, but with an overview of significant information rubrics. The surgeon uses this impression to direct their anamnesis during patient consults. If the consult has not resulted in an explanation of the CST, there is an opportunity to clarify it with the patient's GP in a conversation.

Evaluation

Evaluation was done, to validate the design. From this evaluation came that the CICS did indeed meet the design goal.
Points of improvement were also identified among which the usability of the current visual design and the need for education on how CICS should be used.

Recommendations & Implementation roadmap

To provide the orthopedic center the next steps in CICS development, a recommended implementation roadmap was created. This roadmap shows the steps necessary to reach three defined horizons:
The start of a CICS pilot
Full CICS implementation in the knee arthrosis trajectory
Expansion of CICS to other care trajectories.



A filled in contextual sharing tool

Glossary

This glossary serves as a reference for the abbreviations and terms used throughout this thesis.

- Anamnesis - Information gained by a physician by asking specific questions,
- CICS - Contextual Information Communication System; the name for the final concept developed in this thesis.
- CST - Contextual Sharing Tool; the name for the visual tool used to capture and review contextual patient information within CICS
- GP - General practitioner: doctor in the first line of care that treat acute and chronic illnesses and provides preventative care
- Hollistic - Dealing with or treating the whole thing, instead of a part. Within the medical context: taking into account mental and social factors,rather than just the symptoms of a disease.
- MCN - Managed clinical network; A network of treatment providers organised around a single condition or patient.
- OC - Orthopedic center, within this project reffering to; Reinier Haga Orthopedic Center
- OS - Orthopedic surgeon; doctor that is specialised in diagnosing and treating conditions of the muscoloskeletal system.
- PREMs - Patient Reported Experience Measures; Means that measure the patients' perceptions of their experience whilst receiving care, often in the form of questionnaires.
- PROMs - Patient Reported Outcome Measures; Means that measure the patients' views of their health status, often in the form of questionnaires.
- VBHC - Value Based Healthcare; Healthcare system that bases the value of care on the health outcomes of the patients, instead of on the performed treatments.

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Introduction 1

Introduction

This report is a Strategic Product Design graduation thesis. Strategic Product Design is a Msc program of the Industrial Design Engineering faculty of the TU Delft. The focus of this master is on the business and development context around physical or service designs. It is often described as the specialism that identifies which new opportunities for a business are viable and what a manifestation of this opportunity should look like in conceptual form. This means finding new opportunities and creating a conceptual design that provides the maximum value of this opportunity to all stakeholders. In short, Strategic Product Design allows for the creation of win-win scenarios for all stakeholders.

1.1 Thesis Topic

The main aim of this SPD master thesis is to promote more holistic orthopedic care, by enabling efficient sharing of contextual information between medical professionals in different lines of care. This first chapter will explain why this is relevant and in what context this thesis was conducted. Furthermore it will outline the general approach taken towards the creation of the final design.

1.2 Project Context

In 2017 almost 900.000 people visited an orthopedic surgeon in The Netherlands (Nederlandse Zorgautoriteit, 2019). Almost 70% of these visits were made by people over 45 years of age (Centraal Bureau voor de Statistiek, 2019). With the aging demographics in The Netherlands (Centraal Bureau voor de Statistiek, 2018), the number of people in need of orthopedic care will likely only increase. With already a current total yearly cost of €1.300.000.000 (Nederlandse Zorgautoriteit, 2019), financial pressure will grow to very high levels. As well as the work pressure due to a growing shortage in medical professionals (Ministerie van Volksgezondheid, & Welzijn en Sport, 2018).

This scenario is very likely and is already acknowledged by the Dutch government. To avoid a situation in which waiting lists are years in length, measures are being taken. The Dutch government is stimulating a transition to a more value based healthcare system, to allow for a reduction in costs while improving healthcare outcomes. New systems and organisation styles are being developed and tested. In short, there are many developments that aim to make the healthcare industry more efficient and therefore less expensive.

One of the many developments is the creation of the 'Reinier Haga Orthopedisch Centrum' (orthopedic centre). This centre is designed to be the main orthopedic clinical and polyclinical location for three large hospitals in the region:

the Reinier de Graaf hospital in Delft
the Haga medical centre in The Hague
the Langeland hospital in Zoetermeer

The new orthopedic centre, which from here on out will be referred to as OC, is located near the Langeland hospital. This location was chosen because it allows for the OC to make use of the specialist and equipment of the Langeland hospital if complications during treatment arise.

The creation of the OC results in the merger of the orthopedic care departments of the three hospitals allowing for better specialization, knowledge sharing and research. For the latter category, this constitutes not only medical research, but also system and organisational research.

Innovation for the OC

To promote innovation in the OC a group of stakeholders was brought together during multiple 'Dream Dinners'. These dinners were sessions were the future of orthopedic care was discussed and ideated on through brainstorms. The background of the involved stakeholders was varied, for example: general practicioners, physiotherapists and patient organisations.The Dream Dinners occurred on a regular basis, each time working towards a more concrete and implementable forms of innovations. In parallel with these sessions, this graduation project started.

Project stakeholders

The most directly involved stakeholders for this project were the orthopedic surgeons, or OS's for short, directly employed at the OC. They are responsible for both poly clinical consults as well as surgeries. This puts them at the helm of the patient's care trajectory.

The medical activities of these OS's are consulting with patients, during which they take patient histories, perform physical exams and do check-ups on patients during or after their treatments. They also perform surgeries that are related to repairs of traumas or joint replacements.

Next to the OS, medical professionals such as general practicioners (GP's), physiotherapists, revalidation staff and nursing staff are involved in orthopedic care trajectories and have therefore a small involvement in this project. All of these medical professionals play a vital role in enabling the OS to reach the correct diagnosis and carry out a fitting treatment.

A crucial stakeholder is the patient itself, as they are the sole reason for the existence of the healthcare providers. Others stakeholders are hospital administrative staff, informal caregivers and family.

1.3 Problem Description

The problem that OS's perceive, is a small number of patients for whom no fitting care trajectory can be found. These patients bounce between their general practitioner (GP) and OS without coming to a well fitting care trajectory and therefore health outcome.

As a side effect large expenses are being made to give the patient treatments that are either not effective or not necessary.
Through conversation with the OS's, it became clear that what the OS's experience is a symptom of a larger problem that is at the center of this project:

The provided care does not fully match with the patient as a whole. Therefore overtreatment or the initiation of the wrong treatment can occur. This leads to longer care trajectories until the desired outcome is achieved, causing higher healthcare expenses and reduced health outcomes for the patient.

Potential solutions
During the previously mentioned Dream Dinners, one innovation that came forward as a potential solution to the ill-fitting care, is networked care. This healthcare system promotes a stronger interaction and integration between the different medical professionals and organises them around a single patient.

The theory goes that this allows the patient to receive the care that fits best with them as a whole.
Networked care is a very interesting development, but up until now only a handful of networks have been implemented. Currently the Dream Dinner sessions focus on how networked care can be implemented in the OC context.

1.4 Project Boundary

In healthcare, a practical way to set boundaries for a project is to focus on a specific condition. Based on statistical research conducted before the kick-off of this project, it was concluded that the condition of knee arthrosis was the most interesting to focus on. For elaboration on this please consult appendix A.

The conclusion of the research can be summarised in the following points:

- Knee arthrosis is the most yearly diagnosed condition within the orthopedic specialism;
- Nearly 20% of all diagnosed knee arthrosis patients undergo knee replacement surgery, which is the most expensive treatment per individual in the orthopedic specialism;
- Even though only 20% of all patients undergo knee replacement surgery, the high cost offsets the less expensive care trajectories of the other 80% of patients. Resulting in it being the condition with the highest yearly expenses costs in the orthopedic specialism.
- The treatments for knee arthrosis are the most costly on a yearly basis compared to other conditions, predominantly due to the high cost for a total knee replacement.
- Research has indicated that only 22% of all patient that receive a total knee replacement, rate the result as excellent. With 71% of patients reporting the procedure as an improvement (Choi & Ra, 2016).

The conclusion drawn from the facts above is that knee arthrosis is a condition that has significant impact on the overall costs of orthopedic care. And while only a small group of patient undergo total knee replacement treatment, the financial impact of their treatment is high. Even if this treatment is successful in medical terms, the patient satisfaction is only moderate.
This means that improvements in patient health outcomes for the condition of knee arthrosis could lead to a reduction in care trajectory length. This in turn could lead to a more efficient use of the healthcare resources and therefore a reduction in healthcare costs. This in turn helps to contribute to solve the larger societal problem, which was described in section 1.3.

1.5 Role for Design

During the set-up of this project, it became clear through conversations that the creation of a solution to the problem, as described in section 1.3, can not be achieved from inside the healthcare industry alone. There are a number of reasons for this, but the most significant are pillerasation of the healthcare system and financial motives.
The lines of care organisation of the Dutch healthcare system has resulted in physical distance between different medical professionals like the GP and the OS. This has contributed to a distance that has been created between them. This makes the start of cooperation between them difficult, especially when you take into account the time pressure under which medical professionals are.
There is also a financial factor; some stakeholders in the current medical processes are making large financial gains within the current system. These stakeholders are not motivated to change this system, as it might negatively impact their finances. This can also lead this group to actively hinder the development of a new system.
A design approach will aid in finding a solution to this problem through creation of a multidisciplinary approach. This approach is created by involving all stakeholders with the use of different design methods. This is where strategic product design comes in, as interaction with multiple stakeholders and promoting the creation of a solution that bennefits all stakeholders is at its core.
In this way strategic product design can help to bridge gaps and promote cooperation in finding a solution to the problem.

1.6 Approach

The main structure for this approach is based on the double diamond model (Design Council, n.d.). This model has two differentiable sections in which a diverging and converging phase take place. The 'first diamond' contains the exploration of the project through literature and field studies in the diverging phase. During the converging phase a design vision is created and more concrete design goals and criteria for the project are formulated.
The 'second diamond' contains the creation of the final design. Starting with the application of creative methods to create as many design ideas as possible during the diverging phase. At its widest, a selection of ideas starts to take place based on the criteria formulated at the end of the first diamond. During the converging phase of this second diamond, the design will be developed further into a more concrete design proposal. This proposal is the end of the design process within this project.
In addition to the regular double diamond model, a third diamond was added for this project. This third and final 'diamond' contains the evaluation and recommendation steps. These are final steps to validate and evaluate the design proposal and then distil the result of this into recommendations for future iterations of the design proposal.

Important to note is that the exact approach for the second diamond can only be determined after the design problem and goal are defined. This because the creative process approach should have a fit with the type of design problem and goal that are formulated. For example a well-defined problem allows for the creation of solutions that are correct and knowable, which could be reached through a more linear design process. A ill-defined problem however presents with conflicting opinions and different solutions (Schraw et al., 1995). Therefore a more co-evolutionary approach as described by Dorst and Cross (2001) could be adopted, because it allows for the development of both problem and solution simultaneously.
The same reasoning applies to the exact approach for the third diamond. As the evaluation and recommendations methods are decided based on the type of final design that is produced.

A visual representation of the total approach is depicted in figure 1.1. Note that the color saturation of the diamonds indicates the certainty with which an approach can be formulated at this time.

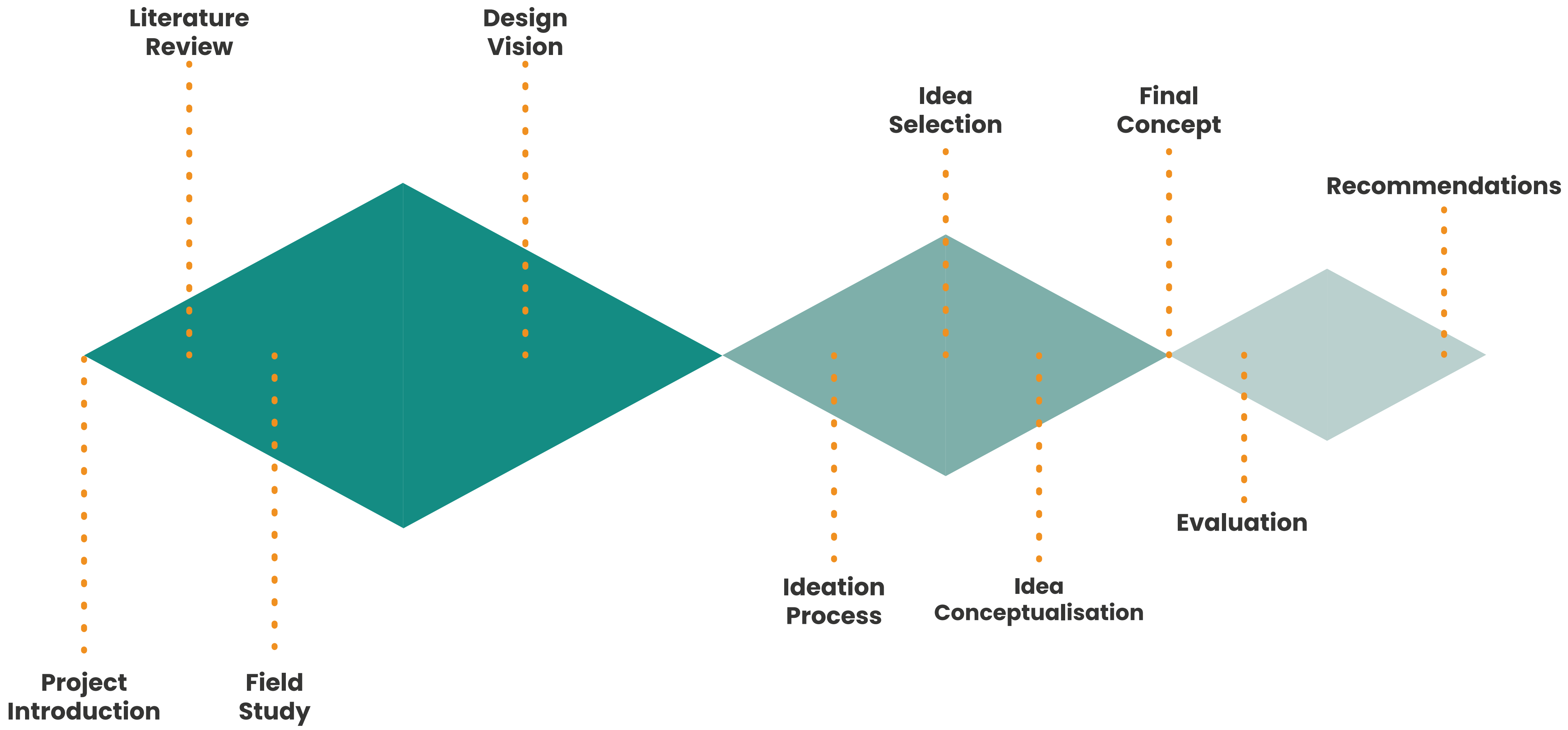


Figure 1.1, Project approach

Literature

2

Introduction

This literature study provides information on the following topics:

- Macro developments in healthcare
- The condition of knee arthrosis
- Value base healthcare
- Networked care
- Interaction between medical professionals

The relevance of these topics differs per topic. The topics of knee arthrosis and networked care are already introduced in section 1.4 and 1.3 of this thesis and are therefore necessary to explore further. The macro developments provide background information about the future context for the design, and are valuable to explore. One of the largest developments is value based healthcare, diving deeper into this can provide useful insights into its popularity and whether it is useful to solving the problem as described in section 1.3. The final topic is the interaction between medical professionals. As improved interaction is at the core of what the dream dinners are trying to achieve, it is useful to look at the current system in place for interaction between medical professionals.

2.1 Macro developments in healthcare

There are a lot of developments that are shaping the healthcare industry of the future. As some of these could be potential (partial) solutions to the problem that this thesis is attempting to solve it is important to dive deeper into them. This deeper literature review can be found later in this chapter.
Other developments provide an insight into the future context of healthcare. They do not warrant further research, but can serve a purpose in setting criteria for the final design to confirm to. These criteria will be formulated at the end of the 'first diamond' and can be found in section 2.4 of the report. For this development analysis, the DESTEP method is applied. Using this method ensures that all main fields of trends are examined (Boeijen et al., 2014, p.59).

Demographic developments

The Netherlands currently has an aging population. The amount of citizens with an age of 65 and above is expected to rise from 19,2% in 2019 to 26,2% in 2040 (Centraal Bureau voor de Statistiek, 2018).

As will be explained later in section 2.3, arthrosis is a condition predominantly caused by wear and is therefore more likely to manifest at increased age. Due to the aging population, the number of arthrosis patients is expected to rise significantly. The current prognosis is an increase of 92%: from 1,2 million patients in 2015 to 2,3 million patients in 2040 (Rijksinstituut voor Volksgezondheid en Milieu, 2018b).

As a result of this significant increase, the pressure on medical professionals treating arthrosis will skyrocket. Without preventive measures this will most likely cause less time to be available per patient. It is not hard to imagine that this won't help the problem of ill-fitting care.

Economical developments

At present, the healthcare labor market is stretched thin, leading to higher workloads on current personnel. This shortage occurs on multiple levels and specialisations within the healthcare industry and will probably increase further with the increased demand for healthcare (van der Aalst, 2019).
This rising healthcare demand is likewise noticeable in the amount of financial growth in the sector. In 2020 the entire healthcare sector is expected to experience more growth than the Dutch economy as a whole, 2,5% and 1,5% respectively (Dantuma, 2019). Most of this growth comes from care for the elderly. Specialized medical care has grown 1,1% from 2017 to 2018 (Dantuma, 2019). However, due to legislation (see: section 2.2 p.7) the room for future growth in this area is limited.

Another important development is the attempt at implementing Value-Based Healthcare. This new economic system for healthcare links financial income for healthcare institutions to their patient treatment outcomes (Porter, 2010).This is in contrast with the current system, where income for the healthcare industry is based on the number of performed treatments, regardless the outcome. Further elaboration on this development can be found in section 2.4 of the report.

Socio-cultural developments

One of the main developments in socio-cultural context is the increased loneliness and isolation of the population. Currently 5,2 million Dutch inhabitants experience loneliness. This number is expected to grow to 5,9 million by 2040 (Rijksinstituut voor Volksgezondheid en Milieu, 2018a). This increase would lead to 41% of the Dutch population to suffer from loneliness .

It is important to note that this increase is only caused by the increase in the number of moderately lonely people. The amount of people suffering from extreme loneliness is expected to remain at current numbers. Part of the reason for this growth is the expected rise in the number of one-person households, which are linked to higher rates of loneliness (Rijksinstituut voor Volksgezondheid en Milieu, 2018a). In light of this project, this development indicates that these kind of socio-psychological conditions occur in more people than one might assume. It is possible for loneliness or other conditions like it, to have a negative impact on the healthcare outcome of a knee arthrosis treatment. This is further elaborated on in section 2.5 of the report.

Another relevant socio-cultural development is the increased role of patients within their healthcare. Due to technology, like the Google search engine which makes basic medical knowledge more accessible, patients are now able to quickly gather information about their illness(es) and share their experiences with others. This has allowed them to gain more insight into their illness(es) and has given them the potential become director of their healthcare (Gerads, 2010).

Especially in the parts of the process before diagnosis and after the initial treatment, the patient can have a directive role. In the period between diagnosis and treatment emotions in the patient tend to be strong causing a shift in the directive role from the patient to the medical professional (Gerads, 2010).

Technological developments

The number of technological advancements within the medical industry is continuously rising. These advancements are expected to lead to more independence for patients, the need for less medical personnel, higher quality of care and cost reductions (Peeters et al., 2013).

One of the most prevalent developments is eHealth. This covers a number of different smaller innovations that use information and internet systems to enhance and support healthcare. Peeters et al. name examples like online medical files that the patients themselves can view, but also ways to digitally communicate with medical professionals.

A similar innovation is telemedicine. This allows for the remote prevention, diagnosis and treatment of medical conditions. It uses technological aids to allow patients to test themselves and send the data to the relevant medical professional.

The main thing these developments have in common is that they allow the patients to monitor themselves or be monitored at a distance, foregoing the need for a physical visit to a medical professional.

Ecological developments

Like nearly all other industries, the healthcare industry is moving towards a more sustainable future. To accomplish this, initiatives like the 'Green Deal Zorg' are set-up (Vereniging Milieu Platform Zorgsector, z.d.). These initiatives are set up to work towards the following goals:

Political developments

As healthcare is the second largest expense for the Dutch government (Ministerie van Algemene Zaken, 2019), they also actively participate in deciding what the future healthcare system should look like.

One of the major pieces of legislation around healthcare is the 'Hoofdlijnenakkoord'. In this document the course for Dutch healthcare industry between 2019 and 2022 is described (Ministerie van Algemene Zaken, 2018). One of the crucial decisions in this document is the complete halt of the cost increase of specialist medical care. This means that the expenses for the medical specialist care are not allowed to increase at all by 2022.

- Reducing CO2 emissions
- Promoting circular working
- Reducing medicine waste in water- and sewer systems
- Creating healthy environments in and around medical locations

(Rijksinstituut voor Volksgezondheid en Milieu, z.d.)

