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How Barriers and Facilitators of Virtual Reality E-health Technology Implementation can be Used to Conform a Website to Practitioners.

A Qualitative Study on the Perspective of Practitioners on VR Implementation Combined with a Literature Review, with Results Leading to the Development of a Website through a User-Centred Design Process.

Master Thesis

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There is a need for innovative healthcare applications: the world is ageing and de-greening, resulting in a decreased working class and a significant shortage of staff in healthcare. Technology seems to provide the solution for this problem. One of these technologies is virtual reality, since it has potential to induce realistic psychological and behavioural responses. However, this technology needs to be implemented in healthcare institutions before it can reach the patient. Therefore, this study focusses on what companies can do to support practitioners to implement their technology. The technological example used throughout this study is Reducept, a virtual reality application for people suffering from chronic pain.

First, barriers and facilitators are identified through a literature review, direct observations and interviews with healthcare professionals. Since barriers are always present, facilitators can be implemented by companies to reduce these barriers. An ordered list is created of estimated cost-efficiency per facilitator to help companies decide which combinations of facilitators can be implemented within their business to support the implementation process.

Moreover, the inclusion of these facilitators need to be communicated to the healthcare professional. A practical example of this, in the form of a website, is included within this study. Together with stakeholders and through a user-centred design process, wireframes for the website of Reducept are created.

Companies need to focus on deciding who their product is suitable for, which will give practitioners more confidence for implementation without thorough clinical evidence. In addition, companies should raise awareness for their technology by focussing on the needs of the practitioner. In general, collaborating with practitioners in both these aspects is crucial for success.

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1. Introduction

This chapter introduces the research study by describing the problem, identifying the goals and possible challenges that arise throughout the study, formulating the research questions and explaining the context in which the research study is performed. At the end of the document, a document structure is presented to provide an overview of the remainder of this thesis.

1.1. Problem Statement

Over the years, the amount of technology we use in everyday life has increased immensely. Moreover, people have been acquiring more technological skills than ever before, making it possible for a larger part of society to contribute to new technological products. This, in combination with the increased possibilities of technology, has caused an increase in the offer of diverse technological solutions in many different domains, such as healthcare (Heinrichs et al., 2012).

There is a need for innovative healthcare applications, since the world is ageing and de-greening (Lutz et al., 2008). According to the 'World Population Prospects: the 2017 Revision' report, it has been estimated that the amount of older people will be more than doubled by 2050. Data shows there were 962 million people globally in 2017 who were aged 60 or over, which is expected to rise to 2.1 billion people in 2050 and 3.1 billion in 2100 (United Nations, 2017). However, as the result of de-greening, the working class is decreasing and there will be a significant shortage of staff in the healthcare department. Technology seems to provide the solution for this problem, as it allows for more efficient care and it can improve the quality of clinical decision-making, which can eliminate or reduce excessive medical testing (Ball & Lillis, 2001). If E-health is adopted and implemented, the data obtained can also contribute to medical research, which could help discover new and effective medical treatments (Alkhaldi et al., 2014). One of the innovative technologies that could be beneficial to the healthcare domain is virtual reality (VR).

Virtual reality can be defined as "a highly interactive, computer-based multimedia environment in which the user becomes the participant in a computer-generated world." (Okechukwu & Udoka, 2011). Usually, this is achieved through a head-mounted display where slightly different views of the virtual world are presented to each eye to create a sense of depth (Lindner et al., 2019). Moreover, virtual reality can be accompanied by audio, which can be projected through a spatial surround sound that enhances the experience of being in another dimension (Bohil et al., 2011). Here, the user can immerse themselves in a digital environment and they can obtain an auditive and visual experience of width, height and depth.

Studies show that virtual reality affects the brain signals and, therefore, it can be of great influence in the healthcare domain (Gatica-Rojas & Méndez-Rebolledo, 2014). Since the brain is a multi-sensory system, and VR engages the entire multi-sensory system more fully than most current psychological interventions, VR has more potential to induce realistic psychological and behavioural responses (Bohil et al., 2011). Furthermore, VR can create a sense of presence, which can be described as a sense of being there, allowing the brain to evaluate the situation more realistically (Ortiz-Catalan et a., 2014).

Back in the 1990's, research already began in conducting exposure therapy through virtual reality. Since then, there have been over 30 randomised controlled trials (RCT) which show that the virtual reality treatment is at least as effective (and sometimes even more effective) than in vivo exposure therapy (Lindner et al., 2019). Moreover, studies show that the virtual reality exposure treatment can even reduce fear in everyday life, meaning knowledge can be transferred from the virtual environment to the real world of the patient (Morina et al., 2015).

After being used in exposure therapy, virtual reality is also integrated in different research domains such as the mental aspect of pain (Hoffman et al., 2004; Tarr & Warren, 2002). For example, one study uses virtual reality in the treatment of burn-wound patients in hospitals, where they are virtually

submerged in a hydrotank when bandages are being replaced. Patients report significantly less pain when exposed to the VR therapy, mainly due to the distractive function of VR. Moreover, the patients who report the strongest sense of presence or immersion within the virtual reality environment also report the largest positive change in their pain scores (Hoffman et al., 2008).

Another study shows the potential of virtual reality in pain treatment: Sato et al. (2010) use virtual reality treatment for patients with complex regions pain syndrome (CRPS), a chronic pain condition that affects a limb after an injury. Within their study, four out of five patients show a pain reduction of over 50% in pain intensity after using virtual reality for five to eight sessions.

Even if the effect of virtual reality is not greater than traditional therapy measures, it could have other advantages. Scozzari and Gamberini (2011) state that advantages are the comfort and safety of the patient, as well as creating a controlled environment for the patient to be in. Additionally, any complex or delicate scenario can be created to benefit the treatment of the patient. VR can also be used as a transition, since the patient might not be ready to face real stimuli, but they might be open to face the stimuli in a virtual reality environment.

Since virtual reality can affect brain signals, it has high potential for effective, innovative and sustainable E-health applications. This is also true for Reducept, the virtual reality E-health application for patients suffering from chronic pain. This application is used as a practical example throughout this study and the application itself is further described in Chapter 2.

In order for virtual reality technology to be an effective tool in the healthcare domain, the technology must reach the patient first. Even though the interest in these technologies is increasing, the actual implementation of virtual reality E-health applications has been lacking behind (Heinrichs et al., 2012).

1.2. Goals and Challenges

The problem statement described above suggests that there are barriers that prevent the implementation of virtual reality E-health applications. However, there are also factors that can enable or support the implementation of virtual reality E-health applications, which are identified as facilitators. Villalba et al. (2013) argue that barriers will always exist, but can be overcome when the necessary conditions are present. Therefore, barriers and facilitators are directly linked to one another, where the facilitators could ensure that the barriers do not exist anymore.

Currently, many studies are performed that focus on identifying the barriers and facilitators of implementing new E-health technologies within healthcare institutions, but not many of them focus on specific virtual reality technologies (Mair et al., 2012). Within this research project, a contribution to this specific research domain is made.

Many studies focus on trying to implement an E-health technology into healthcare institutions and identifying the barriers and facilitators from a business perspective. This means that, most of the time, the practitioner is asked to adapt to the new technology. However, companies could also conform more towards practitioners.

A goal of this study is to look at the barriers and facilitators of virtual reality applications within healthcare institutions from the perspective of the practitioner. By doing this, different barriers and facilitators could come to light and recommendations could be made to companies on how to approach and cater to the needs of practitioners to encourage the adoption and implementation of the virtual reality E-health technology or application. It is important for companies to understand which aspects are important for practitioners.

During this research, different challenges may arise. For example, practitioners are not always keen on working with E-health technologies in general, which can have several reasons. One reason could be that practitioners can be reluctant towards using new technologies. Another reason could be that

practitioners are afraid the quality of contact between patient and practitioner will decrease when implementing E-health technologies (Fitzgerald et al., 2008). These reasons are identified as barriers, but they can also be a hindrance in obtaining useful information. Therefore, it is important to interview practitioners who are open-minded towards the implementation of E-health technologies in order to have a fruitful interview with the practitioner. Most likely, if the practitioner is not open-minded towards E-health technologies, they are also not willing to participate within this study.

Another challenge is to find some practitioners who are not related to Reducept. This is a conscious choice: if the practitioner knows too much about the product, they might be over-enthusiastic or unable to identify which information about the product is crucial, since they know more than other interviewees. However, some of the practitioners are familiar with the product so they can identify limitations of the actual product. To find both practitioners with and without experience with Reducept, practitioners are also sought outside of the network of the company through, for example, personal networks or cold-calling. Cold-calling usually has a decreased willingness to participate since there is no personal investment present (Ellis et al., 2007). This could make finding participants for the study a challenge. Another factor contributing to this is that practitioners undergo a lot of pressure and might not have the time to participate.