Coronavirus

During the project, the virus SARS-CoV-2 broke out. It caused a pandemic that has an immense effect not only on healthcare, but also on society as a whole.

For healthcare it meant that the work pressure rose to extreme heights. Additional IC units needed to be created and staffed for the treatment of people suffering from COVID-19 (the disease caused by the SARS-CoV-2 virus). Massive support for the healthcare personnel arose from across society. At the moment of writing, there is no real indication of what this crisis will mean for the healthcare industry in the long term. It is clear however that it will have an impact on how care will be organised in the future.

Society itself is also forced into making quick alterations to normal day-to-day life. Due to the measures taken to prevent the spreading of the disease, all Dutch inhabitants have been requested to work from home and maintain a distance of 1.5 meters from other people when venturing outside. Visiting elderly relatives in nursing homes has been forbidden, as the elderly are particularly vulnerable to the disease. The prognosis is that after this initial period of the so-called 'intelligent lockdown' a new '1.5 meters economy' needs to be set up. This means that the rule of 1.5 meters distance must be ingrained in the way society behaves, at least until a vaccine is available.

The result of this forced alteration is an increase in the use of videoconferencing services to replace face-to-face meetings. This also applies to the regular healthcare services like orthopedics. The current development is that nearly all poly clinical consults are done using video conferencing software.

These developments also have an impact within the scope of this project. It could very well mean that it becomes much harder for OS's to get a picture of the patient as a whole due to lack of actual face-to-face contact with the patient; only having phone calls or video conferences as a way of communicating.

2.2 Knee arthrosis

The scope of this project is the care trajectory for knee arthrosis. Therefore it is highly relevant to investigate what knee arthrosis is, how it is treated and how it impacts the lives of people suffering from it. The aim is to create a better understanding of what the care trajectory might look like and what the impact of the condition is for the patient.

What is knee arthrosis

Arthrosis or osteoarthritis is a condition where the cartilage, that normally allows smooth motion of the joint, wears down (Centers for Disease Control and Prevention, 2019). This causes the underlying bone to change. The result is a joint that is difficult and painful to use. When the condition is severe enough, it can prevent regular activities and interfere with daily life. Arthrosis that is located in the knee joint is called gonarthrosis.

Who gets knee arthrosis

As arthrosis is a condition predominantly caused by wear, the people who get it are almost always older than 65 years of age. The speed at which cartilage is replaced by the body slows down as a person ages. This leads to a situation where it wears away faster than it can be replaced by the body. Thus making the elderly more susceptible to developing arthrosis.

Other people at risk of arthrosis are those with jobs that require a lot of hard physical labour. This can cause excessive wear on the knee joint and thereby speed up the development of arthrosis.

This also applies to overweight people; there is a strong link between obesity and the development of arthrosis (Centers for Disease Control and Prevention, 2019).

Diagnosis and treatment

The diagnosis of knee arthrosis is made through a combination of a radiological studies (i.e. X-Ray), a physical exam and an anamnesis. The latter are usually done by an orthopedic specialist during a consult.

After the diagnosis, a fitting treatment plan needs to be made. This is based on the impact the arthrosis has on the daily life of the patient and what is medically fitting with the progression of the condition.

Most of the time the first step is to increase physical activity, to stimulate cartilage regrowth and reduce pain. This is often done through guided physiotherapy. In case of obesity, losing weight is a good starting point for the treatment. Reducing body weight will reduce the stress on the knees and can thereby reduce complaints.

Depending on the level of pain a patient is experiencing, painkillers can be prescribed to allow them to conduct their regular daily activities with reduced pain.

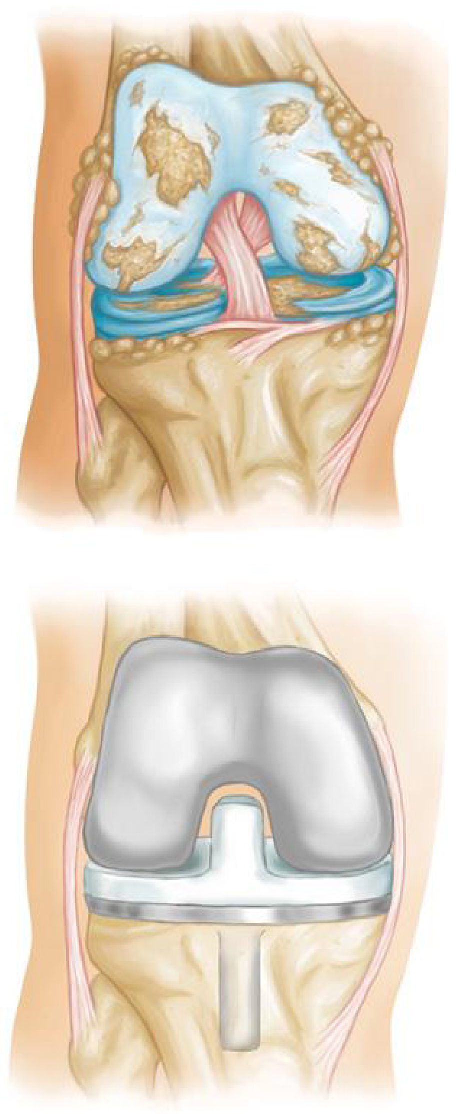


Figure 2.1,
Knee arthrosis before and after prosthesis

For some patients a faster and stronger method of pain relief is needed. In this case, the orthopedic specialist can give corticosteroid injections into the knee. This counters inflammation in the joint, reducing pain and swelling. The downside to this is that these injections only help with short term symptom relief. Within 3 to 4 weeks the joint will get inflamed again due to the irritation caused by the damaged cartilage. (Zorginstituut Nederland, 2019).

Surgery

If the arthrosis causes extensive impact on the daily life of the patient and other treatment options prove ineffective, a surgical option is available.

For the knee there are two types of surgery: the total knee replacement and the unilateral knee replacement.

In a total knee replacement, the entire joint is replaced with prostheses. This prosthetic joint is made up of three parts:

- A metal replacement for the femoral part of the joint
- A metal replacement for the tibial part of the joint
- A polymer insert that allows for smooth motion within the joint

In some cases a patellar prosthesis is added if the patellar cartilage is also heavily damaged by the arthrosis.

A unilateral knee replacement has the same amount of parts that serve the same functions as in the total knee replacement,. The difference is that they only replace one half of the joint, leaving the other half intact. The surgery for both types of prosthetics is nearly identical.

During the procedure, the patient is placed under either general or spinal anesthesia. An incision across the knee is made to provide access to the joint. Using a number of guides the bone is carefully shaped to fit the prostheses. The prostheses go through multiple testfits to ensure the right fit for the patient. Then they are cemented in the bone using a special medical cement, which promotes fusion of the bone to the prostheses. After the motion of the new joint is verified, the incision into the joint is closed.

It is often encouraged to start moving the joint as soon as possible after the surgery. At first the range of motion will be limited, but this will increase with time and physiotherapy.

Recovery

After surgery comes the longest, and for the patient the most intensive, trajectory; the rehabilitation period.

The total rehabilitation period can last anywhere from 6 to 12 months. During the first 3 months, the knee cannot be stressed too heavily. To facilitate this, the patient will use crutches for first 4 to 6 weeks. This is also the period in which the physiotherapist will help to restrengthen the muscles around the joint and increase the range of motion.

General activities and work can be resumed based on feedback from the patient. This is also dependant on the type of work activities. In some cases it can take up to several months before work can be resumed (National Health Service, 2017; Nederlands Huisartsen Genootschap, 2017).

Conclusion

Knee arthrosis is a complicated condition. Its severity strongly differs between patients and therefore so do their care trajectories.
The condition can also have an extensive influence on the daily lives of patients. Preventing them from participating in sports, work or even basic daily activities.

Different treatment options are available with a total knee replacement being the most drastic. Surgery usually halts any complaints, but is not without its downsides in the form of prosthetic wear and a long recovery time.

2.3 Value-Based healthcare

Value-Based Healthcare (VBHC) is a very hot topic even a decade after its conception. The benefits seem obvious, however the transition is difficult due to the large amount of stakeholders in the medical industry. Currently the transition is being incentivised by the government with cost limiting regulations for specialist medical care.

What is Value-Based Healthcare

Value-Based Healthcare is a concept of a healthcare system in which the main goal of the industry is to maximise patient value. This means that the patient value determines the financial compensation for the medical treatment.

Patient value is defined as the patient relevant medical outcome, divided by the costs of the procedures (Porter, 2010), also depicted in figure 2.1. Thus a high patient value can be achieved through improving medical outcomes for the same or a lower cost.

$$\frac{\text{Health outcomes}}{\text{Costs}} = \text{Patient value}$$

Figure 2.2,
VBHC formula

This differs from the current system where the number of treatments and their expenses are compensated, no matter the outcome for the patient. This could lead to situations where overtreatment can occur due to financial stimuli.

According to Porter there are 6 elements that need to be present to maximise the patient value:

- Organisation of care around a single condition or patient population
- A way to measure cost and outcome for each individual patient
- A link between financial compensation and patient value
- Integration of systems between different providers
- The spread of knowledge about health across a country
- An effective IT system

PROMs & PREMs

To measure the health outcome for the patient, two sets of tools are used; PROMs and PREMs.

The PROMs (Patient-reported outcome measures) record the vision of the patient on their current healthcare situation. They often take the shape of a questionnaire and cover subjects such as health-status, disability and quality of life. The completed PROMs are discussed with the treating medical professional and used in determining the next step in the care trajectory.

PREMs (Patient-reported experience measures) are also filled in by the patient and cover the experience and satisfaction of the patient with the healthcare provider. These are processed anonymously and used by the healthcare provider to improve the care they provide. (Kingsley & Patel, 2017)

Current implementation

The government is starting to see the value of the new system and is changing future regulations accordingly. Especially the total halt of allowed expense growth for the specialist medical sector is a strong incentive to look into turning away from the current system. This could lead to a broader implementation than is currently present, as it not yet the main system for the Dutch healthcare system.

Conclusion

The relevance of Value-Based Healthcare to this project is significant. It shows that the health outcome for the individual patient is the main value provider of the future. Focussing on potential solutions that maximise this factor, can help to solve the problem set in the introduction of the thesis. This is also why a next step is to look into methods or systems that focus on improving health outcomes for patients.

2.4 Networked Care

As stated in the trend analysis, networked care is seen as a solution with a large potential for solving current and future healthcare problems. It is also seen as a viable option to increasing patient value in a VBHC context. These two developments are strongly linked to each other and have gained popularity in the same period.

Definition

What networked care is, depends on whom you ask this question. Different organisations have implemented different types of networks within healthcare industries. These networks serve different goals and work in different ways. The main goal however, is always to provide better care for the patients.

The origin of these types of networked care lies in so called a managed clinical networks, or MCNs. Skipper (2010) defines these networks as follows:

“Managed clinical networks (MCNs) are self-supporting groups of professionals working together to ensure cross-speciality sharing of patients and expertise. They are a strong mechanism for ensuring that patients receive the care they need in a timely fashion from the most suitable professional in the network area” (Skipper, 2010, p. 241).

The first managed clinical networks were already formed at the start of the millenium. They were often based around a single condition or group of conditions, like coronary disease (Baker & Lorimer, 2000). These first renditions were formed in Great Britain after The Acute services wrote a review about them in 1998. Their definition of the managed clinical network included that the networks span over all lines of care from primary to tertiary care (Carter & Woods, 1999).

Since that time a lot of pilots and programs have been started with the goal of implementing networked care. This has led to many different implementations of networked care. Examples of this in The Netherlands are the ‘ParkinsonNet’ and ‘ArtroseNet’ networks. These networks allow for better transfer of medical knowledge between the medical professionals. This results in better treatment of a single condition like Parkinson’s disease.

The main way in which this works, is by ensuring that all members of the network share the same high level of knowledge. This requires special schooling before a medical professional is allowed to join the network. Then in cases where further expertise is needed, the network enables professionals to more easily find this expertise and apply it to their case (ParkinsonNet, n.d.). The benefits of these networks are closely linked to the VBHC pillar of spreading knowledge across geography.

Another take on networked care is the creation of a network consisting of different specialisations around a single patient. The Dutch federation for

Medical Specialists calls this ‘Networked Medicine’. It describes a situation where multiple specialisms are involved in the health trajectory of patient at the same time (Federatie Medisch specialisten, 2017). An example of this could be a case where next to the OS, also a physiotherapist and a lifestyle coach join in on the decision making process for the treatment.

The goal of this network is to maximise health outcomes for patients and thereby improve patient value. This is a strong link with VBHC.

To maximise these outcomes, the needs of the patients are at the center of the decision making process. These needs are identified through the information that the patient themself shares with the medical professionals. Most medical information can be pulled from an integrated information system, while information on the patient as a holistic entity comes mostly from the patient himself.

This type of networked care places a large emphasis on the interaction between patient and medical professionals, but also on the interaction between medical professionals themselves.

Effectiveness

Regardless of the particular variations between different definitions of networked care, it is important to look into how effective it is at improving healthcare outcomes. A recent and large meta study done by Brown et al. (2016) looked into the effectiveness of clinical networks for this particular purpose. In this meta-study 22 studies were reviewed, of which 13 qualitative and 9 quantitative.

The studies were conducted with different MCN’s as their scope, often around specific conditions like cancer or diabetes. Also larger groups of medical specialties like cardiac disease and neonatal care were included.

The empirical evidence available showed that MCN’s can be effective ways of creating quality improvement. This quality improvement was seen in both patient and intermediate outcomes. Examples of this first are: improved time to treatment and reduced mortality.

Equally important were intermediate outcomes like: improved knowledge amongst staff and better resource availability.

A large side note is that Brown et al. (2016) also indicated that research is lagging behind the development of MCN’s. Therefore the definitive conclusion is that MCN’s improve quality of healthcare, but whether this improvement can be maintained cannot be determined yet.

The initial results however are positive and show that an implementation of networked care could be a good way to improve health outcomes for patients.

Requirements for success

From the research done by Brown et al. (2016) come a number of factors that are critical for a MCN to succeed. These are:

- Strong leadership by clinical leaders and managers
- Sufficient resources
- Involvement by a broad range of stakeholders

Leadership

The research showed that there was a correlation between strong leadership and MCN success. This leadership consisted of a few dedicated managers and clinical leaders. Two important factors are that the leadership is respected by their colleagues and that they are highly dedicated to the idea of MCN’s.

Resources

Another critical factor in MCN success is sufficient resources. This is not only in the form of financial and technological resources; human resources are also vital to the success of an MCN.

Stakeholder involvement

In order to achieve support for the MCN, it is critical that all (potential) stakeholders are involved in the process. This includes patients, specialist practitioners, general practitioners and management stakeholders. For the best results these stakeholders should be aware of how the network is structured and what patient care trajectories look like.

The importance of the factors described above is confirmed in multiple other publications looking at how an effective MCN can be established (Guthrie et al., 2010; Siggins Miller, 2008).

Topologies

There are many different types of organisational networks. All fit with different requirements and have different measures of complexity. Therefore it is important to have an overview of the different shapes a network organization might take, as described by Gladden (2017). These shapes are heavily based on IT network topology. A short overview of the different topologies is given below (DNSstuff, 2019)

Point to point

A point to point topology is the simplest form of a network topology. It is defined by two nodes that are connected by one link, see figure 2.2. This link allows communication between the two nodes. This topology can be expanded. This creates a daisy chain topology where nodes are added in a single line.

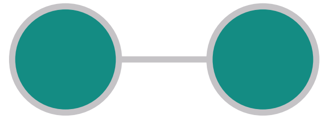


Figure 2.3, point-to-point topology

Advantages: Simple
Disadvantages: If one node or link fails, connection is cut-off

Bus

The Bus topology allows for all nodes in the network to be connected by a single large connecting link, as depicted in figure 2.4.

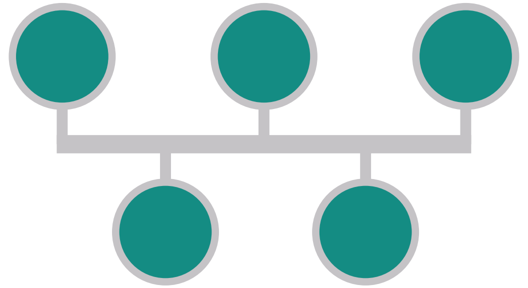


Figure 2.4, bus topology

Advantages: Direct contact between all nodes
Disadvantages: Network is fully dependent on central link. If this fails, al contact is broken.

Star

In a star topology, one node is central and all other connect to that node. This central node relays all communication between the other nodes (figure 2.5).

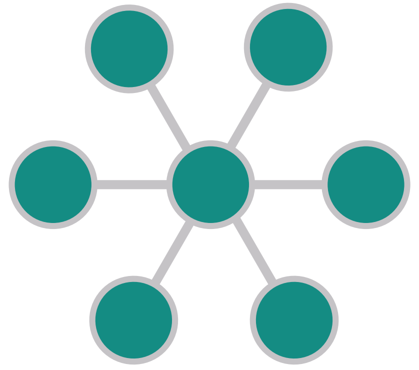


Figure 2.5, star topology

Advantages: Due to the individual connections, the network remains operational if one of the outer nodes fails. Also the central node serves as a save-station for all data dat is sent through it.
Disadvantages: If the central node fails, the network will no longer function. Also the entire speed of the network depends on how quickly the central node can process information. Making it a potential bottleneck.

Tree

A tree topology has different branches that split and connect at different points. All branches are in some way connected to a root node that allows for communication between all nodes, depicted in figure 2.6.

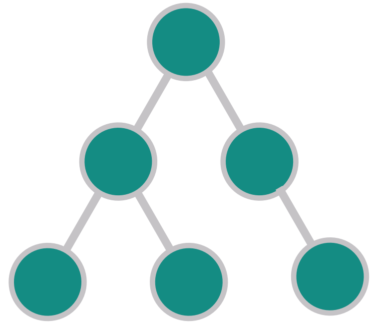


Figure 2.6, tree topology

Advantages: If the root node fails, communication inside of the branches will still be possible.
Disadvantages: Failure of the root node will disconnect branches from each other, making communication between them impossible.

Mesh

In a mesh topology all nodes are connected to all other nodes. This allows for direct contact between nodes, without the need for the communication to pass through another node. This can bee seen in figure 2.7.

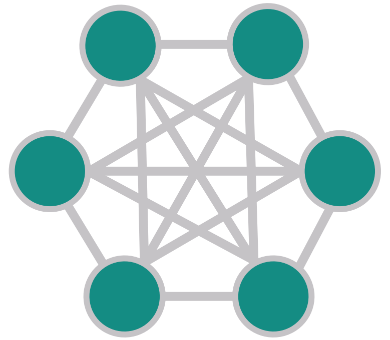


Figure 2.7 mesh topology

Advantages: With all nodes directly connected, the network is still functional if one node fails. There is also no delay in communication, as nodes are directly connected.
Disadvantages: Due to the high number of links, mesh networks are very complex. Setting up a mesh network is an elaborate process.

In reality organizations are never truly one specific topology. They use more of a hybrid configuration with different topologies at different levels within the organisation. However, the topologies described above are in most cases the building blocks for the entire organisation. One description of how these topologies combine is described by McChrystal et al. (2015) as the team of teams topology. This combined topology shows how a number of individual networks can be linked into one large network.
This linked network allows for faster information exchange and better insights into the roles of other teams, while keeping complexity relatively low. These things combined can lead to a better understanding of the common goal.

Applied networks

To make any network that uses the typologies mentioned above successful, there are a number of things to keep in mind. This is especially true when implementing such networks in healthcare contexts. This is also stated by healthcare designer T. Souhoka (personal communication, february 7, 2020). Her findings were that for the network to succeed the following was required:

Sufficient complexity: This allows for the network to contain all necessary resources for the treatment of any patient
Adaptability: This allows the network to be customised for the treatment of a specific patient
Resilience: The ability for other parts of the network to take over in case a certain node or link in the network is lost.
Responsiveness: The network should allow connections between different nodes to be quick, otherwise the network would be ineffective and slow.

Next to these requirements, there is also the point of roles within the network. In order for a beneficial cooperation to exist within the network, it is essential that all stakeholders know the entire possible trajectory of the patient and their roles within it. When this is the case, all stakeholders can add to the trajectory and there is little chance of collision between stakeholders in decision making.

Conclusion

Networked care is a development that allows for the improvement of health outcomes through the creation of a network of medical professionals. These networks can serve to share knowledge across geography or to establish a group of medical professionals around a single patient.

Research has shown them to be effective at improving health outcomes and therefore patient value. This creates a strong tie between networked care and VBHC, with networked care as a possible model for how VBHC can be applied.
For a care network to succeed it needs at least three things: Strong leadership, resources and the involvement of all stakeholders in the network.

The network can also take many different shapes, depending on its goals and organisation style. The network should always be: sufficiently complex, adaptable, resilient and responsive.

In short, networked care can provide the means to more efficiently provide more effective care through structured interactions between stakeholders.
This makes them highly interesting for solving the problem of ill-fitting care, although the complexity of setting up a network also creates a large number of hurdles to overcome.

2.5 Interaction between GP and OS

The core of any type of network is; the interaction between stakeholders. As this thesis aims to improve the information exchange between medical professionals it is highly relevant to look into how these exchanges are organised now and therefore how they might be improved.

Interaction planning

There are predetermined interaction moments between the GP and the OS. According to the HASP guideline (Kerngroep Herziening Richtlijn HASP, 2017), these are:

The moment of referral from GP to the OS
During the care trajectory after consults with the OS, as an update to the GP.
The moment of discharge form OS to GP

There are other undefined interaction moments described in the HASP guideline. These are at the death of a patient or the death of a family member of the patient. From this the following statements can be made as a summary:

Information travels up with the patient when they are referred to the next level of care.
The only time when information is always shared from GP to OS is through the initial referral.

Interaction subjects

The goal of these interactions is always to exchange information about the patient and their care trajectory. The HASP guideline also provides a framework for what information should be exchanged during each interaction.
In practice this framework takes the form of a table. The table is made up out of different rubrics of personal and medical information that should be transferred during the interactions.

While it is mandatory to include most of this information, some is optional. The information rubrics marked as optional for the initial referral are:

- Psychosocial anamnesis
- Family anamnesis
- Also being treated by

Especially the psychosocial anamnesis is an interesting information rubric. According to HASP it describes any psychosocial factors related to the patient (Kerngroep Herziening Richtlijn HASP, 2017). These factors can range from deaths in the patients social circle to their discovery of being adopted, or even the state of mind of the patient at the current time.

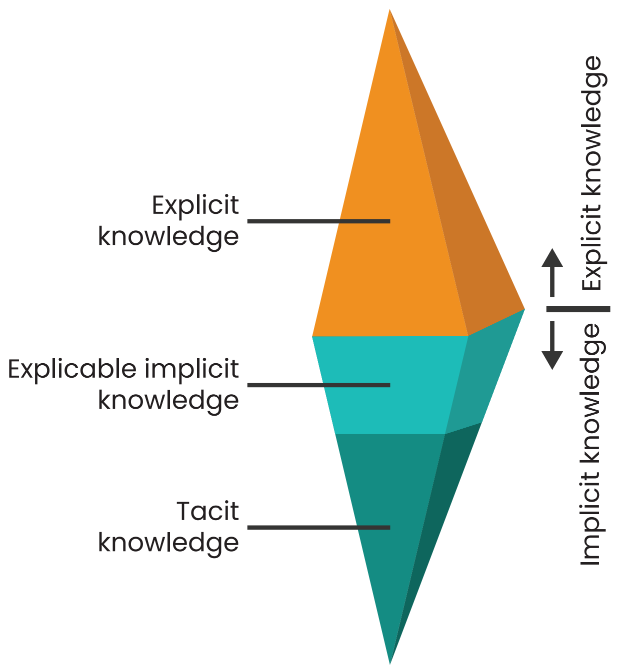


Figure 2.8,
Mental model by Smulders et al.

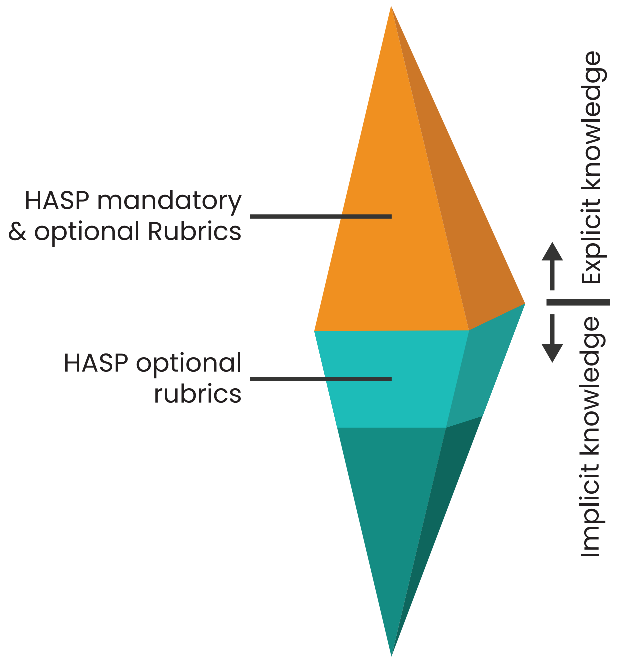


Figure 2.9,
Mental model with HASP

These information rubrics can be categorised using a mental model as described by Smulders et al. (2008), depicted in figure 2.8.

This shows that all of the mandatory information rubrics as described by HASP, fall in the explicit knowledge category. Meaning they can be codified in numbers or short descriptions. The optional rubrics however are a combination of explicit and implicit knowledge, because they can not always be completely codified. For example, a diagnosed depression can be codified, but the circumstances of this depression and the impact on the patient are not easily codifiable.
When put into the mental model, the result is figure 2.9.

While the implicit part of the HASP rubrics might not alter the direct condition of knee arthrosis, it can have a impact on the needs of the patient at that time. Taking this information into account or not can also have a significant impact on the health outcome of the patient (Weiner et al., 2013).

Interaction channels

Appart from when the interactions are and what they are about, it is also important to look at how they take place.

In the case of the referral from GP to specialist, this is done through a service called ZorgDomein. This service is linked to the GP's information system. When the GP chooses the referral option,

the ZorgDomein service launches and provides a selection of locations where the needed specialist can be found. After the GP selects which hospital and specialist they will refer the patient to, the ZorgDomein service creates a electronic message to the hospital. They will then contact the patient to plan the first consult (ZorgDomein, n.d.).

For the update and discharge messages, there are a number of potential communication channels. Examples are letter, fax, email or direct transfer to a closed network. No matter what channel, the specialists medical system makes the message automatically after a consults and allows the specialist to add a message. They are then automatically send to the patient's GP (Kerngroep Herziening Richtlijn HASP, 2017).

Conclusion

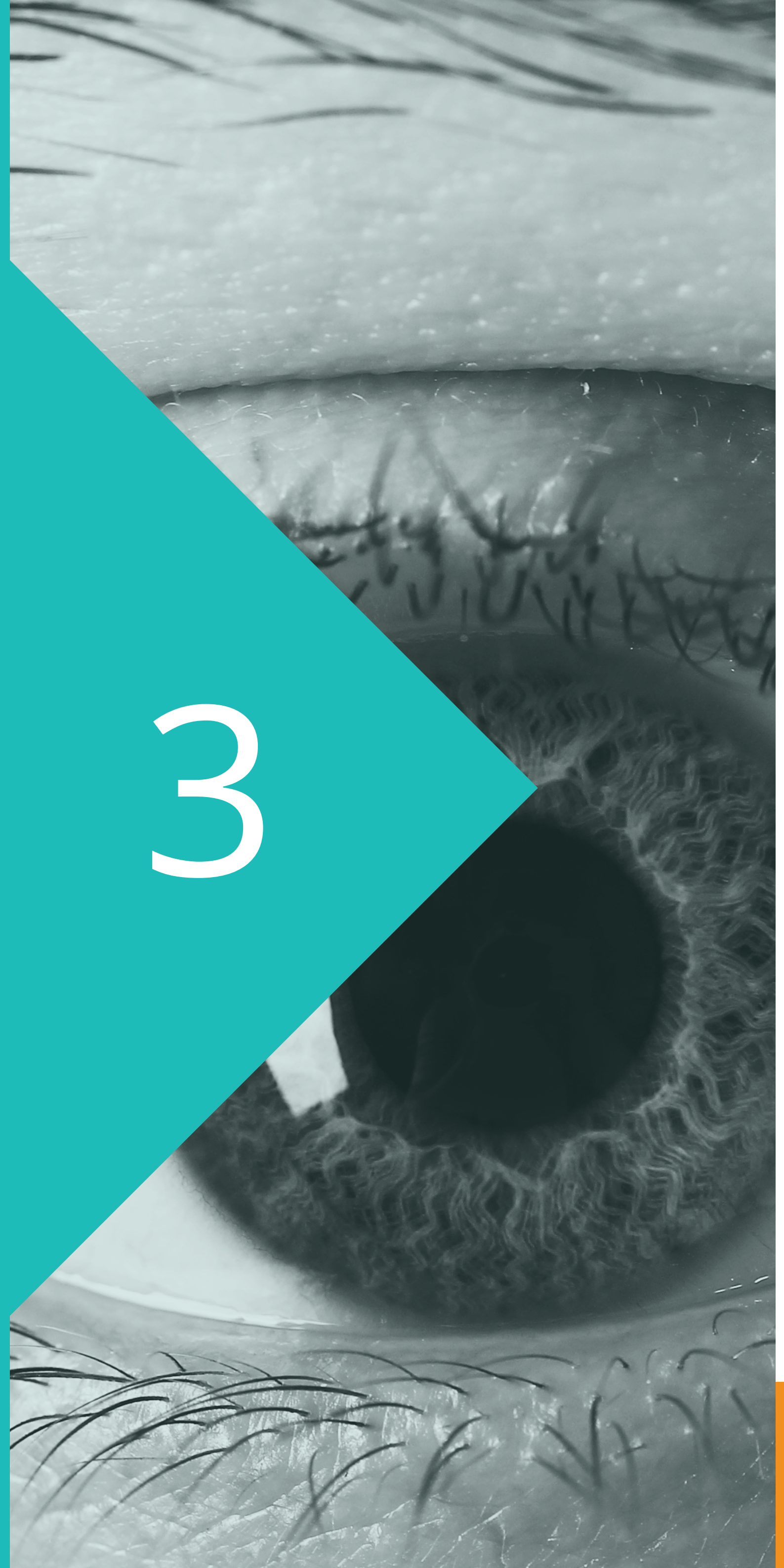
There are few planned interactions between the medical professionals in the current situation. The few that are planned are often to transfer information about the patient. What information this is is partially determined by guidelines, but also leaves room for choice. Currently information that falls in the contextual category does not always have to be shared, even though its value to the health outcome is known.
Channels for the planned interactions are always textual. The serve to enable transfer of medical data and updates. This deeper look into the current interactions has revealed potential issues in this system.

2.6 Conclusion

Through the literature a better understanding has been created of the healthcare industry. There are many trends that are influencing the development of healthcare. The aim of most of these is to improve the efficiency of healthcare while also improving the health outcomes for patients. Value based healthcare is one of the largest developments with the focus on increasing the value of healthcare through improving patient health outcomes. A promising development that enables this improvement of patient health outcomes is networked care. It does this by facilitating more and better interactions between medical professionals. These interactions then lead to better informed decisions. The need for such a system is clear when looking at the current interactions. These are often very few and have a limited amount of information that can be transferred.

Field Study

3



Introduction

To see how much of the literature translates to the real-world context of the OC, field studies were done. The first field study consists of multiple interning sessions. The goal of these is to provide a basic understanding of the current healthcare system and how the stakeholders function within them. It also provides an opportunity to get a full overview of all stakeholders involved in the knee arthrosis care trajectory.

To get more information on the experiences of these stakeholders within the project context, an interview study was conducted. This allowed for deeper research into the needs of the different stakeholders within the care trajectory. The goal for the interviews is to identify gaps and issues in the current system and how significant they are in the real-world context.

3.1 Interning

The first step in the familiarisation is to intern with different medical professionals within the current care trajectory.

Aim

The first field studies are interning and observation sessions with OS's in the out-patient clinic at the Reinier de Graaf Gasthuis in Delft. The goal of these sessions is to get familiar with the processes in these out-patient clinics and who the stakeholders are in the care trajectories. A side goal is to observe any issues with the routines and activities that are currently in place in the out-patient clinic.

Method

To reach the goals as described above, multiple interning sessions were done with different medical professionals. By doing this, a better image can be established of the out-patient clinic as a whole.

The first interning session was with an Orthopedic Specialist during polyclinical check-ups and first consults.

The second interning session was spread out over two half-days with the Physician Assistant. The reason for the split session was to see multiple types of check-ups. The first half-day with one-year check-ups and the second with 2 week post-operative check-ups. This split session could then result in a much better understanding of the role of the Physician Assistant.

A third session was a half-day of interning with the assistants in the polyclinic. This allowed a better understanding of their activities within the care trajectory.

Results

The interning sessions resulted in a more detailed overview of the current care trajectory. This overview was translated into a flowchart that can be found in appendix B.

Stakeholder overview

A second result from the interning sessions is a more complete overview of the stakeholders involved. It is now possible to make a complete overview of the stakeholders and their roles. The stakeholders are divided in internal and external stakeholders. Internal stakeholders perform direct actions within the care trajectory. The external stakeholders have influence on the trajectory, but do not directly act within it in its current state. Below are the 3 most important primary stakeholders. Additional primary stakeholders can be found on the next page.

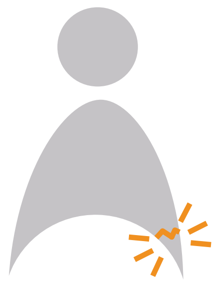


Figure 3.1, patient

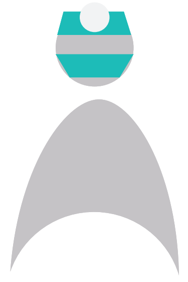


Figure 3.2, orthopedic surgeon

Figure 3.3, general practitioner

Patiënt

A major primary stakeholder in the system is the patient. They are at the center of all actions performed within the system and the reason for its existence. Their primary goal is receive the care needed to no longer feel negative consequences of their condition. The icon for the patient for the remainder of this thesis is figure 3.1.

Orthopedic surgeon

The orthopedic surgeon (OS) is the primary medical professional in the current system after a patient visits the polyclinic. The OS does diagnosis and treatment, including surgery. The OS will be depicted using the icon seen in figure 3.2.

General practitioner

The general practitioner (GP) is the first stop for the patient when they feel like they need medical help. The GP can perform basic tests and is the gatekeeper that can allow the patient progress to more specialised medical care. They also have information about any other conditions and in most cases the personal circumstances of the patient. The icon for the GP is figure 3.3.

Physiotherapist
The Physiotherapist serves a supporting role. They support the patient by guiding them through both treatment and during rehabilitation after surgery. In the current system, there are two separate physiotherapists involved. The first is the in-house physiotherapist who helps the patient mobilize after surgery. The second is the external physiotherapist who does physical exercises with the patient to reduce complaints or helpt rehabilitation after surgery. The latter has longer involvement with the patient in the current system.

Physician Assistant
The physician assistant (PA) serves a assisting role to the OS. A PA can do a lot of things that the OS can do. However he can not perform surgeries and put patients on the surgery waiting list. He can however do check-ups and administer or prescribe medication. This allows the PA to take over tasks from the OS like; post operative check-ups or consults.

Orthopedic Counsellor
The Orthopedic Counsellor is responsible for giving the patient all information that is relevant for surgery. They answer patient questions and have a relatively large amount of time for each patient to do so.

Polyclinical Assistant
The Clinic Assistant (CA) performs a great number of tasks within both the polyclinic and related areas. They are responsible for making sure the polyclinic runs as smooth as possible. Their tasks are:

- Manning the service desk of the polyclinics
- Manning the service desk of the traumatology clinic twice a week
- Preparing injections for possible use during consults
- Back Office tasks
- Phone line for patient and GP calls
- Preparing polyclinical consults 2 days ahead.

Next to the primary stakeholders, there are also a number of secondary stakeholders. These stakeholders are in directly involved in the treatment of the patient.

Family and relatives
The family and friends of the patients have indirect involvement in the treatment. This through both their emotional involvement and aid in the revalidation trajectory.

Health insurers
The health insurers do not have a direct role in the treatment of the patient, but do have a very strong secondary role. They are the main source of finances for the medical professionals. This gives them authority in deciding which treatments they will fund and which they won't.

Dutch government
The dutch government is involvement in many different ways. Their main involvement is through legislation. This can be anything from direct medical legislation to financial legislation. These all have impact on the care trajectory as part of medical processes.

Occupational physician
The occupational physician (OP) can be called in as the link between the patient and their employer if medical treatment interferes with normal employment. The OP is the only person connected to the patient's employer who is allowed to view the patient's medical records if the patients permits this. The OP translates this medical information into a prognosis on how a long the patient will be hindered in their work and what other tasks they could perform. They do not share any medical information with the employer, just a work related prognosis.

Other observations

Another result of the interning sessions are a number of observations on points that stood out or were problematic to the care trajectory. These observations were written down and then grouped by topic. The main observation that has relevance within the scope of this graduation topic is: Problematic communication between GP and OS causing unnecessary referrals and sharing of unclear information. This results in the OS not knowing the reason for the referral.

Observations on other topics were also documented, but did not fit within the scope of this project. A short list of these observations can be found in appendix C.

Conclusion

This interning study brought forth a good understanding of the role of the stakeholders in the care trajectory. It also proved to be a good way to get a feeling for unofficial communication channels and issues within the current care trajectory.

3.2 Interviewing

With a basic understanding of the current trajectory, the next step was to dive deeper into the stakeholders within it. This was done through one-on-one interviews with a selection of the primary stakeholders in the care trajectory.

The interviewed stakeholders are:

- 4 Patients
- OS
- GP

The goal of the interview was to answer the following research questions:

- How is the system for the care trajectory for knee arthrosis currently organised?
- How is the (perceived) flow of communication experienced between stakeholders in the knee arthrosis care trajectory?
- In what ways can the system around the current care trajectory for knee arthrosis be improved?

The patient interviews were held in the polyclinic of the hospital. For the OS and GP, their practice locations were visited for the interviews. Each interview was recorded to allow for analyses at another time. For the complete research set-up please consult appendix D.

Analysis

The first part of the analysis was translating the interview recordings into usable material. This was done by writing statements, made by the interviewee, on individual post-it notes. These notes were then collected on a single place.
After all interviews were processed, a large collection of post-it notes was available for further analysis. These were then grouped into clusters based on the general topic the remark was on. Examples are: Communication, patient roles, finances, etc.
After this initial round of clustering, the individual clusters still were quite large. Therefore the clusters were divided again into groups that represented similar wishes or potential improvements. Examples of these are: Overall experience, care vs daily life, etc.
Within these groups, all statements that said the same were grouped together. All of these groups and single post-it notes were then written down as statements. For the groups a multiplier was added for the amount of post-it notes that the group contained.
The final step was to translate these statements into whishes, where possible. This for example resulted in the statement; 'The physical complaints result in psychological complaints' becoming; 'Take psychological effects into account during treatment'.
This was done for all statements, keeping the multiplier if a statement had one.

Visualisation

To be able to draw conclusions from the research, a visual was made (figure 3.4). This provides a clear indication of which wishes are most common and have the highest impact in the care trajectory.

To achieve this, the wishes were plotted along the trajectory as lines. The length represents the part of the trajectory where the wish is relevant. The line's thickness reflects the intensity of the whish and is directly related to the multiplier mentioned before. Any wishes that were highly specific or were only mentioned once, are left out of the visual. The colour of the wish indicates if it has already been met or not. If the line is green, the wish is met, if the line is orange, it hasn't. Then there is the split between perspectives. All wishes from a patient's perspective are underneath the trajectory line, the medical professional's wishes are above the line. This can also be seen from the icons on the left.

Results

The results from this field study can be summed up in four points:

- Patient wishes met
- Patient wishes unmet
- Medical professional wishes met
- Medical professional wishes unmet.

Patient wishes met

The interviews showed that a large number of patient wishes are currently met. This is especially true for wishes pertaining to the interaction with the medical professionals. This interaction is perceived as personal, explanation is calm and the overall experience is good. Another whish that is met is the ability for patients to have some level of control over their care. This is reflected in their ability to correct their trajectory if they feel that is needed and the ability to have a say in referrals at the GP.

Patient wishes unmet

The only wishes that are unmet for the patient revolve around (the planning of) surgeries. This is represented in a wish of patient to have more time between the announcement of the surgery date and the actual surgery. It is also reflected in the wish to meet with the surgeon performing the surgery, as surgeons might switch due to external influences.

Medical professional wishes met

The only wish that was significantly met for the medical professionals was the ability to scale up treatment in the first line of care. There is some discussion though. As the medical professionals experience many care trajectories in their careers, they are able to see the larger patterns. This lead them to focus more on the points of improvement during the interviews, then on the met wishes.