If these challenges are overcome, this research could largely benefit the healthcare system in the future. Many governments are stressing that innovation in healthcare is indispensable in order to be able to provide healthcare to the citizens, but this means that implementation of the E-health applications is crucial (Omachonu and Einspruch, 2010).

1.3. Research Questions

In order to focus the research, three concrete research questions are formulated.

The first research question focusses on the barriers that prevent the adoption and the implementation of virtual reality E-health applications in healthcare institutions:

RQ1: What are the barriers on the adoption and implementation of virtual reality E-health applications within healthcare institutions?

The second research question is focussed on the elements that make the adoption and the implementation of virtual reality E-health applications possible. These elements are identified as facilitators:

RQ2: What are the facilitators on the adoption and implementation of virtual reality E-health applications within healthcare institutions?

The third research question is aimed at understanding the facilitators identified by the practitioners and translating these facilitators into a website. Doing this could improve the adoption and implementation of virtual reality E-health applications in healthcare institutions, since practitioners receive the information they need regarding barriers they might face and facilitators they need:

RQ3: How can E-health developers use barriers and facilitators on the implementation of virtual reality E-health applications within healthcare institutions to conform their website?

1.4. Context

This research study is performed at RelieVR BV as part of the graduation process of the EIT Digital Master School. It is performed as part of the EIT Digital Master School master Human Computer Interaction and Design with a speciality in Accessible and Adaptive Interaction, fulfilled at the University of Twente (UTwente) and Universidad Politecnica de Madrid (UPM) respectively.

The graduation process consists of this research study and an internship, both performed between February 2019 and June 2019 at RelieVR BV.

1.5. Document Structure

This document consists of nine chapters in total. Each of these chapters, with the exception of chapter one, is mentioned below with a brief explanation of their focus.

Chapter two describes the virtual reality E-health application, Reducept, used throughout this study. This application is the core of the company RelieVR BV, which is also briefly introduced within this chapter.

Chapter three focusses on the methodology used throughout the process. The different methods and techniques used within the project are described.

Chapter four presents a stakeholder analysis. It focusses on identifying the different stakeholders and their influence levels within the different sections of this research study.

Chapter five focusses on user input and describes the barriers and facilitators obtained from the literature review, observations and stakeholder interviews. It also estimates the cost-efficiency of facilitators based on the results obtained.

Chapter six describes a design process example to show how a website can be conformed to practitioners based on barriers, facilitators, user-input and user-feedback. Here, the development of the website of Reducept is described.

Chapter seven comments on the results obtained in the form of a discussion. It outlines possible shortcomings and possible improvements of this research study.

Chapter eight draws conclusions on the results obtained throughout the research process. This chapter also describes recommendations for future research.

Chapter nine provides a reference list of the sources used throughout the research, followed by the appendices containing additional and supporting information described in this thesis.

2. Reducept: The Virtual Reality Application

This chapter focusses on the virtual reality E-health application Reducept, which is created by the company RelieVR BV. This application is the practical example used throughout this research study. First, a brief history of the company is provided, followed by the content of Reducept, which is divided into two parts: pain education and pain management strategies. Due to the sensitivity of possible reproduction by competition, the application is described in general terms.

2.1. RelieVR BV

Back in 2017, Margryt Fennema was working on her master's thesis for the study Digital Innovation for Healthcare. She came in contact with Louis Zantema, a practicing psychologist with a specialty in chronic pain. Together, they witnessed how many patients suffering from chronic pain would not receive timely and adequate care. As a pain psychologist, Louis would treat the mental and emotional components of pain. Both national and international guidelines prescribe pain education as the first intervention for chronic pain (Eccleston et al., 2010). Unfortunately, only a small percentage of patients actually receive pain education and pain management strategies during their treatment and are more often only treated with opioids (Jones et al., 2016).

Therefore, together with patients and practitioners, they decided to build an application which could provide this pain education and train psychological strategies named Reducept¹. For this purpose, the tool of virtual reality was chosen since research shows that virtual reality applications can have a positive influence on pain levels (Jones et al., 2016) as well as the advantages previously described in Section 1.1. Within the virtual environment, the patient receives a visual translation of pain education by going on a journey through the body. Moreover, the different levels include interactions through which the patient can actively acquire strategies to manage their pain in daily life.

Fennema and Zantema officially started their company in January of 2018 in order to make this tool a reality. Through continuous user testing, close collaboration with medical practitioners and professional game developers, Reducept will be ready for release at the end of the summer of 2019.

2.2. Reducept

In the interviews, Reducept is introduced to the interviewees, either verbally or through a demonstration. This provides a more specific context on which questions about implementation barriers and facilitators of virtual reality E-health applications are answered. Therefore, an overview of Reducept is provided here. In order to keep the exact content of the product classified, a general description of the product is presented. This is accompanied by visuals to generate a sense of quality associated with the product.

2.2.1. Pain Education

The framework for Reducept is based on the pain theory by Butler and Moseley (2003): "Explain Pain". Within this theory, they describe that pain is a way to notify us that our body is in danger, which

¹ During the period of writing this thesis, the name of the product changes three times. At the beginning, the virtual reality application is named RelieVR. However, due to legal issues, the name needs to be changed. Therefore, the company remains RelieVR BV, but the product name would be different. At first, the proposed name is Reliviate. Unfortunately, this name also does not comply legally, meaning a third proposition is made. In the end, the definite name becomes Reducept. This development can be seen throughout this thesis, since prototypes of the website are developed with these different names, as can be seen in Chapter 6.

is a positive process. In general, pain also has a large emotional component. In some cases, the brain interprets signals as pain when there is no tissue damage. This is the case when chronic pain is diagnosed in patients without the pain having a medical reason for existence. Through pain education, patients can understand how pain works in their body and they can learn strategies to manage their pain.

There are several learning experiences that Reducept offers, including understanding that there are many potential factors that contribute to the pain, that pain is not an accurate marker for tissue damage, that pain education is a treatment, that pain is an expression of the brain and that the brain can become overprotective or sensitive to signals (RelieVR BV, 2019). Figure 1 shows the start of the pain education training.



Figure 1: A visual of Reducept, the patient can indicate where they experience pain on their body

2.2.2. Pain Management Strategies

Reducept consists of different levels that combine education with training pain management strategies. These strategies are based on Cognitive Behavioural Therapy (CBT), which is proven to be an effective treatment for patients suffering from chronic pain (Thorn et al., 2018). CBT focusses on the cognitive, behavioural and emotional processes, which interact within our body, and how the patient can positively influence these processes. In Reducept specifically, Integrative CBT is used, which allows for combinations of other treatment methods to be combined with traditional CBT exercises.

There are three levels within Reducept that correspond to an important location in the body with regards to the existence of pain where patients can train managing skills through therapeutic exercises. These exercises take advantage of what virtual reality can offer through immersion, which allows for a better influence on the emotions and cognition of the patient (Fennema & Zantema, 2019). Visuals of Reducept are shown in Figure 2.

Currently, different research studies and tests are being performed to measure the effectiveness of Reducept on patients with chronic pain. In collaboration with different healthcare organisations in different domains (e.g. psychology, physiotherapy, etc.), training sessions are held and recorded in order to understand the changes in the experience of pain of the patients. Of the 1562 sessions played thus far, 77% of patients indicate their pain has decreased after playing Reducept. A multi-centre Randomly Controlled Trial (RCT) is held to measure the effect of Reducept on patients with lower back pain. Reducept will be released as an E-health training in September of 2019.





Figure 2: Visuals of Reducept, the patient goes on a journey through the nervous system

Currently, RelieVR BV is developing a mobile application of Reducept, which is installed on the smartphone of the patient and played at home when inserted in (cheap) headsets. This allows practices to have patient practice or train at home. For now, the patient trains on the license of the practitioner. The consumer product is estimated to be released for consumer purchasing in 2020.

Reducept consists of pain education and levels that train management strategies to patients suffering from chronic pain. This virtual reality application is used throughout this research study, both in the identification of barriers as facilitators as well as in the website realisation.

3. Methodology

Reducept and virtual reality are the focus of this research study. In this chapter, the different methods and techniques used during this research study are introduced and described. First, a general overview of the methodology is provided, followed by a theoretical framework behind the methods and techniques. The implementation of these methods and techniques is described in Chapters 4, 5 and 6.

3.1. Methodology Outline

Figure 3 provides an overview of the methodology within this research study. First, the different stakeholders of this project are determined. After the stakeholders are determined and their influence levels are decided, input from the stakeholders is gathered. After, a literature review is performed, which reports the views of the determined stakeholders. Moreover, direct observations are made and interviews are conducted with the stakeholders. The input gathered through these three methods provide results for the first and second research questions described in Section 1.3.

A selection of the interviews and additional input from literature provide the basis for the user-centred design process (ISO 9241-210, 2010) to determine results for research question 3. Since both the input from literature and interviews for the website are different results obtained through the same methods, these elements have been given a gradient colour in the overview.

Each level of this methodology process is described in more details in the remainder of this chapter.



Figure 3: A visual representation of the methodology used within this research study

3.2. Stakeholder Analysis

For every research study, it is important to understand who needs to be included during the process. Therefore, in order to select the participants, all stakeholders are identified. Moreover, the importance of the stakeholder is addressed, which determines the amount of influence the stakeholder has during the process.

Every project has multiple stakeholders, where the term stakeholder holds the following definition: "A stakeholder in an organization is any group or individual who can affect or is affected by the achievement of the organisation's objectives" (Freeman, 1984). It is important to identify all the stakeholders in order to be able to include them during the research study.

Stakeholders can be sorted into four different categories (Sharp et al., 1999):

Users: Users can be identified as people who interact with the system, who control the system, who obtain information through the system or who purchase the system.

Developers: Developers can be identified as people who develop the system or prototype.

Legislators: Legislators are institutions whose guidelines could affect the development or operation of the system. Here, legislators are formal positions, such as the law or politics.

Decision-makers: Decision-makers are usually managers or financial controllers. They can be higher up the hierarchal chain within a company. Ultimately, they have to be involved in the bigger decisions.

It is important to involve stakeholders during the entire design process. However, stakeholders could have conflicting needs. Therefore, it is important to determine to which extent the stakeholder need to be included within the project: some stakeholders are more important and their feedback, needs and expectations need to have a higher priority. In every case, the claim needs to be seriously considered, but their influence level can help determine and prioritise any contradictions.

For this research study, two categories of included stakeholders are made: one for the research on barriers and facilitators, and one for the realisation of the website, since the level of influence differs between these two categories.

3.3. Input from Stakeholders

The input from stakeholders is gathered through different methods and techniques. First, a literature review provides input from different sources and perspectives, and describe both subjective and objective claims. Furthermore, during the internship and research study, the researcher comes in contact with several relevant people which is described in direct observations. The final input comes from stakeholder interviews performed by the researcher.

3.3.1. Literature Review

Since the literature on barriers and facilitators of virtual reality implementation is combined with the input from interviews and observations to obtain a thorough overview, the literature review is part of the results instead of presented prior to the methodology.

A structured literature review provides input from different sources. By deciding on databases, determining relevant keywords and creating search statements, relevant literature is found. The literature is thoroughly analysed and the findings are structured in order to establish relevant input that is then compared to the additional input obtained through direct observations and interviews.

Moreover, additional literature is found for the realisation of the website performed in Section 6.1.1.. This literature is found separately from the literature review performed in Section 5.1.4..

3.3.2. Direct Observations

Throughout the internship, the researcher comes in contact with different people who are relevant to the research study. It is likely that the topic presented in this research study is extensively discussed, although not in a formal interview setting. Therefore, these results are not presented with the results of the interviews. However, these findings and observations might still be relevant towards the goal of the research and, therefore, are described and summarised in a separate section.

3.3.3. Stakeholder Interviews

After the stakeholders are identified, they are interviewed with the goal of retrieving answers to the research questions proposed for this study. Below, the methods and techniques related to the preparations of the interviews are described.

3.3.3.1. Ethical Responsibility

Researchers hold an ethical responsibility to protect the privacy of the participants of the research. Therefore, measures need to be put in place in order to guarantee the protection of data of the participant.

In accordance with the European GDPR (Regulation (EU) 2016/679, 2016), one must put measures in place to protect the privacy of individuals. Therefore, the data obtained is not traceable to a specific individual, reported anonymously and sensitive data (such as ethnicity, religion, political views, health related issues or sexuality) is not acquired. Moreover, the participant is informed that they can stop the interview at any time without reason and obtain or remove their data at all times. Furthermore, the researcher ensures that no physical or psychological harm is done to the participant.

These issues are addressed in an informed consent form which all interviewees need to sign prior to participating within the interviews.

3.3.3.2. Semi-Structured Interviews

When conducting interviews, different methods or techniques for interviewing can be applied. Within this specific research, semi-structured interviews are conducted. Semi-structured interviews consist of general questions set in place by the interviewer, but questions can be altered and additional questions can be added depending on the answers provided by the interviewee (DiCicco-Bloom & Crabtree, 2006).

The method of semi-structured interviews has been chosen because it ensures that the most important aspects and topics are discussed during the interviewees, while allowing for free conversation and new creative insights based on the interview itself. As the objective of this research study is to obtain innovative insights regarding virtual reality E-health implementation, freedom needs to be allowed throughout the interviews.

3.4. Barriers and Facilitators

After obtaining results from literature, direct observations and through interviews, this section provides a summary of all the results. Here, the separate results are compared and merged to form one overview. Moreover, similarities and differences found between the different results obtained are discussed. Additionally, relationships between barriers and facilitators are shown and an overview of cost-effective facilitators is created.

3.5. Realisation of Website

This section addresses the third research question, namely how to use barriers and facilitators on the implementation of virtual reality E-health applications to conform a website to practitioners. In order to address this question, a user-centred design process is used (ISO 9241-210, 2010). This process has been visually depicted in Figure 4.



Figure 4: The user-centred design process ISO 9241-210 (2010)

The user-centred design process puts focus on designing things that meet the user needs. The researcher collects data from targeted end-users (user context) and they translate this information to design criteria (requirements). The requirements form the foundation for creating a prototype (design output), which is evaluated by the end-users (evaluate). Depending on the feedback of the user, the researcher can go back to a previous stage to make adjustments, from which points the cycle repeats. Therefore, this is an iterative process.

The user-centred design method is described in ISO 9241-210, an important usability standard in user-centred design. This method explains six key principles that should be followed in order to effectively execute user-centred design, namely the four principles described above in addition to planning the user design process (and using additional input: interviews, literature) and outputting a design that meets user requirements (website).

3.5.1. User Context

In this particular case, the user context consists of the input obtained from the interviews, direct observations and literature specifically regarding the needs of practitioners concerning websites.

3.5.2. Requirements Elicitation

Input from users, literature and guidelines are translated into requirements. Requirements are measurable and describe how a system performs, which information and data is transmitted or acquired and how the user interacts with the system (Teixeira et al., 2012). While creating a prototype, these requirements can function as a set of rules and guidelines to create an optimal design to fit the user needs. Requirements can result from the user, literature, usability heuristics and accessibility guidelines.

3.5.2.1. User Requirements

User requirements result from the interviews conducted: the input provided by the users is translated into measurable statements that can be incorporated within a system.

3.5.2.2. Literature Requirements

Prior to creating the website, literature is sought to help support certain features specifically related to building (B2B) websites. This literature also generates results that are translated into measurable requirements for the website.

3.5.2.3. Usability Heuristics

In order to create usable websites, usability heuristics are followed. These heuristics are created by Jakob Nielsen and describe guidelines to be followed in order to create generic usable interfaces (1994). There are ten usability guidelines in total, which are listed in Appendix A. Important aspects for website interfaces are:

- providing feedback to users (e.g. if a form has been send)
- using icons and language that the users are familiar with in daily life
- using consistency throughout the website through titles and design
- supporting users by presenting relevant information and instructions
- avoiding irrelevant information and keeping it minimalistic
- helping users discover and recover from errors and proving help and documentation

These usability guidelines are translated into relevant requirements and kept in mind while creating wireframes.

3.5.2.4. Accessibility Requirements

The World Wide Web Consortium (W3C) has published 76 accessibility guidelines in order to help developers build accessible websites that can be used by people with a wide range of functional diversity (Accessibility Guidelines Working Group, 2018). If these guidelines are implemented, assistive products can interact and interpret the code of online content and translate this in the appropriate manner to the user. Moreover, people with functional diversity are able to use the website without encountering any difficulties or limitations.