Medical professional wishes unmet

From the visual it becomes clear that there are many wishes of the medical professionals that are unmet. The main relation between these unmet wishes is the interaction between medical professionals. This is represented by the wishes for shared protocols and routines, better mutual accessibility, better knowledge sharing between lines of care and shorter communication lines. The wish also emerged for a more

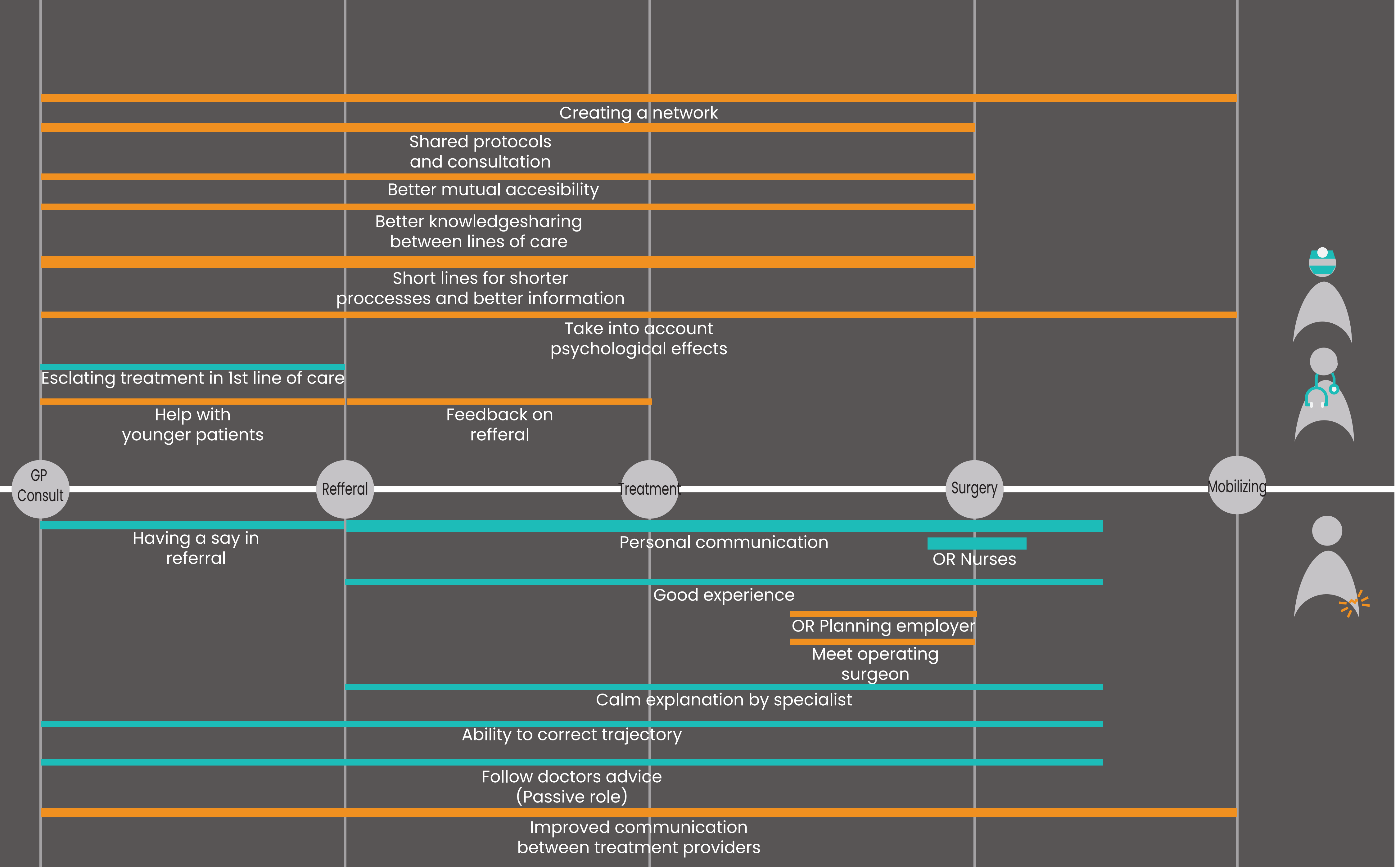


Figure 3.4,
Interview result visualisation

structured approach to the interaction in the form of a network.
The final wish is for a system that allows for a better inclusion of psychological factors in a patient in the decision making process.

Conclusion

From these interviews comes that currently patients are satisfied with the majority of the care trajectories. Only in some situations can the planning and communication around surgery be improved. The medical professionals however do see more room for improvements. They see the need for more interaction between the medical professionals involved in the knee arthrosis care trajectory.

3.3 Conclusion

The combination of both studies has provided a deeper insight in the current functioning of the knee arthrosis care trajectory. They have also shown points of improvement for the trajectory. Within the scope of this project, they mostly pertain to the interactions between the different stakeholders in the care trajectory. This is especially the case for interactions between the different lines of care. With the interviews indicating a strong wish for better communication, inclusion of psychological factors and the interning sessions showing the negative effects of these mis-communications. This also fits with the conclusion drawn in the literature study. The interaction between medical professionals is not optimal in its current state and can have negative impacts on the health outcomes of patients.

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Design Vision

4

Introduction

In this chapter, the obtained information from the literature and field studies will be combined to create a design vision. This vision contains the problem scope that the final design will aim to solve and the design goal it will aim to meet.

4.1 Problem scope

The problem scope has its basis in the points of improvement found in the literature and field study. The interview study provided an overview of unmet wishes within the actual context of the project. These provide a base for the formulation of the project scope.

As stated in the conclusion of the interview section, the unmet wishes on the side of the medical professionals have in common that they are all related to interaction between the different stakeholders in the process. Within this common factor there are also different groups of wishes pertaining to parts of the interaction. Some focus more on the communication infrastructure and available time for interaction, while others are more centered around the sharing of information. These split in groups can be visually represented as depicted in figure 4.1.

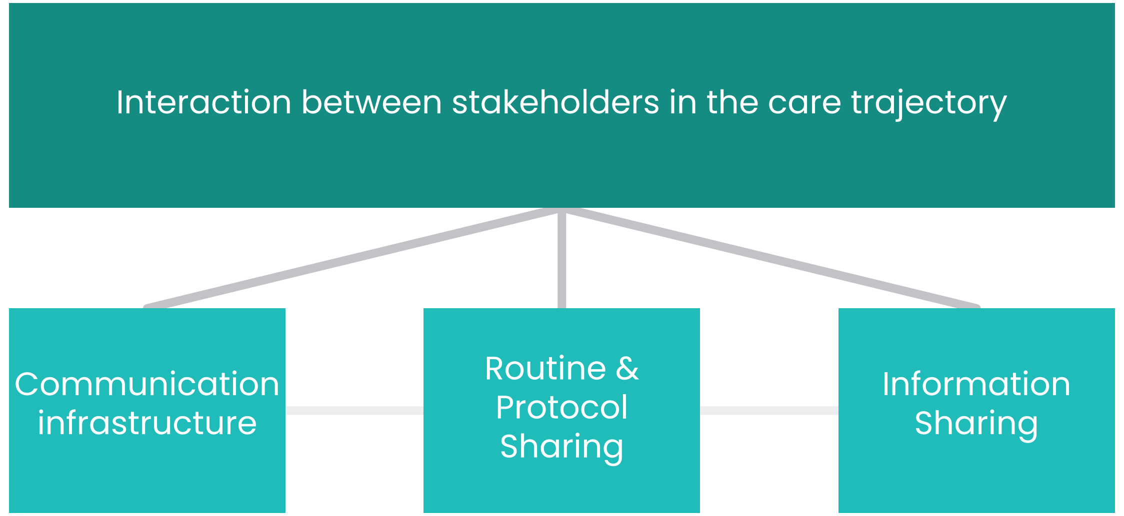

Figure 4.1, interaction split

There are other splits possible that would result in different groups. This split was chosen as it demonstrates clear differences between the groups and allows for selection of a more focussed project scope for the continuation of the project.

In the original design brief, the perceived problem was described as: 'Overtreatment and inefficient use of medical resources'. The underlying cause was described at the time as making incorrect treatment decisions due to a lack of holistic information on the patient.

When combining both the findings from the analysis and the perceived problem, the 'Sharing of information' problem scope fits best. This problem scope is the most directly related to the original problem that was observed. Therefore continuing with this scope will result in the best outcome for the solving of the original problem.

Important to note is that all the unmet wishes as found in the general analysis are interconnected within the interaction between stakeholders. The choice to continue with only a part of this overarching problem is mostly based on the fact that it is not possible to solve the entire interaction problem within this project. However, if part of the problem can be addressed through a more specific design direction, it is likely to also have a positive effect on the overarching problem due to the interconnectivity inside it.

The problem scope for the final design will thus be:

> *"Missing information during the treatment decision making process leads to incorrect treatment decisions"*

4.2 Design goal

From the literature and field studies comes an overview of the journey a patient is likely to make during a care trajectory for knee arthrosis. This general case is depicted in figure 4.2.

Walking through this figure you see the patient move to the first line of care represented by the GP, and then to the second line of care represented by the OS.

Here the patient receives the needed treatment and is then discharged from the second line of care back to the first line of care. This is where physiotherapy might be started in the case of knee arthrosis.

When including the sharing of information into this figure, the result is figure 4.3. The green line still depicts the patient journey, with the black line depicting the information journey. The orange lines are escalation thresholds for escalation to the next level of care. The base knowledge of the GP and the refferal information that the OS receives are also displayed in figure 4.3 as grey base levels.
From this visual it is clear that moments of information sharing between GP and OS are few. The only moment where medical information on the patient is shared for all patients from GP to OS is at the initial referral. This is also the only moment where there is a possibility for information to be missing in communication from GP to OS.

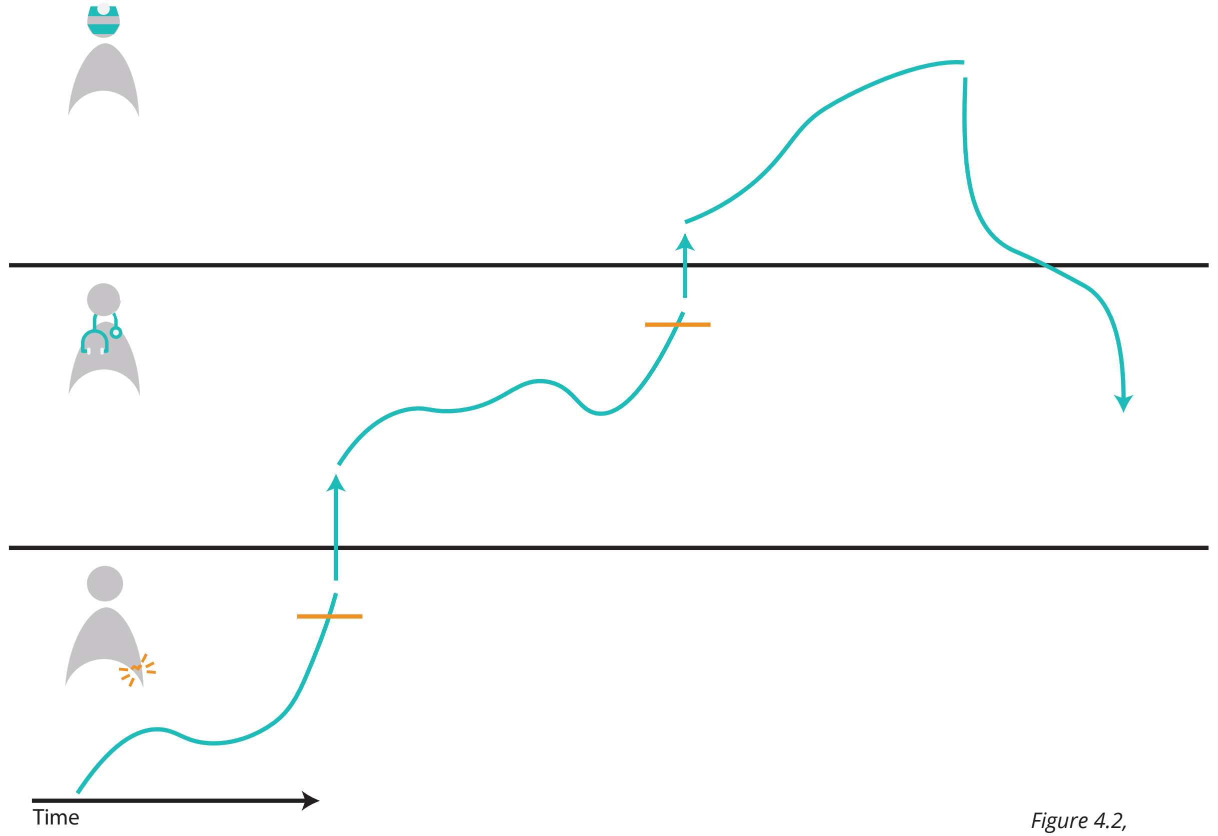

Figure 4.2, patient journey

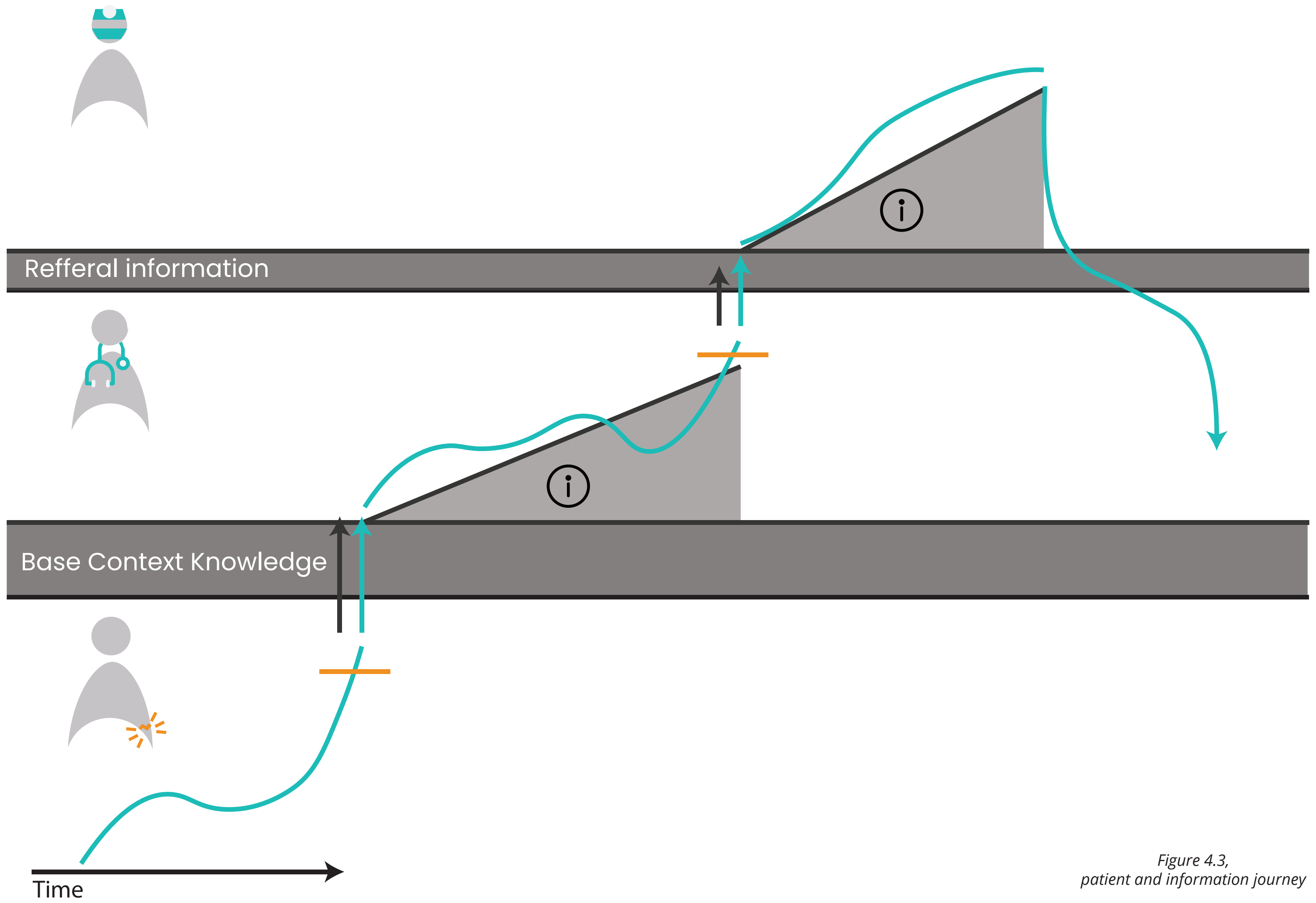

Figure 4.3, patient and information journey

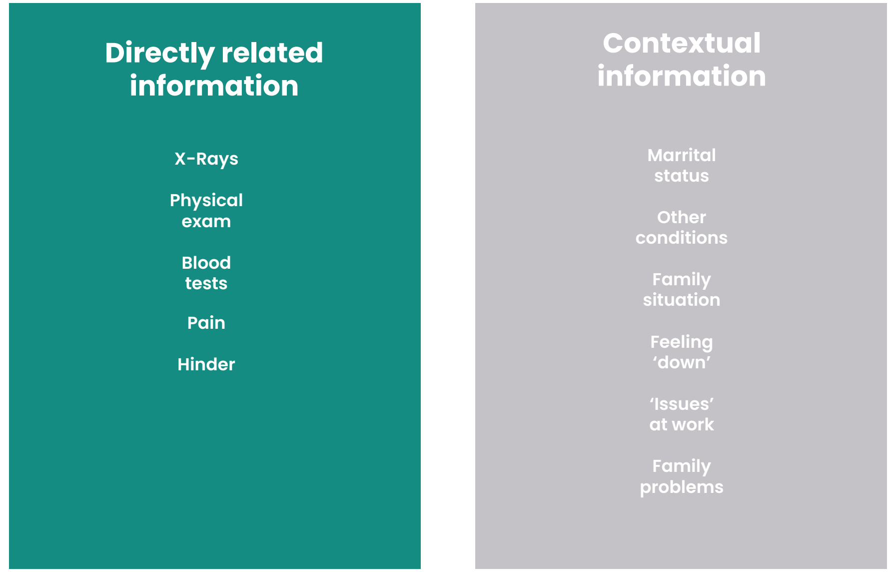

Figure 4.4, information split

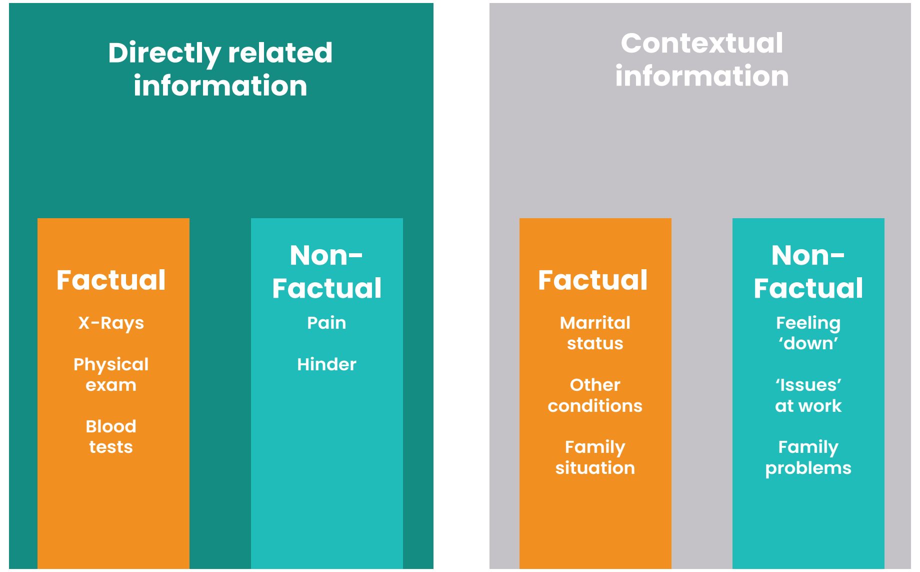

Figure 4.5, second information split

The informational contents of the referral are described by the HASP guideline as can be read in section 2.5. As most of the information rubrics are mandatory, the missing information can not fall withing these rubrics. Therefore the optional rubrics must contain the information that is missing.

Noteworthy about these optional rubrics is that they outline information that enables developing a picture of the patient as a whole. This information might not be directly related to the main condition and can be seen more as contextual information. When put in a schematic overview, the result is figure 4.4.

In this figure there are 2 major categories for information types: directly related and contextual. Directly related information is any information that describes something concerning the main condition. Contextual information is any information about the patient that is not directly related to the main condition. Examples of the information found in both categories can be seen in the figure.

These 2 categories can then be divided further into implicit and explicit information, or respectively factual and non-factual information based on the literature found in section 2.5 of the report. The result of this is figure 4.5.

Reasoning that the non-factual information is missed in the current information sharing system, fits with the literature and field study. Both studies indicated a lack of a method to transfer this patient information. Employing the mental model to visualise the information transfer, as described by Smulders et al. (2001) and introduced in section 2.5, results in figure 4.6.

The figure shows that currently only the explicit knowledge is shared in the referral and any implicit or non-factual knowledge is not shared. In literature section 2.5, it was already determined that parts of the HASP information rubrics are implicit information. Furthermore it stated that not taking this information into account can lead to worsened health outcomes for patients.