The guidelines are categorised in three levels of conformance, namely A, AA and AAA. Level A conformance is the lowest level and must always be implemented within every website to comply as an accessible website. This level describes fundamental functionalities. Level AA is the middle level and should always be implemented wherever possible. Level AAA is the highest level: it is more difficult to implement these guidelines in a website, but developers should strive to add these accessibility guidelines to make it accessible to everyone.

When creating the website, these accessibility guidelines are kept in mind during the design phase and are communicated to the developers during the development phase.

3.5.2.5. Prioritising Requirements using MoSCoW

In order to distinguish between the importance of the requirements in compliance with the influence levels of the stakeholders, the requirements are categorised according to the MoSCoW method (Waters, 2009). The MoSCoW method allows for prioritising requirements into four different categories:

Must-have: In order to create a minimal viable product, these functionalities must be included in the prototype.

Should-have: The functionalities described by these requirements are not crucial for the minimal viable product, but they add a lot of added value when included in the prototype.

Could-have: These functionalities are not essential to the product, but are good additions if time allows for implementation within the prototype.

Won't-have: These functionalities are deliberately excluded from the prototype, but are functionalities that are possible for inclusion in future development and iterations of the prototype.

3.5.3. Prototype

Prototypes can be low-fidelity or high-fidelity, where fidelity can be described as the degree in which the design, presentation and interaction actually represents the final product (Rudd et al., 1996).

For the first iterations, low-fidelity prototypes are created in the form of wireframes. Low-fidelity prototypes require minimal effort and have the purpose to test quickly. They are used to translate the received requirements into a concept, which is then evaluated by the users who provided the requirements. Unfortunately, these prototypes are not accurate enough to test for inconsistencies or shortcomings, but it provides generic feedback to improve the overall suggested concept.

3.5.4. Evaluate

First, the users are asked to evaluate the paper prototype of the first iteration. After the website has been developed, users are asked to fill in a questionnaire to provide feedback on the end-result that can be used for future development.

3.5.4.1. Evaluation of Paper Prototype

The user evaluates the paper prototype through an interview conducted by the researcher. The user and researcher can make edits on the printed wireframes. The feedback and suggestions provided by the user are incorporated in a new design, which forms the basis for the developers to build the actual website.

3.5.4.2. Questionnaire

After the website has been developed, the users are asked to fill in a questionnaire to provide feedback and suggestions on the end-result. The feedback and suggestions are gathered, after which these are structured to generate requirements for future development of the website. The questionnaire contains linear and open-questions per page of the website. Users are asked to provide any thoughts they might obtain when interacting with the website, both aimed at functionality as well as layout and design.

The methods and techniques that are described above form the structure for this research study. Within the following chapters, these methods and techniques are executed in order to answer the proposed research questions.

4. Stakeholder Analysis

This chapter describes the stakeholder analyses, which is the first step of the methodology outline visually presented in Figure 5. The stakeholder analysis includes the identification of the stakeholders and the determination of their influence level. Since the literature review is part of the results, performing the stakeholder analysis first ensures that the literature found is more relevant to the study and more focussed: literature is sought concerning the stakeholders identified. Therefore, the stakeholder analysis is performed prior to the literature review.



Figure 5: Visual presentation of methodology, where the purple color indicates which blocks are relevant for Chapter 4.

As described in Section 3.2., several stakeholders are identified for both the interviews regarding VR implementation as well as the user-centred design process performed for the realisation of the website. The stakeholders remain the same during the research study, but their influence level differs per part. Therefore, two categories are established: *VR implementation* and *Website*. The different stakeholders are as follows:

Users: Within the category of *VR implementation*, there are three different users who are identified, namely the practitioner, the potential buyer and the potential promoter. For the purpose of this research study, practitioners are psychologists, physiotherapists and general practitioners; potential buyers are healthcare innovation managers; potential promoters are identified as E-health enthusiasts and the ministry of Health, Welfare and Sports (VWS). For the first category of *VR Implementation*, the user's overall level of influence is high, since their perspective is the main focus of this study. For the second category of *Website*, their influence level is medium: even though their perspective is used as a foundation for this process, their decisions can be overturned by other parties. Since the study concerns the VR implementation in healthcare institutions, the patient is not considered a source of information for this particular category. However, for the second category of *Website*, the patient can be a user, since they can stumble upon the website. This needs to be taken into consideration. However, since the patient is not the targeted user, their level of influence is low and their active participation is not required.

Developers: During this study, the website developer is the overarching term used for the developers building the website. This group consists of two programmers, a graphic designer and two visual translators (also with a background in graphical design). Since all of them have the same interest and influence during the research study, they are combined into one stakeholder. This stakeholder is only relevant within the *Website* category. Within this category, their influence is rated as medium: if something is not technically feasible, their decision overturns any other decision made, but their perspective is usually a recommendation and can be overturned by other parties.

Legislators: There are two legislator parties involved within this research study. The first legislator is the EIT Digital Master School. Since this project is performed as part of a graduation process, certain guidelines, deadlines and rules need to be followed. Their influence throughout the project is rated as medium, since some decisions can be overturned through communication. The second legislator is the GDPR: these are laws that need to be followed. The influence level of the GDPR is rated as high. However, since these laws should not be conflicting with any other claims made by other stakeholders, there should not be any issues.

Decision-makers: There are two main decision-making parties: the company, RelieVR BV, and the researcher. The researcher is present throughout both categories, whereas the company is only present within the *Website* category. Whilst the researcher is one individual, RelieVR BV consists of the two founders and the investment parties associated with the company. The company has a high influence level in the Website category: they make the ultimate decision and they have the ability to overturn every decision, since they are the financial party behind the website development. The researcher has a low influence level: their main purpose is to acquire the correct information and translate it to other parties. Moreover, they ensure the acquired information is not forgotten during the development phase of the website.

The stakeholder analysis is summarised for the category *VR implementation* in Table 1 and for the category *Website* in Table 2.

	Identification		Influence	
Stakeholder	Role	Key Interest	Торіс	Level
Practitioner	User	Provide information	Implementation	High
Potential Buyer	User	Provide information	Implementation	High
Potential Promoter	User	Provide information	Implementation	High
EIT Digital	Legislator	Organisation	Time	Medium
GDPR	Legislator	Organisation	Law	High
Researcher	Decision-Maker	Acquiring information	All topics	Low

Table 1: The stakeholders of the VR implementation category

	Identification		Influence	
Stakeholder	Role	Key Interest	Торіс	Level
Practitioner	User	Finding information	Usability	Medium
Patient	User	Finding information	Usability	Low
Potential Buyer	User	Finding information	Usability	Medium
Potential Promoter	User	Finding information	Usability	Medium
RelieVR BV	Decision-Maker	Development	R&D	High
Website Developer	Developer	Development	R&D	Medium
EIT Digital	Legislator	Organisation	Time	Medium
GDPR	Legislator	Organisation	Law	High
Researcher	Decision-Maker	Development	All topics	Low

Table 2: The stakeholders of the Website category

During the remainder of this research study, the stakeholders described above are taken into account. When decisions have to be made, this analysis helps to distinct between interests, topics and level of influence in order to make the correct decision for the end-result. The stakeholders for the *VR Implementation* category are involved in determining the barriers and facilitators of Chapter 5. The stakeholders of the *Website* category are involved in Chapter 6 when a website is realised.

5. Barriers and Facilitators

This chapter describes the perspective of practitioners on the barriers and facilitators concerning the implementation of VR E-health technology within healthcare institutions obtained through a literature review, direct observations and stakeholder interviews. This part of the research study is visually depicted in Figure 6.



Figure 6: Visual presentation of methodology, where the purple color indicates which

5.1. Literature Review

The first method to gather information on barriers and facilitators is a literature review. First, a decision is made about which search engines are used to find the relevant literature. After, keywords are determined in order to filter between the large amounts of literature these databases offer, which are entered in literature search statements to find more specific and relevant literature. The process of creating these statements is described in the following section, followed by the results of the literature review.

5.1.1. Search Engines

There are many different search engines that can be used to find literature. For this particular study, three different search engines are chosen:

Google Scholar: Google Scholar is a well-known literature search engine. It is a specific component of Google that searches through many different databases and finds literature. Due to this, it is very easy to find many articles, but it can be difficult to find the actually relevant articles in the large search returns. Therefore, it is a good starting point to finding literature, but other databases can be used to find a more specific subset of literature.

Scopus: Scopus is the abstract and citation search engine and database of Elsevier. It covers different disciplines, namely life sciences, physical sciences, social sciences and health sciences. Through the university account, access to all the different abstracts is granted. This search engine is focussed on journals and it is a good option to find a smaller subset of substantiated literature.

PubMed: PubMed has been chosen as the third search engine, since it is specifically focussed on life sciences and biomedical topics. Therefore, it contains mainly health-related articles, which means it automatically filters journals and articles for the specific domain. This search engine will return less articles than Google Scholar, but more specified.

By combining these three search engines, different articles are found that can help answer the research questions proposed for this study.

5.1.2. Keywords

In order to create literature search statements, keywords are identified. These keywords are used to filter through the large offer of journals and articles found through the search engines. Keywords are chosen carefully because they determine the outcome of the literature search.

Since this study is focussed on **virtual reality,** this must be a keyword in the search. Technology in health is very broad and will return a lot of results. By entering virtual reality as a keyword, many irrelevant articles are filtered out.

Secondly, the domain in which virtual reality is employed is important to specify the articles to the correct domain. Since virtual reality can be used in many different domains, health needs to be introduced here. Therefore, the term E-health is used as keyword. Since it is spelled in different ways both **E-health** and **ehealth** are possible.

Moreover, the intention or topic of the article is specified further. Since this research is about finding the **barriers** and **facilitators** of E-health implementation, these two terms are keywords in the search.

Moreover, the goal is to adopt and implement the VR technology. Therefore, the verbs **adoption** and **implementation** are keywords that should be present in the articles.

Last but not least, if the search still returns many articles, the articles could be further specified by including the keyword **pain**. This might return research that is specific about the implementation or adoption of technology within treatment for patients with (chronic) pain. This specific patient group might contain different barriers or facilitators than other patient groups. However, since that is not the main aim of this research, it will only be applied if the return of results is very large and allows for further specification to find relevant literature.

5.1.3. Literature search statements

Using the keywords described before, different literature search statements are made. **Virtual reality** needs to be present within every search term. The keywords **E-health** and **ehealth** are synonyms of each other: therefore, only one of them needs to be present within the article. Even though the research is aimed at both the **facilitators** and the **barriers**, articles that focus on only one of the two aspects are still relevant to the study. Therefore, either facilitators or barriers needs to be mentioned within the article. The same applies to the terms **adoption** and **implementation**. Last but not least, a different statement is made for further specification when including the word **pain**.

Following this criteria, the literature search statements are noted down as follows:

1: "virtual reality" AND (ehealth OR E-health) AND (barriers OR facilitators) AND (implementation OR adoption)

2: "virtual reality" AND (ehealth OR E-health) AND (barriers OR facilitators) AND (implementation OR adoption) AND pain

Google Scholar:

Using the first search statement, Google Scholar delivers 2.600 results. The second search statement returns 1.390 results. Even though this is still a large amount of articles, it is difficult to specify the articles further. For example, many articles that are returned focus on training healthcare professionals. However, these articles cannot be eliminated since virtual reality can also be used to train the patient. Therefore, a quick scan is made to find relevant articles for this study.

A second search is conducted through eliminating the word 'education' (by adding 'NOT education' to the statements), since this is a common word in the articles related to educating healthcare professionals. By doing this, some relevant research might be deleted from the search. However, it specifies the results further and returns 117 articles. Therefore, the combination of the first and second statement allow the researcher to find some relevant articles. In total, eight articles are selected from Google Scholar after reading the abstracts and scanning the documents.

Scopus:

Entering the first search statement returns six results, but not all articles are relevant. The second statement delivers even fewer results and only duplicates with what had already been found through Google Scholar. The choice is made to broaden the search to find more relevant articles. The following statement is entered:

3: "virtual reality" AND health AND barriers AND implementation

This statement delivers 25 results. After reading the abstracts, scanning the documents and eliminating the duplicate results, three new articles are included in the literature review.

Pubmed:

Entering the first statement delivers 16 results. After eliminating duplicate results, reading the abstracts and scanning the results that were left, only one article is added to the list for the literature review. After entering the second statement, no new relevant articles are returned.

5.1.4. Literature Results

In total, twelve published articles are selected to be relevant to this study. An overview of these papers is provided in Table 3.

Author	Year	Title
Kramer, T., Pyne, J., Kimbrell, T., Savary, P., Smith, J., & Jegley, S.	2010	Clinician Perceptions of Virtual Reality to Assess and Treat Returning Veterans (1)
Glegg, S., & Levac, D.	2018	Barriers, Facilitators and Interventions to Support Virtual Reality Implementation in Rehabilitation: A Scoping Review. (2)
Glegg, S., Holsti, L., Stanton, S., Hanna, S., Velikonja, D., & Ansley, B.	2016	Evaluating change in virtual reality adoption for brain injury rehabilitation following knowledge translation. (2)
Schmid L, Glässel A, Schuster-Amft C.	2016	Therapists' Perspective on Virtual Reality Training in Patients after Stroke: A Qualitative Study Reporting Focus Group Results from Three Hospitals. (2,3)
Glegg, S., Holsti, L., Velikonja, D., Ansley, B., Brum, C., & Sartor, D.	2013	Factors influencing therapists' adoption of virtual reality for brain injury rehabilitation. (1,2,3)
Bohil, C., Alicea, B., & Biocca, F.	2011	Virtual reality in neuroscience research and therapy (1)

Table 3: An overview of the research papers used for the literature review

Author	Year	Title
Tashjian, V., Mosadeghi, S., Reid, M., Howard, A., Lopez, M., & Spiegel, B.	2017	Virtual Reality Reduces Abdominal Pain in Hospitalised Patients: Results of a Controlled Trial. (1)
Riva, G.	2005	Virtual reality in psychotherapy: review (1)
Ortiz-Catalan M., Nijenhuis S., Ambrosch K., Bovend'Eerdt T., Koenig S., Lange B.	2013	Virtual Reality: Emerging Therapies in Neurorehabilitation. Biosystems & Biorobotics (1)
Lindner, P., Miloff, A., Zetterlund, E., Reuterskiöld, L., Andersson, G., & Carlbring, P.	2019	Attitudes toward and familiarity with virtual reality therapy among practicing cognitive behaviour therapists: A cross-Sectional survey study in the era of consumer VR platforms (3)
Laver, K., George, S., Ratcliffe, J., & Crotty, M.	2011	Virtual reality stroke rehabilitation – hype or hope? (1)
Ogourtsova, T., Archambault, P., & Lamontagne, A.	2017	Exploring barriers and facilitators to the clinical use of virtual reality for post-stroke unilateral spatial neglect assessment (1)

The literature is analysed and summarised by the researcher below. First, the different barriers are identified, followed by the different facilitators. Per barrier or facilitator, the literature that mentions the aspect is mentioned, followed by an explanation of how it is described and discussed within the literature. Moreover, some contradictions are highlighted or possible explanations are provided. The barriers and facilitators are presented in a random order.

5.1.4.1. Barriers of VR E-health Applications Implementation

Negative Pre-misconceptions

Mentioned by: Lindner et al., 2019; Bohil et al., 2011; Glegg et al., 2016

When the first virtual reality E-health applications were introduced in the healthcare sector, clear barriers came to light. The first barrier was expenses, where VR E-health technologies could easily cost up 10.000 USD. The technology was also less accessible, since it was physically heavy and required high technical proficiency for use. Moreover, the technology was not as advanced: the resolution, field-of-view and refresh rates were low, causing sickness among users (Lindner et al., 2019). Glegg et al. (2016) also mention that unfamiliarity with the technology and its perceived difficulties led to a low self-efficacy regarding the technology.

Some of these barriers are still prominent today as the next sections will highlight. However, some of these barriers have diminished over time through the evolvement of the technology which resulted in increased quality, decreased costs and increased usability. However, this negative first impression leaves many practitioners with many questions and this experience with VR E-health technology may sour the practitioner's enthusiasm for VR (Lindner et al. 2019). This, in itself, is a first barrier that causes the adoption and implementation of VR E-health technology to become slow (Bohil et al., 2011).

Unaware of VR Advances

Mentioned by: Lindner et al., 2019; Glegg & Levac, 2018

Building forth on the negative pre-misconceptions, many practitioners are not aware of the new advances VR has made that could reduce these previous concerns. 86% of the participants in the study of Lindner et al. (2019) have never experienced VR before and more than 52% are unaware of the existence of a consumer market for the VR platforms. The low rate of familiarity with VR technology could explain why it is not a popular tool to use: study shows that having experience with VR in a non-clinical setting makes it more likely for that individual to use it in the future, also in clinical settings. Here, time might be essential: once VR becomes part of the everyday technology, it can feel more natural for practitioners to use it in clinical settings (Lindner et al. 2019).