This line of reasoning was further substantiated during the interviews; for example a GP stated the following: 'I never get the question [from the OS]: We want to do this, what kind of patient is this and can they handle it? [...] If there was a moment where I was asked whether there was any information on the patient, besides the knee; I would have things to report [on the patient]'

An OS shared an anecdote on a patient that experienced severe physical complaints, but where only mild objective causes were found. After most other treatments options were tried without relief of the patient's symptoms, a surgery was performed. After the patient was under narcosis, multiple surgical scars were found on the patient. After the surgery, the results for the patient were disappointing. The patient continued to experience complaints that were not fully objectifiable.

During the entire care trajectory it became more and more clear that mental factors played a large role in the patient's complaints. This lead the OS to the believe that in hindsight, with the gathered knowledge, the surgery might not have been the best solution for the patient and that in retrospect a different treatment decision would likely have been made.

This situation could have been avoided if the contextual patient information had been available, which likely would have placed the patient's complaints in a different light and would have altered the treatment decision.

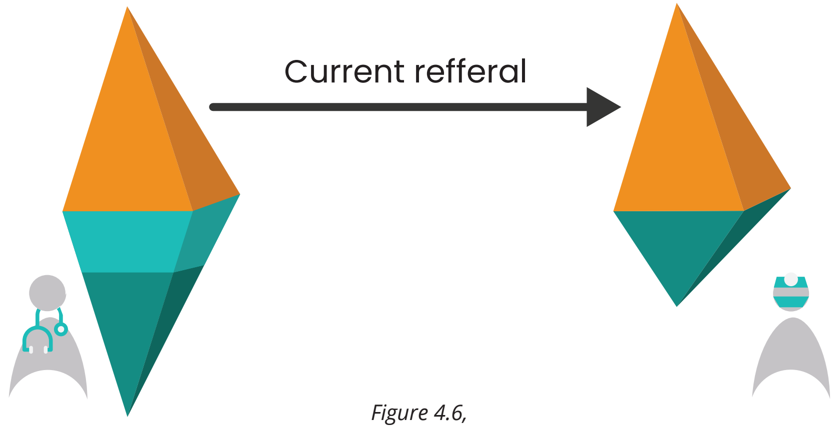

Figure 4.6, refferal in mental model

From all the above statements follows that this missing implicit contextual information is a significant reason for ill-fitting care and negatively impacted healthcare outcomes.

The aim of the final design is to achieve a situation analogous to figure 4.7, that is the implicit patient information should be translated into something explicit which can be shared between the GP and OS. To facilitate this, the goal of the design is to:

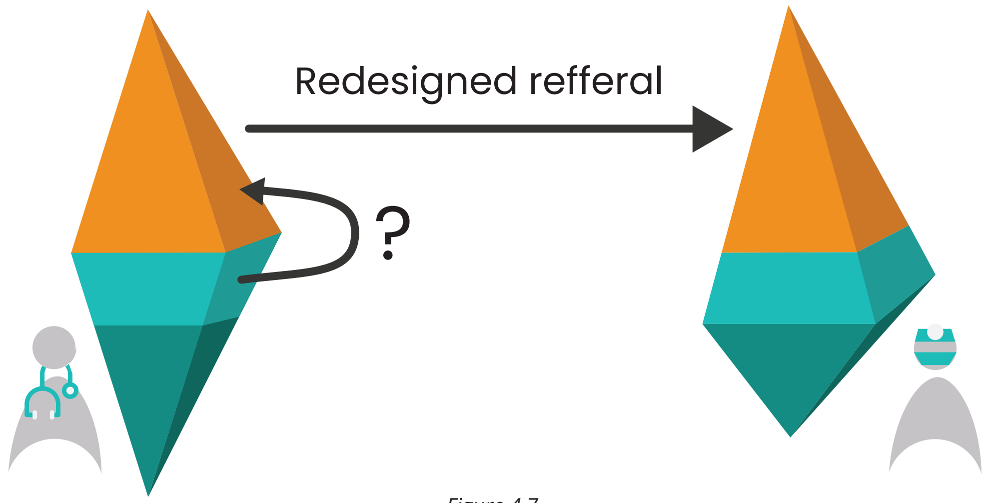

Figure 4.7,
design goal in mental model

Enabling easier sharing of contextual patient information between the GP and the OS in the initial referral

4.3 Design assumptions

In order to progress the project a number of assumptions were made. These assumptions were based on the research that was done before and on experiences gained throughout the project within the medical environment. The assumptions are as follows:

The reason for the limited amount of contextual information being shared as standard from GP to OS, is the combination of time pressure and a lack of functional methods to do so.

This assumption also stems from the interview with the GP, and some personal experiences added to this. During the interview the GP demonstrated the referral methods.These only allowed for textual communication. As contextual information can be largely implicit (see section 4.2), translating it into explicit writing can be a time consuming process. The GP does not have time to do this between consults. Even if it was done, it would likely result in large piece of text. The chance an OS might not have the time to read it during consult preparation is high. For these reasons, the contextual information is often not shared as standard.

The OS is not aware of the information that the GP has available.

This assumption is based on the interview with the OS and several conversations with OS’s during the project. The OS can not tell how well a GP knows their patient. Therefore they cannot assume that there is more useful information for them than the referral documents state. They could enquire about this information, however the time pressure makes it impossible to do this for every patient. This means that inquiries for information from the OS to the GP are a rarity and happen only in an marginal amount of situations.

The GP has a base level of contextual information about a patient through their experience over time with the patient and access to the complete medical records.

This assumption is based on remarks made by the GP during the interviews described in section 3.2 of the report. During the interview the GP made clear that there was definitely more contextual information on patients available from them. The GP indicated that this information came from experience with the patient due to the longer relationship the GP has with the patient.

The GP is not aware of the information needs of the OS.

Also an assumption based on the interview and further strengthened by personal conversations and experiences. The GP has a very limited amount of knowledge on the process and routines of an OS. This means that they do not know which information could be relevant to the process of the OS.

Besides this, there is also an amount of hierarchy in the communication between GP and OS. The GP does not want to overburden the OS with information that may or may not be useful to their process. This to protect the relationship and prevent negativity between the two medical professionals.

The result is that even in specific cases with many contextual factors, the information that is shared is very limited.

4.4 Design Criteria

To test whether the design meets the design goal, it is important to set criteria that the final design should meet. These criteria are based on all of the research that has been conducted. The following criteria have been formulated.

Requirements

- The system redesign must allow for the sharing of contextual, implicit information as standard.
- The system redesign must provide the OS with contextual, implicit information about a patient.
- The system redesign must allow for contextual information sharing from GP to OS and vice versa.
- The system redesign must inform GP's about what information rubrics need to be shared.
- The system redesign must be applicable to all arthrosis patients, no matter variances in the individual care trajectory.
- The system redesign must indicate how significant a certain type of information is for a specific patient.
- The system redesign must adhere to Dutch law with regards to the exchange of medical information.

Aims

- The system redesign should be cheap to implement.
- The increase in time pressure on both GP and OS should be minimized.
- The system redesign should be expandable to other medical professionals than the GP and OS.
- The system redesign should be implementable in a relatively short time period.
- The system redesign should play into the shift towards value based healthcare.

System design 5

Introduction

This chapter covers the design process from the set of problem created at the end of the Design Vision to the creation of the Final Design.

5.1 Creative process approach

As described in the general approach (section 1.6) the approach for the creative process can only be determined once the design goal has been formulated.

In design, the creative process is often depicted as a chronological linear process of one large diverging stage and one converging stage. However, this process does not always fit with all design problems.

For this project the design goal and corresponding problem can be seen as ill-defined problems. This is due to the variety of potential solutions and conflicting opinions on the problem (Schraw et al., 1995). When designing for an ill-defined problem, a co-evolutionary approach can be used. This type of approach allows for the iteration of both problem and solution simultaneously (Dorst & Cross, 2001).

As this corresponds to the development of this project so far, this approach was chosen. It allowed a continued 'sharpening' of the design problem, while at the same time iterating on solutions to this changing problem. The implementation of this process was also heavily influenced by external factors, with the most impactful being the outbreak of the COVID-19 as described in section 2.1.

It heavily limited the ability to apply often used creative activities such as large creative brainstorm sessions with the client and other stakeholders. This holds especially true for this project as the stakeholders, as noted in section 3.1, come from the medical world and hence had other priorities.

All of the considerations above led to a co-evolutionary approach with a focus on short moments of effective and efficient validation with the client and users. These moments of validation allowed for the testing of developed solutions and the further sharpening of the problem.

The resulting process can be seen in the overview as depicted in figure 5.1.

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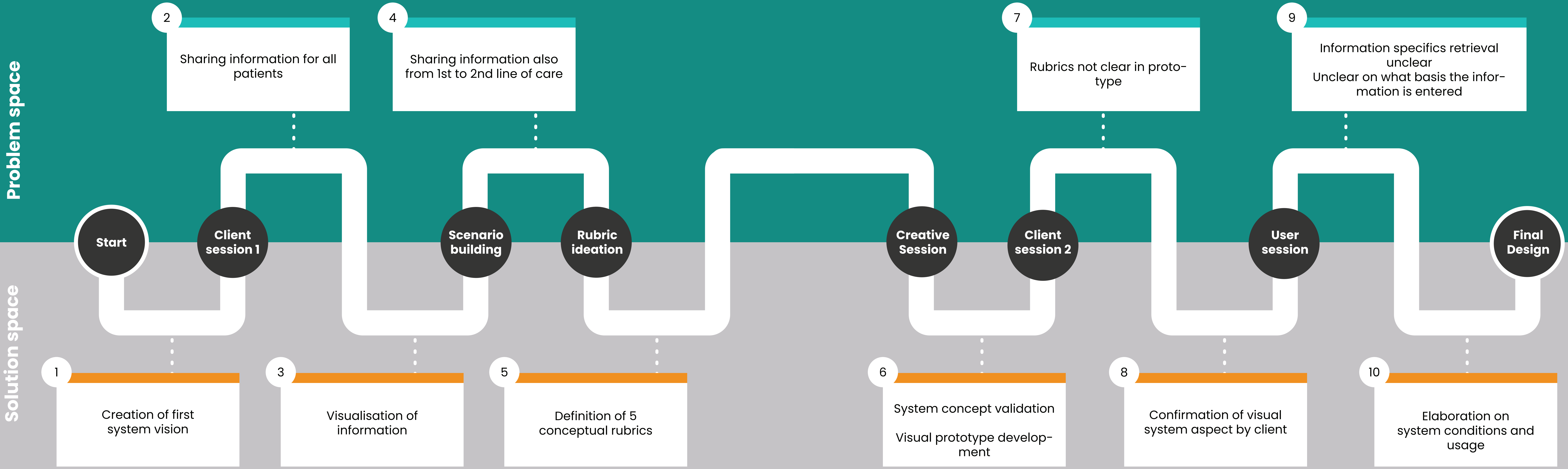
5.2 Process overview



Problem space

Solution space

Start

1 Creation of first system vision

Client session 1

2 Sharing information for all patients

3 Visualisation of information

Scenario building

4 Sharing information also from 1st to 2nd line of care

Rubric ideation

5 Definition of 5 conceptual rubrics

Creative Session

6 System concept validation

Visual prototype development

Client session 2

7 Rubrics not clear in prototype

8 Confirmation of visual system aspect by client

User session

9 Information specifics retrieval unclear

Unclear on what basis the information is entered

10 Elaboration on system conditions and usage

Final Design

Figure 5.1,
creative process overview

Figure 5.1 contains all design activities that resulted in design iterations on either the problem space or the solution space. These activities are depicted as the gray dots. After each activity follow the main takeaways of this session in the problem space, the solution space or both. This overview provides brief descriptions of the design activities and developments in problem and solution space. The numbers for the takeaways correspond to the numbers in this summary. Activities that have had a large impact are covered more in-depth in section 5.3.

● Start

The starting point for the creative process were the design criteria and design goal as formulated in the design vision. Based on this knowledge, intuition and knowledge gained a conceptual vision for a solution was created. This vision was the first entry into the solution space.

1 First vision

The vision was based around the creation of information rubrics that would cover all contextual patient information. The GP would use a tool to score the impact of each rubric on a specific patient. The tool would then give the GP a recommendation if direct communication with the OS would be necessary. If this recommendation was followed up, the OS would receive an alert with the standard referral. If the OS also wanted direct communication after reading the GP, the conversation between the GP and OS would be scheduled and executed.

● Client session 1

This client meeting served both as a validation for the conceptual vision and as a brainstorm. The conceptual vision was pitched after which a short brainstorm followed. This led to several significant changes in problem and solution space.

2 Sharing for all patients

The client indicated that using a tool to calculate if more information needs to be shared is not possible. This is because it is impossible to determine what information is most relevant for the care trajectory in advance. Thus creating weighted rubrics and calculating a recommendation is not possible. The resulting conclusion is that the contextual information needs to be shared for every patient, without selection in the first line of care.

3 Visualisation of information

Due to the implicit nature of contextual information, sharing it for every patient requires different communication style than the current textual referral. To this end a visual concept was created that could display the information rubrics and their significance for the patient.

● Scenario building

During this activity multiple information journeys were created for different scenarios. The aim of this activity was to find new elements for the solution space.

4 Scenario building

During the creation of these scenarios it became clear that there can be a need for the information to not only travel from the GP to the OS, but also the other direction.

● Rubric ideation

During this ideation session, five contextual information rubrics were created. This was necessary, since it's impossible to communicate information if it is not clear what information should be communicated. These 5 rubrics were created by combining the HASP, MCTF and ICF contextual factors into a single set of combined factors. For more information on this process can be found in section 5.3.

5 Definition of rubrics

The result of this activity was the creation of the following rubrics: general health factors, personal mental health factors, social factors, work factors and lifestyle factors.

● Creative session

The goal of the creative session was twofold; gain new ideas to use during the creation of the final design and validate the concept that had been developed. Due to the coronavirus, the creative session could not be done with direct stakeholders, but was instead done with family members.

6 Validation and development

The result of this session is the validation of the current concept development. A visual prototype was also developed using the insights up to this point.

● Client session 2

During this session, A prototype of the visual aspect of the system concept was proposed to the client for validation.

7 Prototype usability

The prototype needs improvements for usability and readability.

8 Confirmation of visuals

The visual tool works well for the entry and review of contextual information.

● User session

This session is the first evaluation moment by future users other than the client. This session was organised online through a e-mail. With an open request for any feedback that the users could come up with.

9 Information retreaval unclear

It is not clear how the OS can get the specifics for the information in the tool. It is also not clear on what basis the GP enters the information.

10 Elaboration on system

To address the unclarity, further development on the system conditions and usage was done.

● Final design

This process resulted in the final design.

5.3 Design activities in detail

Some of the afore mentioned design activities had more impact or preparation than others. The activities with the highest impact and amount of preparation will be discussed further in this sub-chapter. These are: Client session1 , Rubric ideation, User session 1 and the Creative session

Client session 1

This first user session served as both a creative moment and a validation moment in the creative process.

The first step during the session was to validate the design vision with the client by presenting the findings of the design vision: the problem scope and the design goal. The client agreed with these findings and saw a solution to them as highly relevant to solving the problem as defined in section 4.1.

This initial validation was then followed up with a loose creative session. It was initialized by sharing the formulated solution in the shape of the first vision. As explained in section 5.2, the first vision largely hinged on the idea of identifying which patients have significant contextual information during the referral process. Then only communicating this information between GP and OS for those patients.

The client indicated that it would be impossible to determine when contextual information is significant enough to share, as this is completely dependent on what type of care trajectory this patient will have in the second line of care. Since it is not known upfront what care trajectory the patient will enter, it is not possible to know what information is significant during the referral stage. It was concluded that the basis of the first vision was not viable, and therefore neither was the first vision itself.

To mitigate the impossibility of making a selection of patients in the first line of care, the contextual information for all patients would need to be shared in order to overcome the design problem. As a side effect, it was concluded that it would no longer be possible to have a planned conversation between GP and OS for each patient, as this would take too much time for both.

During the remainder of the session, new potential solutions to the now more defined problem were explored.

This resulted in a new potential solution in the form of a visual method for transferring the contextual information. A visual method could allow for faster capturing and reviewing of the contextual information than text, making it viable to do this for all patients. Another result was the shift from initiating a conversation between GP and OS before the first OS consult, to after the first OS consult. This conversation would then only need to take place if the information in the visual was not clarified during the patient consult.

This way these conversations between GP and OS would not be the norm, but would only occur if other ways of gathering more detailed information had failed.

These insights and new solution vision were then used in the further development of the final design.

Rubric ideation

In order to meet the design goal of sharing contextual patient information, it is necessary to determine what information should be shared. A basic list of information rubrics was already described by the HASP guideline in the literature section 2.5. However, these rubrics are very broad and can therefore not provide a overview of the patient on a useful level.

To create suitable rubrics, two often used frameworks were used; the ICF framework and the MCTF framework.

The ICF (International Classification of Functioning, Disability and Health) framework is a WHO framework. It is the international standard for describing and measuring health and disability (WHO, 2018).

The ICF splits the contextual information into environmental and personal factors. The environmental factors are described as the physical, social and attitudinal environment of a person's life. The personal factors are not detailed further, as the WHO finds that they differ to much between cultures. The WHO does provide factors they include in this category, such as: gender, age, coping styles, character, etc. (WHO, 2002).

The MCTF (Musculoskeletal Clinical Translation Framework) is focussed specifically on conditions of the musculoskeletal system. It allows for a complete and accurate description of the condition, but also the contextual factors.

The MCTF splits the contextual factors up into: psychosocial considerations, work considerations, lifestyle considerations and whole person considerations (Mitchell et al., 2017).

To create a set of contextual information rubrics that provide complete coverage, a combination of the HASP, ICF and MCF guidelines was used. This way, the definitions of multiple sources were combined to form one coherent set of information rubrics.
Before the guidelines could be combined, all rubrics needed to be on the same level of abstraction. This was not the case for the ICF rubric, which lacked the required detail in comparison to the MCF rubric, due to the ICF not detailing personal factors.

To solve this an expansion on the ICF framework was used that reformulated the division of contextual information. This resulted in the ICF contextual factors: Comorbidity, work personal, work environmental, family, mental personal factors and lifestyle factors (Heerkens et al., 2017).

To create a single set of universal contextual health factors, the factors form both ICF and MCTF were clustered based on similarity. This process resulted in 5 contextual information rubrics that should cover all possible contextual information factors:

- General health factors
- Personal mental health factors
- Social factors
- Work factors
- Lifestyle factors

The general health factors rubric describes all information on the overall health of the patient, in for example other conditions or medicine use.

The personal mental health factors rubric covers all information on the emotional and mental state of the patient, like psychological or mental conditions.

The social factors rubric covers all information related to the social environment of the patient, like developments around family and friends.

The work factors rubric covers all information related to the work ethos and work environment of the patient, like job satisfaction.

The lifestyle factors rubric covers all information on the lifestyle of the patient, like physical activity and smoking.

User session

After the development of the protype following the second client session, a user session was held. During this online session, the prototype and system concept were validated with future users.

The setup for the session was as follows:

The client first sent an introductory email to 11 potential future users with the time available to provide feedback. Then users all received an email with a link to the visual tool prototype and a explanation of how it should be used in the real world context.
In this email they were also asked to share any thoughts they had on the prototype and system, negative or positive.

Unfortunately only 2 users had the time to reply, however their feedback proved useful in further development.

The first user indicated that the visual tool worked well and could provide a quick insight into the contextual patient information. They also indicated that it was unclear on what basis the information was entered into the visual, whether it was a questionnaire or some specific questions asked by the GP.

The second user also indicated that the visual aspect worked well for its intended purpose. However it was unclear to them how they could find out the specific factors behind the resulting visual profile, as these specifics can make a big difference in how the information influences the care trajectory.

From these replies, two main conclusions were drawn:

- The visual aspect of the tool works well for its intended purpose. It allows for a quick capture and review of contextual information.
- The functioning and goals of the tool and system need to be explained thoroughly to all users. If not, unclarities about how it can be used arise which could lead to it not being used correctly or at all. Education of users therefore is important when implementing this system.

Creative session

This subchapter covers the creative session that was organised during the second half creative process.

Aim

So far it had been impossible so far the organise a large session the facilitate a diverging step in the creative process due to COVID-19. Therefore it was felt that any insights such a session would provide, could have been missed during the creative process until this point. To prevent this, an improvised creative session was organised to validate that the session results match the current developments of the concept.

Method

This creative session is based on the Brainwriting method (Boeijen et al., 2014). In line with this method 3 how-to's were created based on the criteria formulated in the Design Vision stage (section 4.4):

- How can you capture information?
- How can you score/grade something?
- How can you share information?

These how-to's were then written down on three different pieces of paper. With 4 participants and 3 pieces of paper, one participant had a rest period. During the session each participant would had 5 minutes to write down as many answers to the how-to questions as they could think off. After 5 minutes the pieces of paper were passed on to the participant on their left, allowing them to make a full circle during the creative session.