Glegg & Levac (2018) also mention that the perceived ease of use and perceived usefulness are barriers to the implementation of VR in the clinical settings, which comes from perceptions based on previous knowledge. Creating awareness for advances made in these factors could decrease this barrier in the future.

Eligibility of Patients

Mentioned by: Tashjian et al., 2017; Bohil et al., 2011; Ortiz-Catalan et al., 2014; Kramer et al., 2010; Laver et al., 2011; Ogourtsova et al., 2017; Riva, 2005; Schmid et al., 2016; Glegg et al., 2016

There are some limitations that are paired with the virtual reality E-health technology. For example, hospitals cannot provide the technology to certain patients due to "active neurological symptoms, ongoing nausea, vomiting, injury to the face or neck, epilepsy, too frail or debilitated or receiving mechanical ventilation." (Tashjian et al., 2017). Moreover, the technology might not be suitable for patients with mental health problems (Kramer et al., 2010) or wheelchair users (Glegg et al., 2016) depending on the application. This means a significant part of patients in general cannot be treated with virtual reality.

Other studies mention the possible side-effect of cybersickness as well (Ortiz-Catalan et al., 2014; Laver et al., 2011; Riva, 2005; Schmid et al., 2016). However, Bohil et al. (2011) mention that this effect is not always present within studies and it can be overcome due to improvements in technology so that images do not lag behind and trigger cybersickness. Currently, since there are some cases of cybersickness, practitioners are anxious to recommend the technology to all of their patients: this means the technology loses its appeal, even though this side-effect might not be present in many studies. However, as Lindner et al. (2019) mentioned in previous research, cybersickness was largely present when technology was not as advanced, leaving a lasting impression on practitioners.

Patient's Unwillingness to Try

Mentioned by: Tashijan et al., 2017; Glegg et al., 2013; Kramer et al., 2010; Laver et al., 2011; Ogourtsova et al., 2017

When Tashjian et al. (2017) ask eligible patients in hospitals to try VR E-health technology, up to twothirds of the patients are unwilling to try it. Here, they state, that the technology is mostly turned down by older individuals. Other studies also mention that older age is a common barrier in the implementation of VR E-health technology (Laver et al., 2011; Ogourtsova et al., 2017). Kramer et al. (2017) mention they found the VR E-health technology suitable since they were working with younger individuals.

Glegg et al. (2013) mention that patients were not showing much motivation to try the VR E-health technology and that this is constituted as one of the main barriers by practitioners. However, they find that the literature state patients across a range of diagnostic and age describe working with VR E-health technologies as "interesting, enjoyable, and motivating rehabilitation tools." Riva (2005) also supports this: in a study, 80% of the sample of participants prefer the VR treatment over traditional treatment forms. Glegg et al., (2013) state that the barrier of this lack of motivation, or the unwillingness to try the technology, could also result from another factor, namely the relatively low level of VR experience amongst therapists: if a practitioner cannot work efficiently with the technology, or if they portray any hesitance towards it, it could influence patients and have them become less motivated. This statement should be taken with caution, they advise to perform more research on the relationship between experience of VR and the determinants of the use of VR by practitioners.

Lack of Clinical Evidence-Base

Mentioned by: Bohil et al., 2011; Laver et al., 2011; Ortiz-Catalan et al., 2014; Glegg et al., 2016; Glegg & Levac, 2018; Kramer et al., 2010; Lindner et al., 2019

The literature is contradicting regarding the amount of evidence available for VR based systems in healthcare institutions. Whilst some state that there is a large body of literature available (Glegg et al.,

2016), others state that there are not many high-quality studies done (Laver et al., 2011) or that they are too few and too small to draw strong conclusions (Ortizan-Catalan et al., 2014). Since these studies are performed three to five years apart, it is relevant to presume that more studies have been performed as the VR technology has further developed and has become more accessible. The most recent study mentioning this is performed in 2018 (Glegg & Levac). They state that the evidence-base is growing, and that more research is becoming available. However, if this evidence actually reaches the practitioner is the main concern, since three studies name a lack of clinical evidence as one of the main barriers of the implementation of VR within the clinical practice. (Bohil et al., 2011; Ortiz-Catalan et al., 2014; Laver et al., 2011)

Even though the evidence-base for VR technologies in general is growing, the lack of an evidencebase for specific VR technologies is a different issue altogether. For example, in general, VR can engage the user through the full multi-sensory system. However, if the specific application engages the user as well is completely dependent on the quality and content of the specific application. Therefore, before practitioners want to use the application within their practice, they want to obtain specific evidence first, which can be a time-consuming and costly process. They might have confidence in the VR technology in general, but this does not automatically translate to every application using VR (Ortiz-Catalan et al., 2014; Laver et al., 2011; Kramer et al., 2010).

Moreover, even if there is specific evidence for the VR E-health application, practitioners might not trust this evidence for different reasons such as believing that the samples used were non-representative to their own patients (Lindner et al., 2019).

Lack of Transfer

Mentioned by: Lindner et al., 2019; Glegg & Levac, 2018; Laver et al., 2011; Schmid et al., 2016

Related to clinical evidence is the concern of improvements not translating into real-world situations (Lindner et al., 2019). For example, if the virtual reality E-health application would result in improvements, these improvements should also be present outside of the virtual reality environment. It is important for this transfer to take place. Otherwise, the positive result would be limited to the virtual environment and this would require patients to continuously wear virtual reality devices in order to experience improvements in their situation.²

Therefore, studies express that more research needs to be done in order to test if skills learned in VR can also be applied in real-world functional settings (Glegg & Levac, 2018). Laver et al. (2011) suggest that this can be related to software and hardware, since programs containing more life-like visual displays correlate more with the real-world and can, thus, more likely transfer to real-world improvements.

However, other studies already see real-world improvements being made through training in virtual reality (Schmid et al., 2016). Therefore, this barrier is very situational and related to specific applications. More research should be done to confirm if this aspect is related to the naturalistic methods and realism used within the applications.

Realism

Mentioned by: Lindner et a., 2019; Kramer et al., 2010; Schmid et al., 2016

Not unrelated to a lack of transfer, but a barrier on its own, is the realism of the application. Some studies express concerns that the graphics are cartoonish, outdated or simply not realistic enough, which could have an effect on the reliability of the application and its impact (Lindner et al., 2019;

² In their studies, Kuipers et al. (2017) describe a first-class transfer (through a literal representation) and a second-class transfer (through a figural representation or metaphor). Through their studies, they discover that companies designing E-health applications focus on designing the game itself, but do not put emphasis on including artefacts that support the transfer of knowledge. Since 'lack of transfer' is a barrier, companies need to consciously design for transfer.

Kramer et al., 2010). Moreover, it can be off-putting to patients since it can be regarded as childish, which can negatively influence the mindset of the patient during treatment (Schmid et al., 2016).

Standardised Platforms

Mentioned by: Bohil et al., 2011; Ortiz-Catalan et al., 2014; Riva, 2005

Where the technology of VR has been advancing, the compatibility with other available technologies (specifically used within healthcare settings) is still an issue (Ortiz-Catalan et al., 2014). Currently, there are no standards, frameworks, or easy ways to integrate the technology with current platforms and this slows the adoption of VR E-health technology (Bohil et al., 2011; Riva, 2005). However, companies are reacting to this problem and they are striving to deliver applications and devices that work on their own and don't require any integration with current systems (Bohil et al., 2011).

Reliability of Hardware

Mentioned by: Lindner et al., 2019; Bohil et al., 2011; Glegg et al., 2013; Glegg et al., 2016; Kramer et al., 2010; Laver et al., 2011;

Different studies state that concerns about technical aspects of the VR treatment remains one of the highest ranked concerns and, therefore, one of the main barriers, even though these concerns have decreased over recent years (Lindner et al., 2019; Glegg et al., 2013). This can be directly linked to the unawareness of the advances made in VR, since these technological issues might be solved. However, previous negative experiences can prevent practitioners from trying to use the VR E-health technology, let alone implement it fully within their treatment (Bohil et al., 2011).

This is supported by Glegg et al. (2016) who ask practitioners to work with virtual reality E-health technology over a period of time in their study. Post-test, 41% of practitioners are not able to identify any areas where they lack confidence, and only some express concerns about managing technological issues. However, if there are technological issues, they need to be managed: even though these instances might be few, any occurrence needs to be solved and that remains a concern (Kramer et al., 2010; Laver et al., 2011).