Participants

Due to COVID-19 it was not possible for any of the project stakeholders to join the creative session, this was also the case for any fellow student. Therefore the participants for this session were family members that were part of the same household.
Important to note is that none of the family members had ever participated in a creative session before. This meant that the results might not have the same level of depth as with experienced participants.

Results

The session resulted in a large number of solutions to the how-to questions. A number of these solutions were either the same or highly similar. To consolidate the number of solutions to a workable amount, ones that were similar were clustered together. This resulted in a number of solution clusters per how-to. An overview of these can be found in figure 5.2.

Conclusion

This session provided a large range of solutions for each of the how-to's. As with any creative session, the largest part of the solutions was not viable for this project. The solutions that were viable had already been previously identified and considered for the redesign. Therefore it was concluded that no real alternative solutions that could contribute to were missed in the creative process, but that the chosen solutions were validated in this creative session.

How can you capture information?

Textually	**Visually**	**Auditive**	**Cognitive**
- Writing	- Drawing - Photo - Videoing	- Recording	- Remember

How can you share information?

Textually	**Visually**	**Multi media**	**Verbally**
- Mail - Messaging - Pigeon - EPD - Refferal - Message board	- Gestures - Smoke - Drawing	- TV - USB-stick - Alerts - Video call	- Speech - Presentation - Meeting - Listening - Phoning - Radio

How can you score/grade something?

Visually	**Numbers**	**Behaviour**	**Structure**
- Diagrams - Colour - Thickness - Dark/light - Signs - Big/small - Scenario's	- Percentage - Scale 1-10 - Font size - Pricing - Factors	- Rewarding - Raise voice - Thumbs up	- Hierarchy - Award - Priority list

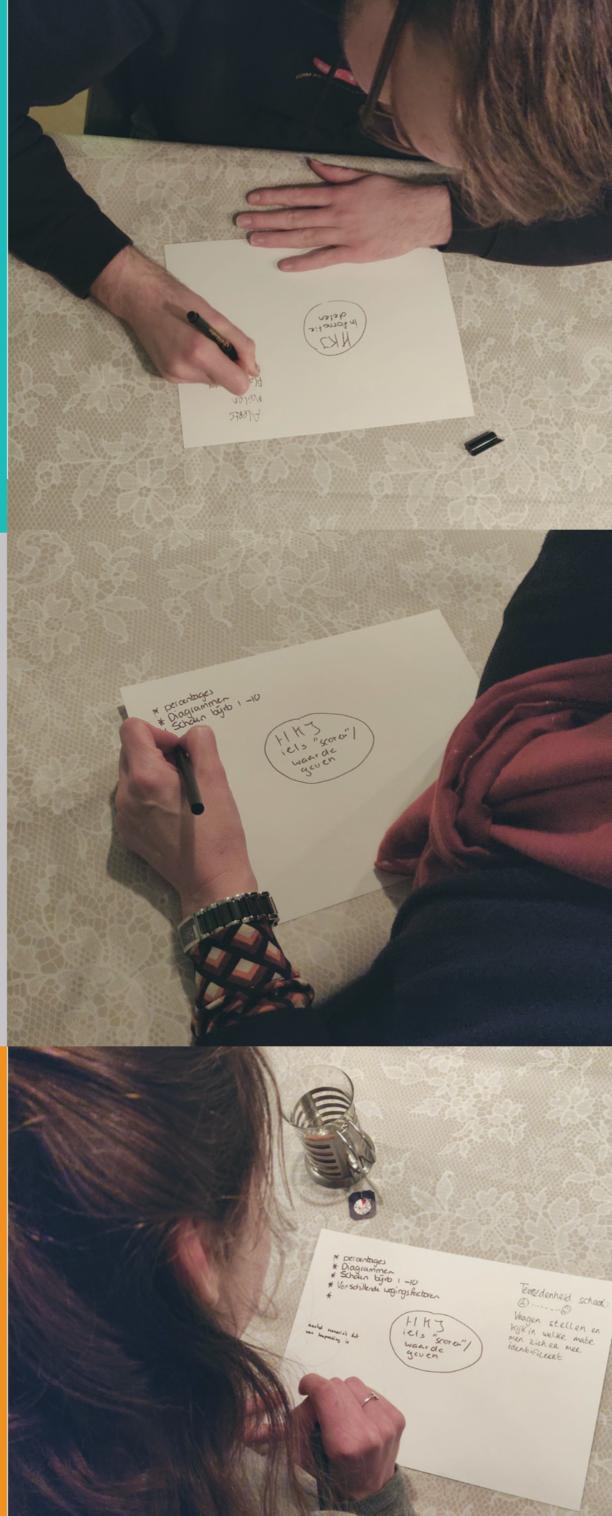


Figure 5.2,
creative session results and photos

Final Concept

6

Introduction

This chapter covers the final system design, called the Contextual Information Communication System (CICS). The goal of this system is to enable easier sharing of contextual information. This is done by including a completed contextual sharing tool with each referral. This tool provides an overview of the contextual information for a specific patient. The OS can use this additional information as a guide for a more efficient consult with the patient, or as a reason for contacting the GP directly. This increase in available contextual information can aid in providing care that fits better with the patient as a whole.

A more detailed look at CICS and its functioning will be given in the remainder of this chapter. This follows a four part structure:

- User journey
- Contextual sharing tool (CST)
- CICS as a system
- Implementation plan

6.1 User scenario

The best way to give a good overview is through a visual User Scenario as in figure 6.1. It demonstrates step by step how CICS will be used. Below you can find additional information for each step, to go along with the overview.

1 A patient with knee complaints visits the GP for a consult. Here the decision is made to refer the patient to the OS for further diagnostics and treatment.

2 The GP creates the referral documents as normal. Part of this procedure now is to also fill in the CST based on the contextual information of the patient. This allows the GP to include this information in the referral in a fast and intuitive way. The complete referral then gets send to the OS through the existing channels.

3 The OS receives the referral documents through the usual channel. He then uses both the textual document and CST to prepare his consult. The inclusion of the CST provides the OS with a basic contextual impression of the patient. From this the OS can use that information to tailor the anamnesis during the consult to find the underlying information of the CST.

4 The patients visits the OS for the consult. During the anamnesis, the OS asks targeted questions about the patients context by using the tool as a conversation guide. This way the patient has the ability to explain the contextual situation themselves. This information can then be taken into account when deciding on the next steps of the care trajectory.

5 If the contextual profile of the patient could not be explained during the consult, the OS can request a direct conversation with the GP. They plan this conversation through already existing channels like Siilo. The conversation itself can be held through phone or video conferencing channels that are already in use. This allows for the direct sharing of implicit and explicit contextual patient information between GP and OS. But due to the optionality of this step, it does not overburden the GP and OS with conversations that do not contribute new information.

6 Whether through the patient consult or direct communication with the GP, the OS now has a better understanding of the contextual information of the patient. This allows the OS to give a better informed treatment advice to the patient, which will result in better outcomes for the patient as a whole.

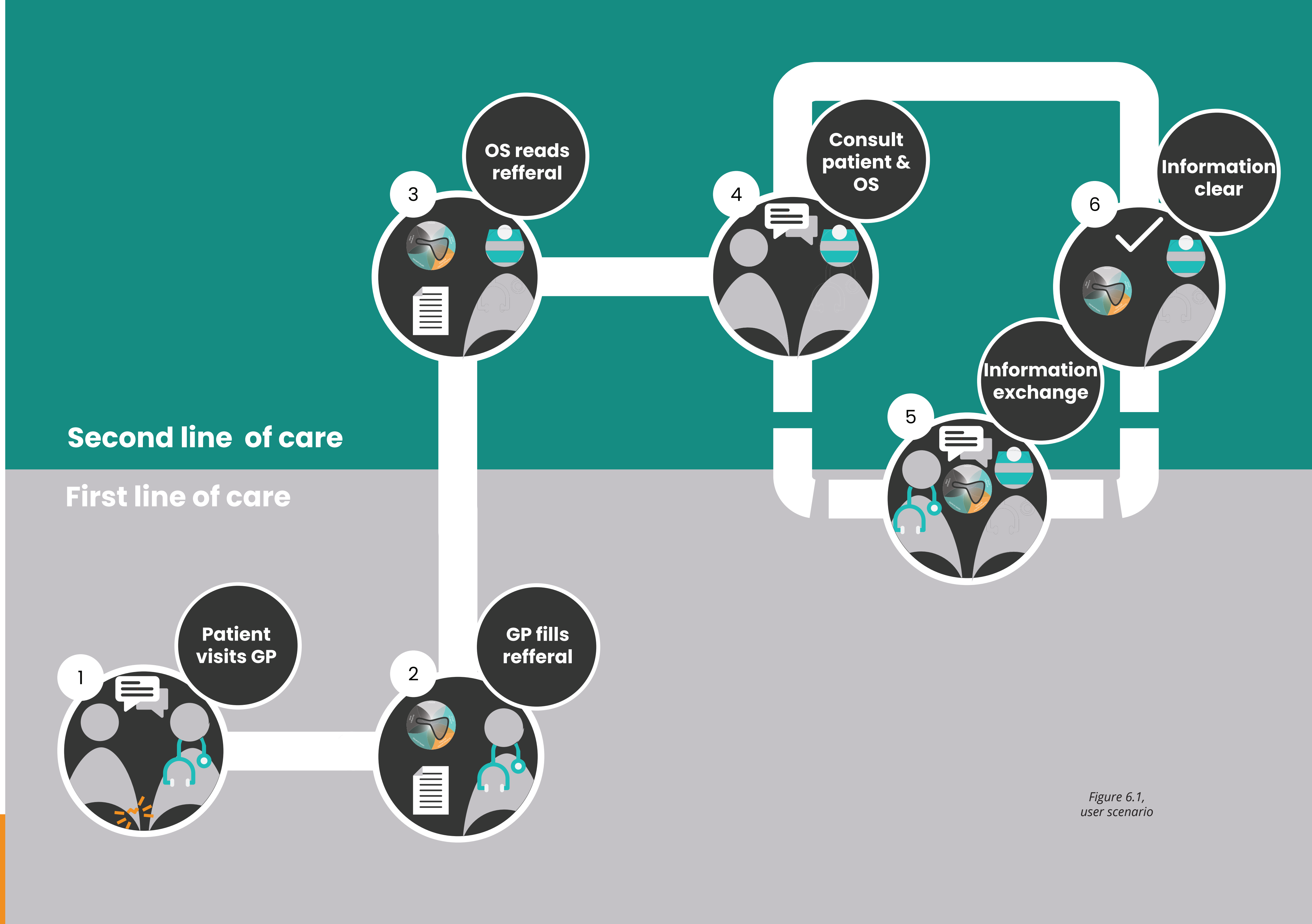


Figure 6.1, user scenario

6.2 Contextual sharing tool

The contextual sharing tool (CST) is at the center of CICS and enables the capture of an impression of contextual patient information. The CST is also the carrier of the information and is shared with the OS as a means of providing them with an impression of the contextual patient information. The contextual sharing tool can be divided into three main parts:

Information rubrics

The information rubrics represent what information can be captured in what fields of the tool. There are 5 different information rubrics for the contextual factors:

- General health factors
- Personal mental health factors
- Social factors
- Work factors
- Lifestyle factors

Each rubric covers a different type of contextual information and together to cover all possible contextual topics.

Visual layout

The information rubrics are displayed in the visual layout of the CST, figure 6.2. This layout exists of a circular shape divided in five equal sections; one for each rubric. These sections have their own specific colour. The colours have a gradient from nearly transparent to opaque from the center to circumference of the circle respectively.

Interactive patient profile

The previously mentioned gradients are used when placing the markers for the interactive patient profile This profile is the main point of interaction for the GP. It consists of five markers that can be moved between the center of the circle and its circumference, see figure 6.3. Each marker can be moved on an axis through the center of its respective section. During the positioning of the markers, the CST draws lines between each tool. The surface within these lines is then filled with a single opaque colour, creating a visual profile of the patients contextual information as seen in figure 6.4.

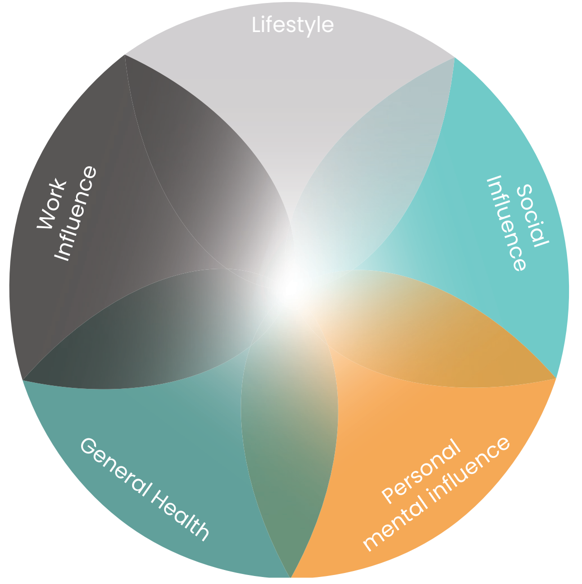


Figure 6.2, visual layout

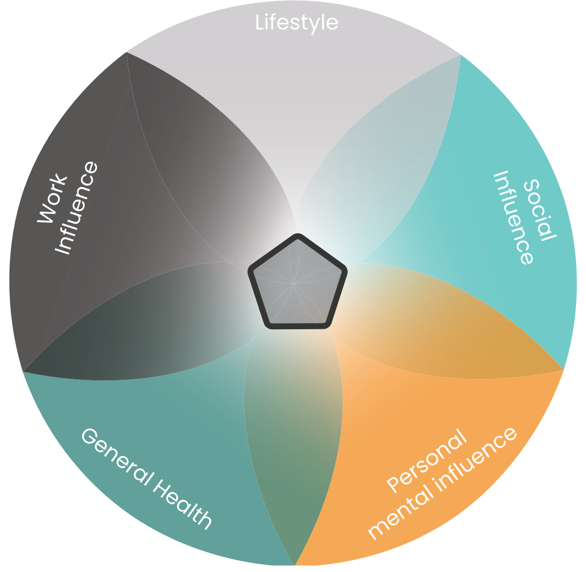


Figure 6.3, standard CST

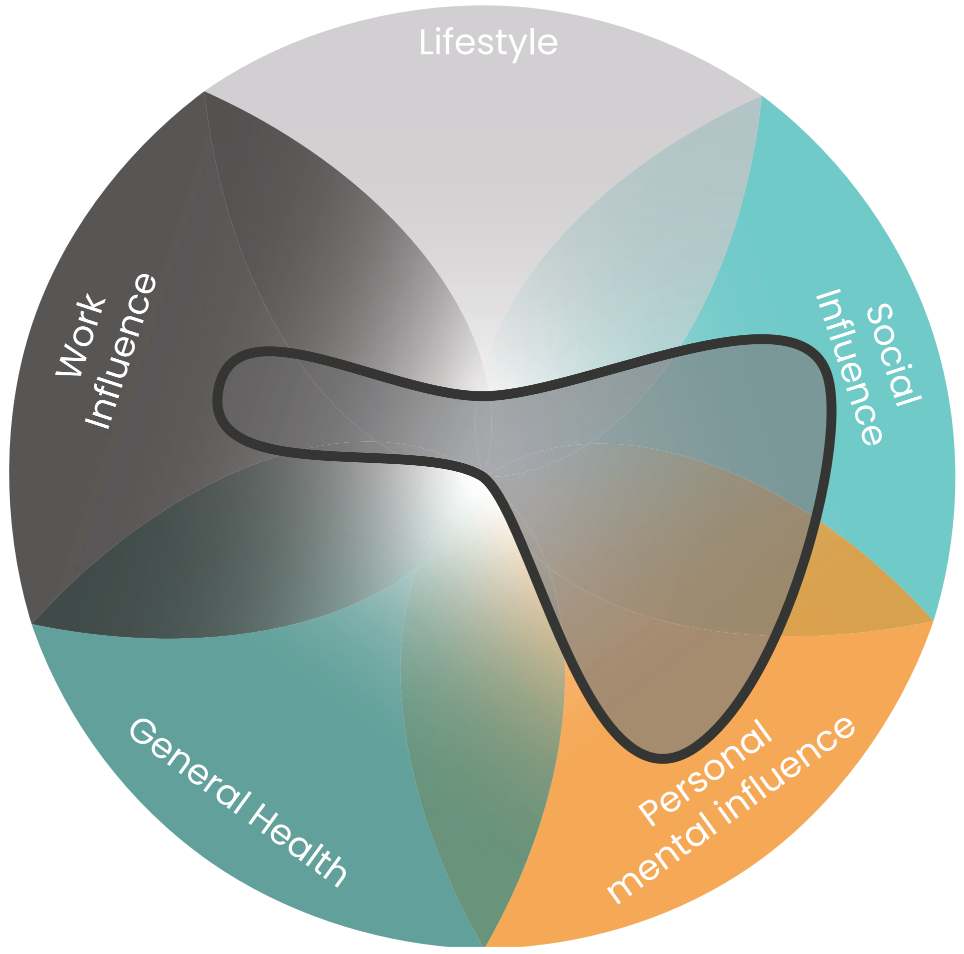


Figure 6.4, CST with patient profile

Entering information in the CST

To create the profile the GP moves the marker of the respective rubric, to a location in the gradient that matches best with the significance of that rubric for this patient.

This is then done for all five markers. The result is a profile that provides an overview of what contextual information is significant for this specific patient. A visual representation of this proces is figure 6..

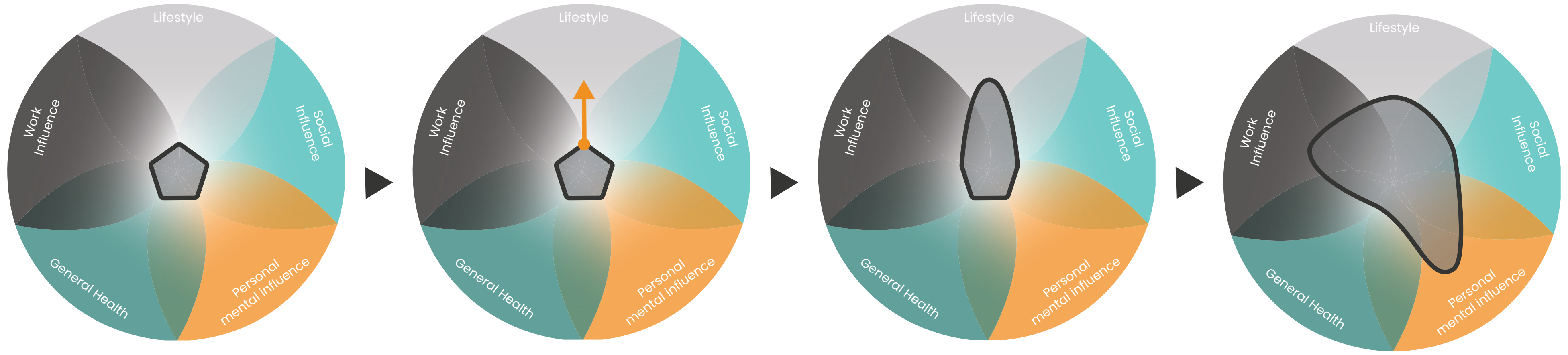


Figure 6.5, entering profile in CST

6.3 Routines and Integrations

Part of CICS functioning are a number of routines and integrations that allow it to function as intended. The two most significant are:

- Referral system integration
- Time allocation for communication

Referral system integration

To promote the inclusion of a CST for every referral, it is important that the CST is integrated into the standard referral routine. A potential effective and efficient way of doing is, is by making it part of the systems that are already in place to handle the referral. This could be including it in the options for a ZorgDomein referral process for example. Integrations like this make the system part of the already existing routine and software and prevents the creation of new separate systems that need to be learned by medical professionals.

Time allocation for communication

Time slots need to be created for the communication between GP and OS. This way, if the OS needs to use the ability to directly contact the GP, there is time available for this. A potential set-up could be a dedicated daypart for communications in every other week. It is recognised that this would reduce the time assigned to other medical activities. However, due to the improved health outcomes it is possible that care trajectories become more efficient and thereby shorter. This development then reduces the need for consults and cancels out the negative effect of the communication time slots.

6.4 System value

CICS as previously described has added value for the treatment decision making process, but also for a number of other contexts.

Decision treatment making process

Within the care trajectory, CICS can facilitate the exchange of implicit and explicit contextual patient information. With this information, the treatment providers involved in the care trajectory get a more complete overview of the patient. This allows them to advise the patient on what treatment is best for them as a person and not only their knee. As a result, care trajectories will fit the patients better and have better health outcomes.

The role of CICS within this process can be illustrated in a revised version of figure 4.7, resulting in figure 6.6. This shows how the CST serves as an enabler for the explication of the implicit patient information that the GP has. By sharing the CST, the OS then also receives this now explicated patient information, which he can use as described in section 6.1.

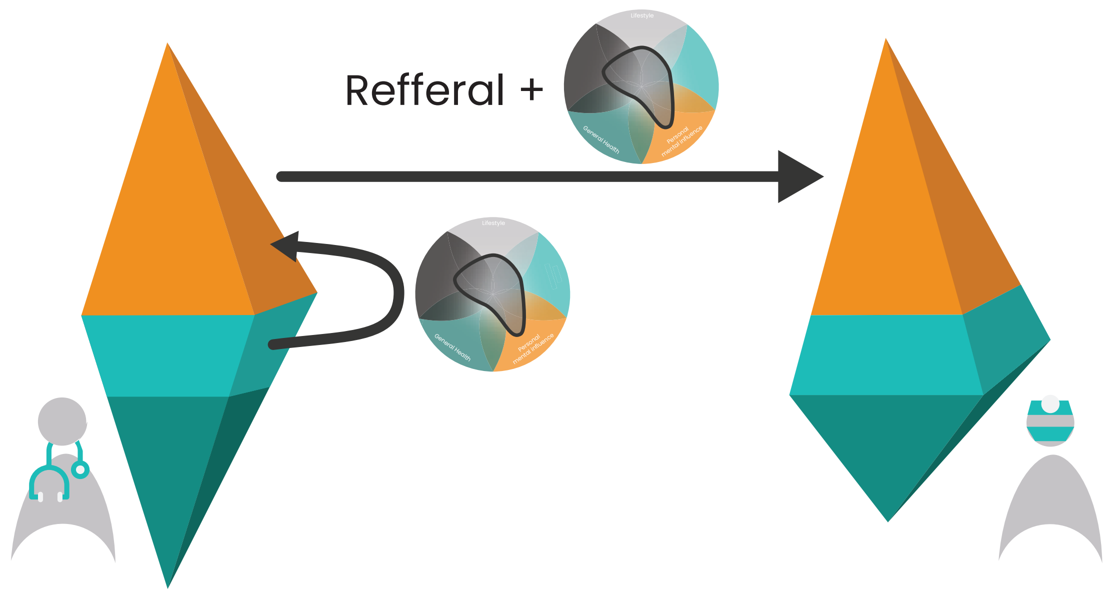


Figure 6.6,
Mental model with CICS

Networked care

The CICS also provides a value within networked care applications: the ability for the network of treatment providers to get an impression of the patient as a whole. Similar to the value for the regular treatment decision making process, it allows treatment providers to better advise a patient on the best care trajectory for them. It also allows the sharing of the contextual patient information within the network. This heightens the effectiveness and efficiency of meetings within the networks, as all treatment providers are already aware of the patient profile.

Value based healthcare

CICS also has value within the context of value based healthcare. It enables the treatment providers to take the contextual patient information into account, the care trajectory can be better tailored to the patient. This in turn can lead to improved patient health outcomes as described in the literature section 2.5.
Following the principles of value based healthcare as described in section 2.3, this will increase the patient value. When put into the central formula for VBHC the result is figure 6.7, depicting the relation between CICS and health outcomes. Through using CICS, the medical professionals are facilitated in taking contextual patient information into account. Because of this, the treatment decision will have a better fit with the patient as a whole as. In turn, this will have a positive impact on the health outcomes of the patient.

$$\frac{\text{Health outcomes}\uparrow}{\text{Costs}\downarrow} = \text{Patient value}\uparrow$$

Figure 6.7,
VBHC formula with CICS

CICS also works on the denominator side of the formula. By increasing the fit of the care trajectory with the patient, ineffective and unnecessary diagnostics and treatments can be avoided. This means that a cost reduction is possible.

The result is that by using CICS, the numerator side of the formula can be increase and the denominator side reduced. Thus creating a higher patient value in a very effective way.

If VBHC is implemented and financing is done on a patient value basis, this will positively impact the financial income for the treatment providers and stimulate CICS adoption and implementation.

6.5 Envisioned system applications

CICS has applications within a number of larger systems, such as the patient referral as described in section 6.1. A number of other application contexts were also identified, these will be elaborated on in this subchapter.

Patiënt conversation tool

A possible other implementation for the CST in direct contact with the patient. In this context, the patient would fill in the tool themselves before the consult with the GP. During the consult they would then discuss the tool which allows the GP to gather insight into the current state of the patient. The GP then fills in the CST in the referral with both the profile created by the patient and their own views as a basis. The process then follows the scenario as described in section 6.1.

Dynamic patient profiling

Another possible application is to use the CST as a living object during the care trajectory of a patient. This means that it not just a snapshot used during decision making, but gets updated at different points during the care trajectory. These points can for example be: after initial treatment, before and after surgery, before a referral to a physiotherapist. By updating the CST during the entire care trajectory, it becomes possible to follow the development of the patient during the care trajectory. This can provide good insight into what effect the treatment is having on the patient.

PROMS & PREMS

Another application context is by using the tool as part of the PROMs (section 2.3) for a care trajectory. The tool could indicate improvements in the patients contextual circumstances during the care trajectory. These could then ben taken into account when determining patient outcomes, in turn making the PROMs cover more information and thereby making them more complete. This increase in PROMs information then allows the OS's to better evaluate the care trajectory and its fit with the patient. Through this improved evaluation, current and future care trajectories can be adjusted for a better fit with the patient.

Network composition aid

The CST can also be applied in a care network where multiple medical professionals are involved with one patient, as described in section 2.4. In this context it can aid in determining what medical professionals should be involved in that patients care trajectory. If for example a patient has a highly significant amount of personal mental factors, it might be useful to include a psychologist in the treatment team.

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6.6 User evaluation

To evaluate CICS and identify point of improvement, an evaluation with users was done. This sub-chapter describes the evaluation set-up, the results and conclusions.

Aim

The aim of this evaluation is to receive feedback on the validity of the design as a concept and on how it can be used other than the proposed scenario. To achieve this evaluation, three questions need to be answered:

- What works well in the current design and its proposed scenario?
- What doesn't work well in the current design and its proposed scenario?
- Are there other applications for the design and if so, which?

Method

For this evaluation the method is based on the Product Usability Evaluation (Boeijen et al., 2014, p.133). This allows for the evaluation and validation of products within its actual use conditions. These conditions can either be real, or simulated. In this evaluation the conditions will be simulated, as due to the Corona outbreak a realistic setting is not achievable.

Participants

There are two main sets of participants in this evaluation, these are:

- OS's. They portray themselves in this evaluation and act as they would in the out-patient clinic.
- Medical students. They portray the role of GP, as currently the GP's are unavailable due to the corona virus outbreak. The medical students involved are nearing the completion of their study and therefore have a basic level of experience that enables them to do the evaluation in the place of GP's.
- Patients. The patients will be portrayed by me during the role-playing sessions.

Session set-up

The evaluation set-up is as follows:

First phase

A set of patient persona's are created (figure 6.8). These each have complaints which are in line with the needs for a referral. They also each have story which describes their personal context.

For each of these persona's a referral is created. This includes the usage of the tool from the design proposal. This is done by a student of medicine. Feedback from the students about the usage of the tool is registered.

Second phase

One of the created referrals is shared with an OS. They then have the chance to go read them.
A role-playing session is done of the first consult, with me as the patient. This allows for the evaluation of the tool as a conversation aid.

Persona 1: Peter

Peter is a 67 year old man. He did physical work in the harbour all his life. He has now been retired for 6 months.
He cycles and walks regularly. He has smoked his whole life and still does. He is also a type 2 diabetic. He is having to adjust to being home more often now, and this has impacted the relationship with his wife. This results in stressfull moments.

The reason for Peters visit is his right knee. It has become increasingly painful over the last 3 months. He has tried exercising more, doing physiotherapy and taking painkillers. However these do not provide enough aleviation of the pain to funtion in day-to-day life. The current suspicion he suffers from arthrosis of the right knee.

Persona 2: Linda

Linda is a 54 year old woman. She lives a busy life as a high level executive for a multinational.
She does not have much time to excercise, but does do yoga when she can. She has also been diagnosed with a burn-out 6 months ago and has been recovering since. Unfortunately this has resulted in s period of depression and stress.

The main reason for Linda's visit is pain in het left knee. She finds that it is very uncomfortable and so far physiotherapy and painkillers have not provided aleviation. She also feels that it should be looked at by a specialist as she does not want to live with the discomfort for long.

Figure 6.8,
Patient persona's Peter and Linda

After the consult, feedback is gathered from the OS. This is feedback on the tool itself, its role in the consult and how it has influenced their interaction with the patient. They are also presented with the ability to have a conversation with the GP, feedback is then gathered on if they would use this ability or not and why they choose for either option.

Analysis

After the sessions, the feedback from all participants is analyzed. This is done by writing down each individual statement made and turning them into points of improvement.
These points of improvement are then included in a design iteration that will result in an improved final design.

Results

The results of the evaluation will be discussed for each of the two phases separately.

Phase 1

The first phase of the evaluation had 2 participants in the form of medical students nearing graduation. They both created a normal textual referral and used the CST to create a patient profile for both persona's.

The textual referrals were highly similar between the two participants. These will not be elaborated upon further as they are not the main topic of this evaluation and also will not be altered when using CICS instead of the current referral system.

As both participants created a CST for each patient persona, the result of the first phase are 4 different CST's. These are displayed for each persona as seen in figure 6.6, 6.10, 6.11 and 6.12.

For persona Peter, the CST made by participant 1 (P1) is characterized by an emphasis on the work influence, general health and lifestyle factors. The CST made for persona Peter by Participant 2 (P2) has an emphasis on the personal mental health influence and social influence with a slightly lower general health and lifestyle factors. As can been seen in figure X this results in two inherently different CST's.

For the second persona, Linda, the CST as made by P1 is characterized by high significance of all rubrics apart from work influence and general health. The latter two are scored at around medium significance. The CST made by P2 for persona Linda has a strong emphasis on the Work influence and personal mental influences with lower significances on social influences and lifestyle rubrics. This again results in highly different CST's as can be seen in figure 6.9, 6.10, 6.11, 6.12.

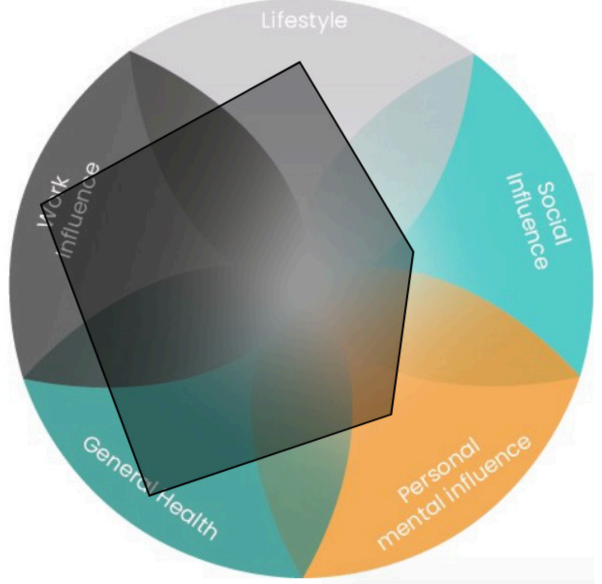

Figure 6.9,
CST of persona Peter by P1

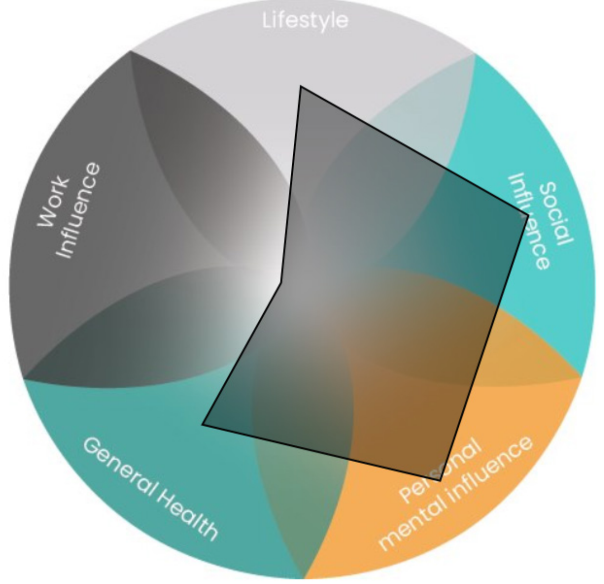

Figure 6.10,
CST of persona Peter by P2

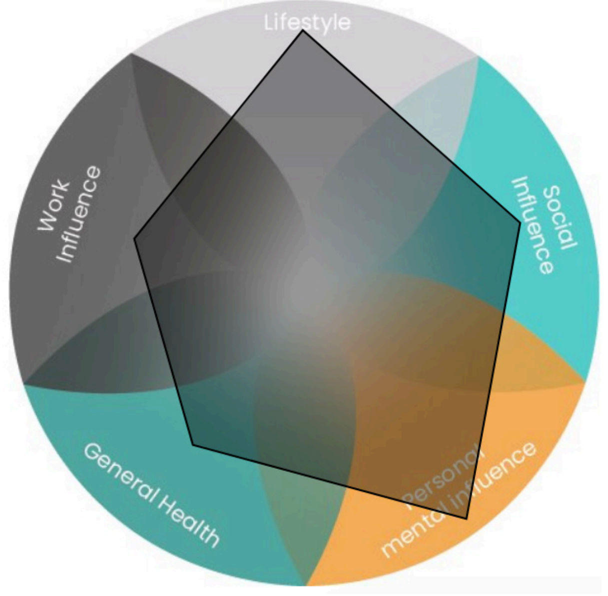

Figure 6.11,
CST of persona Linda by P1

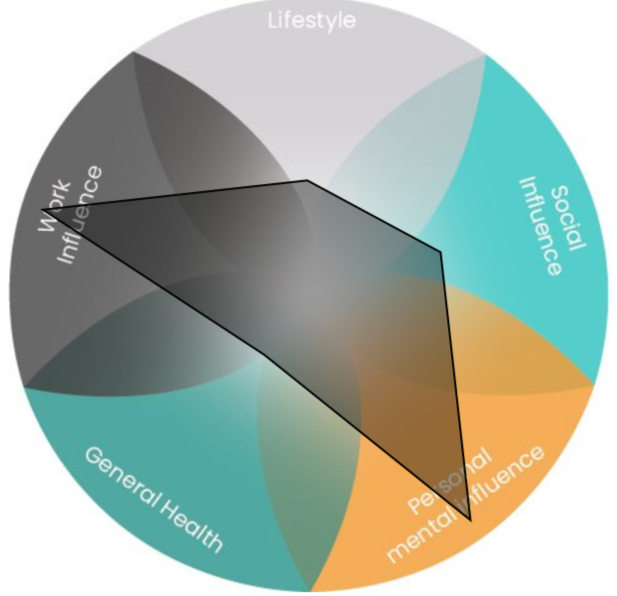

Figure 12,
CST of persona Linda by P2

The final part of the first phase was the feedback sent in by both participants as answers to the research questions formulated at the start of this section.

What worked well in the current design and implementation?

P1
- Ease of use
- Fast overview of patient without time intensive reading
- Forced to think about own judgements of a patient.

P2
- Ease of use.
- Nice design.
- Provides insight in information that is not currently included in a referral.

What did not work well in the current design and implementation?

P1
- The tool is subjective and its result likely differs between users.
- The information could influence the judgement of the OS, when a clean slate could be beneficial.

P2
- For some factors the placement of the profile is hard to decide.
- Hard to see how points in the profile are placed in relation to each other.

Are there other implementations for the design?

P1
- Providing information in patient transfers (between specialists or specialists and assistants).
- Patient self-education by providing insight in potentially influential factors in conditions or symptoms.
- In referrals from OS back to GP, by the OS filling in their own views so the GP can compare the two.

P2
- Let the patient fill in the tool as well as the GP.

Phase 2

As described in the set-up the second phase of the evaluation consisted of sessions with OS's in which patient consults were simulated through role-playing and feedback gathering through the questions described previously. There were two OS's participating in these sessions, which will be referred to as OS1 and OS2.

The initial referral that was shared with OS1 for the consult was the referral and CST created by P1. From the consult came a number of insights:

- The CST did not match with the patient in the eyes of the OS
- This mismatch lead to the OS going into the consult with the wrong focus for the anamnesis
- The mismatch was corrected quickly due to anamneses being focussed on it
- The profile is a snapshot of the patients current context
- Need for thorough instructions for GP on how to use the CST
- Certain words in a referral can be a 'red flag' without the CST
- The points of the profile are indicative of the information, the surface it creates on the CST is not. The current CST could cause confusion on this.
- The goal of the CST should be explained to the patients.

For the consult with OS2, the referrals made by P2 were used. This session resulted in the following insights:

- Seeing a patient face-to-face is very valuable for an OS as it allows them to create a better picture of who the patient is as a person
- There is a risk of over information if the CST and textual referral show the same information.

Both OS's also provided feedback through answering the previously formulated reserach questions. These were their answers:
What worked well in the current design and implementation?

OS1
- Provides a fast overview of patient context
- Can direct anamnesis and thereby make a consult more efficient

OS2
- The CST provides a fast overview of the patients contextual information

What did not work well in the current design and implementation?

OS1
- The GP needs to create the profile in the correct and intended way. Otherwise it can misdirect a consult. These misdirections can be quickly corrected however.

OS2
- There is a risk of having information double in both textual referral and CST. This could be a problem as it could waste valuable time.

Are there other implementations for the design?

OS1
- The CST can also be used when referring the patient to other specialists or treatment providers like physiotherapists.
- The CST can also play a more direct role in consults by going through the profile during a consult with the patient.
- The design can also be implemented in internal meetings on patients, to get all involved treatment providers on the same level of knowledge on the patients context.

OS2
- The CST can also be used as a standard part of the patient dashboard in the electronic patient file. With it updated before every check-up by the patient. This would provide the OS's with a current overview of the patients contextual information and allow them to compare them with the last CST as a means of evaluating treatment progress.

Analysis

The analysis for the evaluation will be split up into two parts:

- A discussion based on the results of the first phase
- A discussion based on the results of the second phase

First phase discussion

From session results

From the differences between the CST's made by P1 and P2 it is clear that two different approaches were used. This can be explained when looking at the created profiles combined with the data given to both participants in the persona's.

For example, persona Peter used to perform physically demanding work, but has been retired for 6 months. Despite this, P1 entered a high significance for the work influence rubric while P2 did not, as seen in figure 6.9 and 6.10.

A reasoning for this is that the physical labour performed by Peter could indeed have contributed to the creation of his symptoms. However at the current time, he no longer performs this work and it is therefore not part of the snapshot of his current contextual

From this example, a trend can be identified in the approaches by both P1 and P2. P1 has scored the information in the CST based on the likelihood of the information having an effect on the direct symptoms of the patients. While P2 has used the CST as a method for creating a snapshot of the current contextual situation of the patient. This means that the usage of P1 does not fit with the main goal of CICS, which is providing a contextual overview of a patient at the time of referral.

The reason for this incorrect usage is likely to be in the information and education givven on how to use the CST and the main goal of CICS. The participants both received short instructions which allowed for different interpretations of the use. This likely resulted in P1 using the CST as a tool to indicate potential underlying contributors to the symptoms, while P2 used to tool to create the contextual snapshot.

The main takeaway from this is the importance of thorough education and information for the users of CICS and the CST.

From feedback

The feedback provided by P1 and P2 indicates that the CST is easy to use from a usability standpoint. From this feedback also comes that it provides fast insight into information that is not currently shared in this manner.
A noted side effect of CICS is that it confronts the GP with any prejudice that exists towards a patient. This was not an intentional effect, but could have a positive impact on how the GP perceives patients.

A concern voiced by P1 is that the tool is subjective and will likely differ between GP's for the same patients.
It is likely that the profiles created between different GP will indeed differ, this is also displayed in the differences between the CST's created by P1 and P2. Subjectivity is part of the implicit nature that the contextual information can have, therefore CICS was designed with the subjectivity in mind. Because of this, subjectivity is not a problem for the usage CICS and can be made to have little to no impact.

A large reason for this is that since the CST does not contain specific information, the OS will always need an interaction with the patient and possibly GP to get the underlying information. In this interaction any misinformation can be corrected. This works well for the smaller differences between CST's like a small difference in score for a specific rubric. Large differences can be avoided the correct instruction and education of GP's in how to use the CST and what its goals are.

The feedback also indicated a usability issue of the points being difficult to see in relation to each other. This indicates that creating further iterations of the CST to solve usability issues is necessary.

Another point of concern was that the profile could prejudice the OS and therefore taint their view of the patient. It was argued that in some cases it could be better to have the fresh view of the OS as a complete blank slate.

While this can be true for some cases, literature (section 2.5) indicates that the ability for the OS to take this information into account is beneficial for the health outcome of the patient. As a professional, it is the OS's responsibility to not allow information on a patient to result in significant prejudice.

The other potential implementations of CICS and the CST indicated in the feedback align with the ones identified in section 6.5. Therefore they provide no new insights but do serve to strengthen the ones identified in the previously mentioned section.