Self-Efficacy

Mentioned by: Glegg et al., 2013; Glegg et al., 2016; Glegg & Levac, 2018; Kramer et al., 2010; Laver et al., 2011; Ogourtsova et al., 2017; Riva, 2005

The perceived (technological) self-efficacy of practitioners is a common and important barrier, which is directly linked to the technological barriers. Where practitioners are concerned with the reliability of hardware, the actual concern lies with the fact that they will not be able to solve the technological issues quickly themselves. In one study, more than half (52%) of the practitioners express concerns about not being able to use the technology (Glegg et al., 2013). However, interestingly, only a very small minority of practitioners in general who participate in the study have actual experience with VR technology.

Besides the technological issues and concerns, practitioners mention they have a lack of knowledge about how to implement the technology within their treatment (Glegg et al., 2013; Glegg & Levac, 2018; Kramer et al., 2010; Laver et al., 2011; Ogourtsova et al., 2017). They express anxiety about using such technology or having difficulty explaining the system to clients. As Glegg et al. (2016) demonstrated, these concerns could diminish when practitioners gain more experience with the specific VR E-health application, or through well-written protocols and manuals to support the practitioner. The pre-misconceptions of VR technology being difficult to use can only be countered when practitioners gain hands-on experience, but this costs time.

Time

Mentioned by: Glegg et al., 2013; Glegg et al., 2016

Practitioners need to gain hands-on experience with VR in order to become more comfortable with it and to be more likely to use it in the future (Lindner et al., 2019). However, gaining experience with the technology and preparing to implement it correctly within treatment requires time. Glegg et al. (2013) state that time to learn and use the system is, besides knowledge on implementation, the most significant barrier.

In most cases, practitioners do not receive much time to learn the technology. Once it is decided to use the technology within treatment, it is expected to be directly implemented. However, becoming familiar with a technology would reduce the barrier of self-efficacy and it could have influence on the barrier of affecting the practitioner-patient relationship, which is described next. This is demonstrated by Glegg et al. (2016) who describe that, even though time remains a barrier for practitioners after working with the technology, other barriers surpass it in significancy, showing that becoming familiar with technology could, at least, reduce some of the negative effects the time barrier introduces.

Practitioner - Patient Relationship

Mentioned by: Ortiz-Catalan et al., 2014; Kramer et al., 2010; Laver et al., 2011; Riva, 2005; Schmid et al., 2016

Every practitioner has a confidential and trusting relationship with their patient. However, if practitioners are struggling with setting up the technology or unable to solve technological issues (barriers: reliability of hardware, self-efficacy), it could negatively effect the existing relationship due to, for example, frustration (Schmid et al., 2016). Kramer et al. (2010) explain that multitasking between screens and patient could influence the relationship as well.

Moreover, practitioners express concerns that VR applications could replace their role, diminishing the personal relationship present in the current healthcare strategies altogether (Laver et al., 2011; Ortiz-Catalan et al., 2014). However, Schmid et al. (2016) interview practitioners whom state that the social interaction and motivation cannot come through a computer, meaning their role as practitioner remains essential within the treatment.

Moreover, other research suggests that using VR E-health technologies could actually strengthen the relationship between the practitioner and the patient, turning the barrier into a facilitator. Riva (2005) states that VR could play a supportive role in the treatment and thus contribute to an enhanced relationship.

Incompatibility

Mentioned by: Ortiz-Catalan et al., 2014; Glegg et al., 2013; Glegg et al., 2016

Different studies mention another barrier, namely the incompatibility of the VR technology with both the current treatment as well as with other technologies currently used. For example, Glegg et al. (2013) mention that the offered VR E-health applications do not match the current treatment approaches of the practitioners, meaning practitioners would need to adapt to the technology. Moreover, the VR systems usually consist of different hardware, software and drivers, meaning there is no standardisation for the technology and no congruent way of implementing these technologies (Ortiz-Catalan et al., 2014; Glegg et al., 2016).

Overabundant Offer

Mentioned by: Ortiz-Catalan et al., 2014

Since people are acquiring more technological skills and creating applications becomes more accessible to everyone, the amount of applications are also increasing. The same is true for E-health technologies and applications. Moreover, not every solution works for every patient. This barrier is also reported by Ortiz-Catalan et al. (2014). They state: "It is unlikely that VR interventions will be

appropriate in all cases as a sole one-size-fits-all solution. At this point it is difficult for clinicians to choose an appropriate VR intervention from the large number of available technologies."

Costs

Mentioned by: Lindner et al., 2019; Bohil et al., 2011; Ortiz-Catalan et al., 2014; Glegg & Levac, 2018; Laver et al., 2011; Ogourtsova et al., 2017; Riva, 2005

A frequently mentioned and highly influential barrier, is the cost associated with the VR E-health technology. Earlier research stated that such VR technologies were unaffordable in most cases (Bohil et al., 2011; Laver et al., 2011; Riva, 2005). Later research state that, while high financial costs are still viewed as expensive, they are no longer the most top-rated barriers (Lindner et al., 2019). However, high costs have always been associated with VR technologies and might remain a mental barrier, even though the costs of the technology have decreased tremendously over time (Ortiz-Catalan et al., 2014).

Moreover, different versions of the systems have come to the market, offering similar (yet slightly less advanced) features that could be sufficient for treatment. However, the costs associated with conducting clinical trials and implementing the technology (such as investing time in the technology, clinical and technical support and acquiring additional space) remain high (Ortiz-Catalan et al., 2014; Glegg & Levac, 2018; Ogourtsova et al., 2017; Riva, 2005).

5.1.4.2. Facilitators of VR E-health Applications Implementation

Evolving of Technology

Mentioned by: Lindner et al., 2019; Ogourtsova et al., 2017; Riva, 2005; Schmid et a., 2016; Bohil et al., 2011

In 2016, several virtual reality platforms were released in the consumer market. Hereby, it allows for practitioners to obtain more practical experience with the VR platform and the general public could generate more positive feedback on the increased user-friendliness of the VR platforms since the evolvement of the technology (Lindner et al., 2019).

This facilitator has direct links with the barrier "Unaware of VR Advances" mentioned above: if practitioners are aware of the advances made and the newly released consumer platforms are cheaper and more accessible, it could facilitate the implementation of the VR E-health technology (Bohil et al., 2011). Moreover, the attitude towards the technology has a large influence on the actual implementation or adoption by the practitioner: therefore, the improvements in the technology could ensure a better attitude towards the technology and be a facilitator for the implementation process.

Schmid et al. (2016) state that one of their practitioners mentions that the VR technology has to become cheaper and robust, which is something that can be achieved through technology evolvement. It also requires an overall attitude change: "Technologies that were hardly ever used ten years ago, such as the internet, e-mail, and video teleconferencing, are becoming familiar methods for diagnosis, therapy, education and training" (Riva, 2005). If practitioners can see the added values of those technologies now within their treatment, they might understand that VR E-health technologies could be beneficial as well.

Training

Mentioned by: Lindner et al., 2019; Glegg et al., 2013; Glegg et al., 2016; Riva, 2005; Ogourtsova et al., 2017; Schmid et al., 2016

Providing training or education to practitioners on how to use the VR technology as well as how to implement the specific VR E-health technology within the practice is perceived as a significant facilitator (Glegg et al., 2013): "Increased learning opportunities about how to use VR in clinical practice may positively influence therapists' perceived ease of use of the technology as they gain knowledge and skills in applying this new treatment approach." This is directly linked to affording

practitioners time to learn the technology in order to improve their low self-efficacy and feel more comfortable with the technology and, thus, feel more comfortable about implementing the technology (Glegg et al., 2016; Glegg et al., 2013; Ogourtsova et a., 2017; Schmid et al., 2016).

Besides training, continuous mentoring could also be of added value, since it could decrease the practitioners anxiety of having to solve issues by themselves and knowing they have someone to rely on. In general, helping practitioners apply their clinical skills to the technology and improving their technological skills over time is a key factor in successful implementation of VR E-health technology (Riva, 2005; Glegg et al., 2016). Moreover, standardised training programs can also be useful to increase knowledge or VR in E-health settings and to improve the general attitude towards the technology, also mentioned in the previous facilitator (Lindner et al., 2019).