Second phase discussion

From session results

The first session showed that a there is a possibility for an OS to be misled by a incorrect CST. In the case of OS1 and persona Peter it resulted in the OS focussing on the wrong information rubric in the first part of the anamnesis.

However, because the OS was now focussed on gather more information on that rubric it was quickly discovered that the CST was incorrect during the anamnesis. So while it is possible for a CST to mislead an OS, the consequence of this is small because the focus on the wrong area leads to the discovery of the incorrect CST. Therefore this error could be seen as self-correcting.

Naturally incorrect CST should be avoided. As already identified previously, the reason for the incorrect CST was the insufficient instruction and education of the creator of this CST. From this session also came the clear need for thorough instructions and education of the GP. This session added to this that feedback from the OS to the GP could aid the GP in improving the correctness of the CST's in the future. The main takeaways of this session are the need for thorough instruction and education of users and the ability for the OS's to provide feedback to the GP's.

The second session showed strong indications for the benefits of having a fast visual overview of the patients contextual information. OS2 found the visual highly useful in providing a quick overview of the patient.

What also became clear was that face-to-face contact remains vital for the OS to get a picture on who the patient is. OS2 even described looking at the portraits of patients before a consult to get an idea of who the patient is.
One of the most emphasised points made by OS2 is the need for both textual and visual parts of the referral.

While the CST as a visual part provides a fast general overview, it does not convey details. The textual referral might not provide as quick of an overview, but just single words in it like depression or burnout are a red flag for the OS. A combination of both therefore is optimal, with the CST as a quick visual representation and the textual referral for more detailed information.
Important to note however is that the role of the CST can differ per patient. For most patients, it will not show any significant deviations from the information available in the textual referral. However, for a small group of patients there will be differences. These patients are likely to also be the 'complicated' patients where additional attention is needed and where implicit contextual information can play a large role in the care trajectory design. As there apparently is more significant information to them than can be documented in the standard textual referral.

From feedback
From the feedback came that the CST provides a fast overview of the patient context and therefore helps focus a consult on the relevant information. This results in more efficient consults and can help to shape an image of the patient before the consult.

It was also shared that there are still risks with the use of the CST as it can either be used incorrectly or lead to over information which both can lead to inefficiency in the consults.

The other implementations discussed with the OS's during the evaluation are highly similar to the ones described in section 6.5. With the idea of the CST as a dynamic patient profiling tool being one of the most emphasised.

Conclusion

Conclusions can be drawn from the evaluation and its results as described above. This is done by answering the research question posed at the start of the evaluation.

What works well?

- The CST allows for easy and fast entry of contextual patient information by GP's.
- The CST also provides a clear and fast overview of this information to the OS's.

What does not work well and should be improved

- The usability of the CST should be improved as its current visual design can make creating the profile more difficult.
- There is a clear need for instruction and education on how to enter information and read the CST.

Are there other applications for the design?

- Yes, they align with the envisioned applications described in section 6.5

.

From the points above comes that the CST fulfills the design goal set in section 4.2 by enabling easier sharing of contextual patient information between the GP and the OS.
However, there are still improvements to be made before CICS can be implemented on a larger scale. Therefore the next step should be designing a recommended implementation plan that provides opportunity for further testing and development of CICS and the CST.

Recommendations 7

Introduction

This chapter provides an overview of recommendations for the future on three levels:

For CICS as a concept.
For the dream dinner project team with regards to the continuation and implementation of CICS.
Other areas of interest that were identified during the project and could be explored further.

This split allows for recommendations to be given on three different levels of abstraction from CICS. This is visualized in figure 7.1.

7.1 Recommendations for CICS

These recommendations are directly related to the the design of CICS and come from the concept evaluation (section 6.6) and insights gathered during the project.

CST usability

The evaluation showed that the usability of the CST should be improved. Currently its usability is sufficient for concept validation, but is has not been optimized for implementation. In depth development of the CST usability should be dan to optimize the entry and review of information. A method for doing this could be an internship or graduation project for students within the Industrial Design Engineering faculty. They could perform an in depth project into how the CST can be optimised for the information is aims to convey and its users.

Design of an instructional and educational package

The evaluation clearly illustrated the consequences of incorrect usage of the CST. While these consequences are likely to be corrected, the goal should be to avoid these if possible. A good way to achieve this is by designing thorough instructions and education that can be provided to the users. This allows current and existing users to gain knowledge on how CICS is used and what it goals are.

7.2 Recommended implementation roadmap

The roadmap described in this subchapter provides a recommendations for how the project can best be continued after the ending of the graduation project. This roadmap is based on the different types of research done in this graduation project.

Roadmap

It is important to note that a implementation roadmap could be the topic of a graduation thesis by itself. This is also why the implementation roadmap described here is under the recommendations chapter and should be seen as an initial suggestion. Although it is based on research done in this project, there is a high probability that are things which are not included also play a significant role in the implementation process.

The roadmap created in this subchapter is based on the methods described by Simonse (2017) and is represented by figure 7.1.

The roadmap is divided by three strategic horizons. These horizons can also be seen as major milestones in the implementation and development of CICS. These are:

- CICS pilot
- CICS implementation
- Expansion of CICS implementation

They are also depicted in figure 7.1 near the top row of the visual.

CICS pilot

The steps that are recommended to take towards the creation of a pilot of CICS are the following:

Creating a dedicated project team
It is recommended that a dedicated project team is created for the further development and implementation of CICS.
The current dream dinner project team could take this responsibility, as the goals of CICS and the dream dinners are aligned in stimulation of interaction between medical professionals. Because of this parallel between networked care and CICS, it is also likely that the requirements for their effective functioning are similar. Based on the literature as seen in section 2.4, this means that the project team should provide:

- Strong leadership
- Sufficient resources
- Intensive stakeholder involvement

It is likely that CICS will not be implemented if these requirements are not met.

Gathering of a small group of motivated stakeholders.
In order to create a pilot, participants are needed. These participants need to be motivated to try CICS and improve it by providing feedback. This group

should consist of all involved stakeholders and users.
The first steps towards gathering such a group of stakeholders were already taken during the dream dinners as mentioned in section 1.2. It is therefore recommended to continue building on these steps and create a core group of stakeholders to participate in the pilot.

Approach insurers for financial resources
As previously mentioned, one of the requirements to be fulfilled by the project team is the presence of sufficient resources. One of the most important resources is funding, as this allows for the project to continue and therefore for CICS to develop.
A potential financial partner for this project could by a health insurer with an interest in applying the principles of value based healthcare. This because of the method in which CICS fits within value based healthcare as described in section 6.4. Even though CICS will not have been proven in actual usage at this point, it is recommended that insurers are at least approach to allow for potential future collaborations.

Promote further iteration on the CICS design
As already described in the CICS related recommendations, the current design is conceptual and needs further development. While this could be done simultaneously with the pilot running it is recommended to already start projects to iterate on the design.
In the previously mentioned CICS related recommendations is also described how this can be done through cooperation with the TU Delft.

Set-up pilot plan
Before the actual pilot can be started a plan should be created that states the aims of the pilot and how these are to be achieved. A recommendations for these aims are:

- Find additional points of improvement for CICS
- Experiment with different communication channels

Other aims of the pilot can be formulated by the project team with input from the stakeholders.

CICS Implementation

These are the recommended steps towards the complete implementation of CICS for all knee arthrosis care trajectories at the OC.

Approach potential partners to fulfill CICS system requirements
As described in section 6.3, CICS has two main requirements that need to be met for it to function effectively. One of these is an integration into the current referral systems. To enable this, partnerships are needed with providers of the current referral systems. An example of a potential partner is ZorgDomein, as the field study showed that they offer one of the most prevalent referral systems in use.

Inform participating patients
Because the exchange of contextual information as in CICS is new, it might raise questions amongst patients. It is therefore important to address these by informing patient of the use of the system and why it benefits them.

Expansion of CICS implementation

The following steps are recommended for the expansion of the CICS implementation to other care trajectories within the OC

Build brand around CICS
A potential next step from this is to actually start using the more holistic approach that CICS helps facilitate in the branding of the OC towards patients and potential new users.

Select and set-up pilots in other care trajectories
Because different care trajectories also differ in the way they are set up, it is wise to create individual pilot plans for each trajectory. It is recommended to create these in cooperation with the new stakeholders of these trajectories that are not already involved in CICS. This way the requirement of stakeholder involvement gets expanded to the new care trajectories.

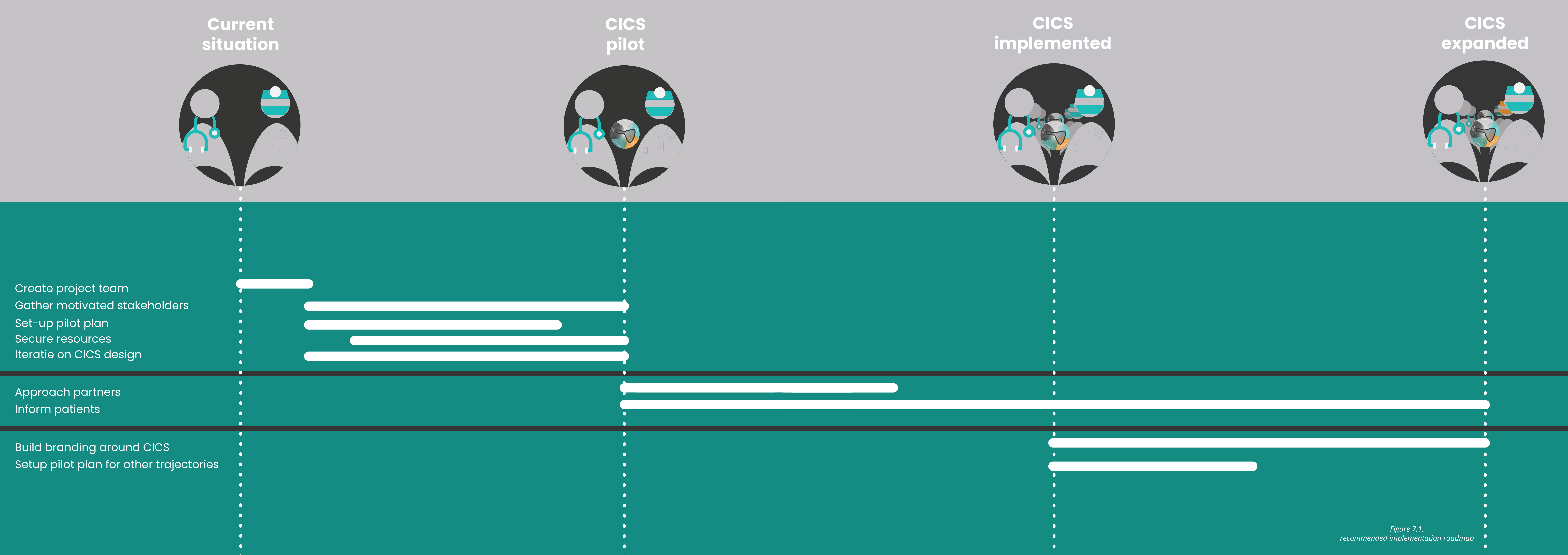

Figure 7.1, recommended implementation roadmap

7.3 Other areas of interest

Besides the recommendations described above, there is also a category that is not related to CICS or the project. This category consists of observations made during the project that could prove interesting to explore, but were not included in this project.

Integration of work & care

From both the interning sessions and interviews came a patient wish for better integration between work and care. This was most strongly represented by the wish for a better method of planning surgeries that would allow for time to make arrangements at work. The patient would feel like they were abandoning the employer, with the current short term planning for the exact surgery date. It was recognized that this planning is heavily influenced by short term factors, but a more specific indication could help. Further exploration of this perceived problem could be valuable to the care trajectory.

Filtering of consults

From the other observations during the interning sessions, comes that some consults have almost no added benefit. This is especially true for the 1 year post surgery check-up consults. As described in appendix C, these consults have almost no added value to either treatment provider or patient. Therefore it is recommended to evaluate the current protocols for consults and discontinue the ones that have no real value for patient and treatment providers.

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8

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Visuals
Illustrations, photos and icons sourced from: Freepik.com

Appendices

9

Appendix A: Project boundary research

Research was done to determine the boundary of the project. As stated in the report, an effective way of setting boundaries in a healthcare project is by focussing on a single condition. This process is explained in this appendix

Aim

The aim of this research is to determine what orthopedic condition is the most desireable to focus on the the graduation project. In order to determine what condition is most desireable, criteria that this condition should meet were formulated:

- High financial impact of the condition. Increasing efficiency and thereby reducing costs is one of the goals of the redesign. The higher the initial costs, the more effect the redesign can have.
- High patiënt impact. Another project goals is to provide more and better care options for patients. Therefore the more impactful the diagnoses and treatments for patients, the more effective the redesign will be.
- High occurrence rating. For the redesign to have the most affect the condition of choice should be occurrent. A redesign for a niche trajectory will not have the same impact and will also have less opportunities for improvement.

Method

To validate the knee arthrosis trajectory for these criteria, statistics research was used.The data for this validation was sourced from the Nederlandse Zorgautoriteit (2019) and the CBS (2019).

These datasets will be cross referenced to come to a conclusion on which condition fits best with the criteria described above.

Result

The cross referenced data gave the following results. This data covers 2017 for The Netherlands, as it was the latest complete dataset at the moment of conducting the research.

The top 5 most occurrent orthopedic conditions are:

Knee arthrosis	136024 patients
Hip/pelvic arthrosis	64764 patients
Meniscal lesion	55059 patients
Bicep impingement	45416 patients
Endoprosthesis check	40845 patients

Total cost per condition on a yearly basis:

Knee arthrosis	€ 292.887.350,-
Hip/pelvic arthrosis	€ 234.154.450,-
Meniscal lesion	€ 63.658.585,-
Bicep impingement	€ 34.048.415,-
Endoprosthesis check	€ 7.527.175,-

In order to judge patient impact, the number of patients undergoing the most impactful treatment can be used. Because the most impactful treatment is often a surgery, this treatment was used for this statistic. Also the total costs of the treatment are included, to indicate the financial impact of the treatment.

Knee arthrosis- total knee replacement:
24953 patients / €228.326.940,-

Hip/pelvic arthrosis - total hip replacement:
24333 patients / €206.824.000,-

Meniscal lesion - large knee surgery
18923 patients / €37.790.760,-

Bicep impingement - large shoulder surgery
3372 patients / € 11.867.925,-

Endoprosthesis check - diagnostics
2916 patients / € 1.768.710,-

From all the data described above follows that:

Knee arthrosis is the most occurrent orthopedic condition
Knee arthrosis is the most expensive orthopedic condition on a yearly basis
Knee arthrosis has the highest number of patients undergoing surgery, with the highest total cost for the treatment.

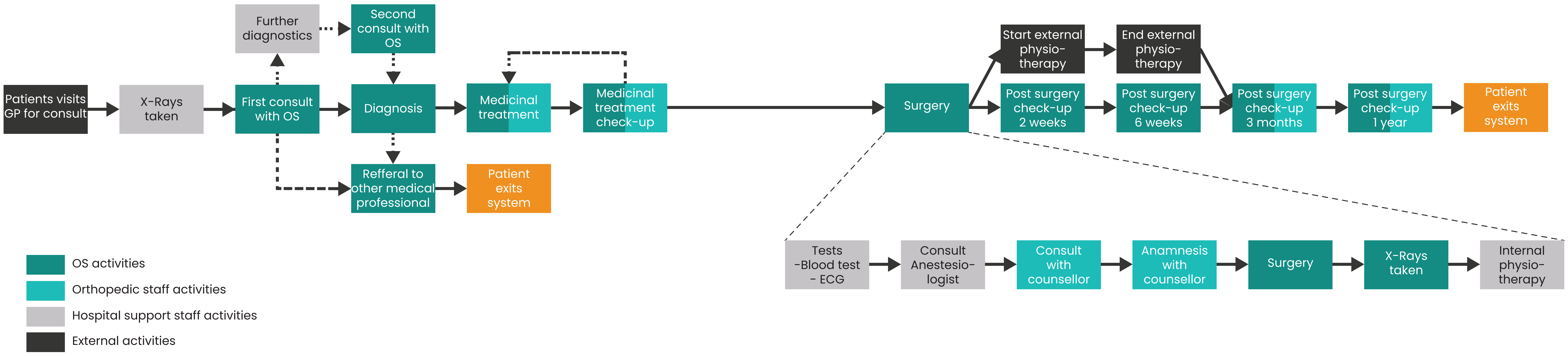
Conclusion

From the data above the following is concluded:

Knee arthrosis scores highest on the occurrence criteria, as it is the most occurring orthopedic condition
Knee arthrosis also scores highest on the financial impact criteria, as it is the condition with the highest annual costs.
Knee arthrosis also scores the highest on patient impact. It is the conditions with the most diagnosed patients and has the highest number of patients undergoing the most impactful treatment.

From the statements above it is concluded that the condition that best fits as the project boundary is knee arthrosis.

Appendix B: Care trajectory flowchart



Appendix C: Other interning observations

This appendix summarizes the other observations that were made during the interning session that were not significant within the project.

- The 1 year post operative check-up serves hardly any purpose. This was also explained by the physicians assistant that I joined for that session. He argued that if there is a problem, this comes to light at the 2 or 6 week check-up. If problems do arise after this date they tend to be severe and the patient will almost always contact the hospital themselves. If not, the 3 month check-up will catch any issues that have not been noticed before. This makes the 1 year check-up obsolete, with it not even mandatory according to protocol.
- The current computer systems are not fully optimized for quick and easy use during consults. They have been significantly improved over previous iterations, but still can negatively impact the workflow during patient consults.
- During the interning sessions, it became clear that patients have a preference for consults by phone. This is especially the case for check-up appointments and patients who do not have any complaints.

Appendix D: Interview research set-up

Introduction

The goal for this specific research is:

'Identifying problems and best practices within the current care trajectory for knee arthrosis, based on the professional and personal experiences of medical professionals and patients'

In order to achieve these goals, the following research questions will be used:

- How is the system for the care trajectory for knee arthrosis currently organised?
- How is the (perceived) flow of communication experienced between stakeholders in the knee arthrosis care trajectory?
- In what ways can the system around the current care trajectory for knee arthrosis be improved?

Method

The method for this study will be one-on-one interviews with all the predefined primary stakeholders in the knee arthrosis care trajectory.

Participants

The participants for this study will be one of each of the predefined stakeholders and a minimum of 3 patients. Resulting in the following list:

- Orthopaedic specialist
- GP
- Patients

Recruitment

For the medical professionals recruitment will be done through the use of direct contact and emails. Using the dream dinners, organised by the management of the OC, as contact points for engaged potential participants.

Patients will be recruited in the hospital while visiting an orthopedic polyclinical consult. The patients that will be approached, either have gonarthrosis or have a consult for the likely diagnosis of gonarthrosis. They will be approached using the methods that are already in use for medical research.

The preferred way of of taking the interviews is face-to-face. However alternative methods like videoconferencing and phone calls can be used if meeting in real life turns out to not be possible within a reasonable timeframe.

The interviews will be guided with preformed questions. This allows for the interview to stay on track and provide the needed research data. This in turn will ensure the research questions are answered.

The prepared questions are:

- How do you feel about the current relationship/interactions you have with your patients/treating medical professional?
- What would your ideal relationship/interactions with your patients/treating medical professional look like?
- Could you give an example of what you experienced positively in the current system?
- Could you give an example of what you experienced negatively in the current system?

Analysis

In order to process the interviews, they will be recorded using a phone. This allows for later playback of the interview for analysis.

During this analysis, the recording of the entire interview will listened to and summarising notes will be made. This will be done for all interviews. These will then be clustered in groups with similar thoughts. These clusters represent similar needs or wishes among all interviewees. This allows them to serve as a source for the requirements for the redesigned system.

Materials

A specific set of materials can be used to help the participant remember their experiences. This is relevant as it allows for a more complete answer to the research questions.

Potential materials for the interviews therefore are:

- Blank paper for the participant to write/draw on.
- A list all known stakeholders, as a backup.
- A schematic system overview, to fill in blanks in memory.

The use of these materials will not always be the exact same. Their use depends on how the interview unfolds and how well the participant can answer the premade questions. If the participant seems to struggle with remembering the process or is focussed on a specific part, the materials can help them remember or expand their thoughts.

Alternative method

The method described above relies on the input from directly relevant stakeholders. Meaning local and involved medical professionals and patients. In the unfortunate case that it might prove difficult to hold interviews with these stakeholders, it is important to have an alternative. This alternative would be to find different stakeholders to interview. This could be relatives or acquaintances who have the same roles as patient or medical professional, but without the local aspect. This would widen the patient and medical professional searchfield, making for a more likely interview opportunity.

There is also the possibility that planning and logistics makes interviewing stakeholder difficult. In this case alternative communication methods can be used. This can be video-conferencing through Skype or even phone calls.