Technical Support

Mentioned by: Glegg et al., 2013; Glegg et al., 2016; Kramer et al., 2010; Laver et al., 2011; Ogourtsova et al., 2017

Different studies highlight that a facilitator would be for practices to acquire non-practitioner staff members who can assist with both the set-up aspects related to the technology as well as technical support (Glegg et al., 2016; Kramer et a., 2010; Laver et a., 2011; Ogourtsova et al., 2017). Moreover, these staff members could function as educational support as well, helping practitioners to acquire more skills and increase their efficiency whilst using the technology (Glegg et a., 2013). This role could also be regarded as the mentorship role described above.

Organisational Support

Mentioned by: Glegg et al., 2016; Glegg et al., 2018

Directly linked to the facilitator of technical support is the organisational support. Organisational support can be the acquisition of non-practitioner members to help directly with the implementation of the technology, but it also covers acquiring additional space or location for the technology and providing practitioners with additional time to familiarise themselves with the new technology (Glegg et al., 2016; Glegg et al., 2018).

Knowledge Transfers (KT)

Mentioned by: Glegg et al., 2016; Glegg & Levac, 2018; Ortiz-Catalan et al., 2014; Ogourtsova et al., 2017

Providing other methods of support for practitioners in order for them to gain more knowledge about the specific VR E-health technology, also known as knowledge transfers, are an important facilitator as well. "KT interventions involve the implementation of awareness, educational and behavioural change strategies targeted towards key stakeholders (e.g. clinicians), which promote the uptake of evidence and aim to foster behaviour change." (Glegg et al., 2016). Thus, examples of KT methods include manuals, protocols and instructional or educational videos. This targets the direct barrier of self-efficacy, for practitioners will gain knowledge about both the technology as well as implementation possibilities (Glegg & Levac, 2018).

Multiple studies report that such KT methods would be a significant facilitator to a successful implementation process (Glegg et al., 2016; Glegg & Levac, 2018; Ogourtsova et al., 2017; Ortiz-Catalan et a., 2014). These KT methods could be web-based or provided through the purchase packages. However, one study did show that practitioners do not always consult the KT methods, as more than 40% relied on the knowledge of their coworkers to fix problems (Glegg et a., 2016). Practitioners who did use the KT methods, such as a provided manual, found it useful and wanted to quickly be able to access certain specific sections due to time constraints.
Better Treatment

Mentioned by: Lindner et al., 2019; Bohil et al., 2011; Ortiz-Catalan et al., 2014; Glegg et al., 2013; Ogourtsova et a., 2017; Schmid et al., 2016

Another very significant and often mentioned facilitator is the added value of VR E-health technology to the quality of the treatment. The technology allows for new possible additions to the treatment process, such as improved homework assignments and providing exposure material (Lindner et al., 2019). Moreover, VR offers the possibility to immerse and interact in a virtual environment, resulting in a sense of presence. Studies show that, in different domains, a sense of presence through VR can have a large positive effect on the symptoms of the patient such as neurorehabilitation as well as pain relief (Bohil et al., 2011). Practitioners see this as an enrichment of treatment options and possibilities (Schmid et al., 2016).

Moreover, the technology can provide structured feedback in some cases, which could be of added value to the treatment process of the patient (Ortiz-Catalan et al., 2014). The performance expectancy and the outcome of the usefulness for the patient were rated as determining factors on the decision of practitioners would accept and implement the technology or not (Glegg et al., 2013; Ogourtsova et al., 2017).

Independence of Patient

Mentioned by: Ortiz-Catalan et al., 2014; Laver et al., 2011

Allowing patients to continue therapy without consistent supervision could also rest in better treatment overall, but it is a facilitator on its own. By providing tools to patients, such as VR technology, which they can use at home (or without supervision) as part of their therapy plan can result that the patient spends more time on therapeutic activities without additional staff costs or additional staff time required (Ortiz-Catalan et al., 2014). Moreover, it can allow for these additional therapeutic exercises to take place outside of the formal therapy session, which could be of added value as well (Laver et al., 2011).

Motivation of Patient

Mentioned by: Ortiz-Catalan et al., 2014; Glegg et al., 2013; Glegg et al., 2018; Schmid et al., 2016

The motivation of the patient in their own treatment is very important. When exercises are more enjoyable, the exercises are more likely to be maintained over a period of time, which is necessary in order to achieve the changes in the nervous system that results in sustainable results (Ortiz-Catalan et al., 2014). VR can offer variable content, appropriate and changing level difficulties and even a form of competition, which are all identified as motivational factors of tested VR games. Moreover, receiving direct feedback can have a motivational effect: when patients understand and learn why a task is completed successfully or unsuccessfully, it prevents frustration and it promotes learning (Ortiz-Catalan et al., 2014; Schmid et al., 2016; Glegg et al., 2018).

Practitioners notice the increased motivation of patients and, in one study, 29% of practitioners name this as one of the main intentions to implement VR within their treatment (Glegg et al., 2013). Additionally, Schmid et al. (2016) also state that their practitioners mention that the patient motivation convinces them to implement VR devices within their clinical practice.

Participation in Research

Mentioned by: Glegg et al., 2016; Laver et al., 2011; Schmid et al., 2016

Multiple studies mention that, when practitioners are involved in research regarding the VR E-health application, it can support the successful implementation of the application within their treatment (Glegg et al., 2016). This would increase their knowledge about multiple aspects of the application, including how to implement it within their treatment, how to successfully select and engage patients, the effectiveness of the approach and it will improve their technical abilities when supported by the researchers (Laver et al., 2011). Moreover, practitioners can exchange information with researchers,

device engineers, other practitioners and patients about the treatment method. This form of interprofessional collaboration is desired, since practitioners gain more knowledge this way and could share positive strategies amongst one another (Laver et al., 2011; Schmid et al., 2016). Furthermore, by researching together with practitioners, the evidence-base for the specific application in a clinical setting can grow, which would decrease the barrier 'lack of clinical evidence-base'.

Recommendations

Mentioned by: Glegg et al., 2013; Glegg et al., 2016

The recommendations of colleagues are important to practitioners. Glegg et al. (2016) state that "physical and occupational therapists value the opinions and experience of their peers in incorporating new knowledge into practice." The same study also reported that 40% of their participants rely on their colleagues instead of manuals of other forms of KT. Therefore, if a colleague recommends a specific VR E-health application, the practitioner also knows they can contact them for help, which could diminish some anxiety. In their earlier research, peer influences are also rated as a primary facilitator (Glegg et al., 2013).

Novelty

Mentioned by: Kramer et al., 2010

The novelty of VR technology is not often mentioned as a facilitator, but using new popular technology within a practice could attract new patients and, thus, have a positive influence on the status of the practice (Kramer et al., 2010). This way, you can also distinguish yourself from other practices.

Collaboration in Design

Mentioned by: Ortiz-Catalan et al., 2014; Glegg & Levac, 2018; Glegg et al., 2013

Different studies recommend to work together with the practitioners in order to create applications that are relevant and impactful on both the practitioner as well as the patient (Ortiz-Catalan et al., 2014; Glegg & Levac, 2018). They stress that applications must meet the needs and satisfy the goals of practitioners and patients, which can only be done by actively involving both parties (and other relevant stakeholders such as caretakers and researchers) throughout the design process.

Moreover, it is important that the applications are user-friendly, which is one of the facilitators. However, there is no universal standard for creating user-friendly applications: while there are relevant guidelines to be followed in this regard, the user-friendliness can only be decided by evaluating interfaces and applications with the actual end-users of the application within their specific environment and context performing their specific tasks. The limitations practitioners face, such as integrating technology within their routine and the lack of time for this, require efficient solutions: these are only adopted, and these are only discovered by working together with practitioners (Glegg & Levac, 2018).

Besides this, it is also relevant to state that universal health applications can almost never be onesize-fits-all, which is also identified as a barrier for the implementation of E-health (Glegg et al., 2013). This is also apparent when looking at the conclusions provided within the literature studies. They are critical about their findings on the barriers and facilitators of VR E-health implementation in the general clinical setting, stating that their studies are more qualitative than quantitative and that research is necessary for specific domains to see the effects is specific contexts (Glegg et al., 2018). Therefore, when creating applications, as well as KT material, it is important to work closely together with stakeholders. This is demonstrated in Chapter 6, where KT, in the form of a website, is created together with the relevant stakeholders.

5.2. Input Obtained through Direct Observations

In some instances, the researcher is in a position to talk to a healthcare professional or practitioner in an informal setting. Here, the topic of the research is raised outside of the formal interview settings.

However, some of the insights gathered are interesting and beneficial to this research. Therefore, these observations are discussed within this section describing direct observations. The observations are made at the office of RelieVR BV and with a researcher at Radboud UMC (Hospital) and can be found in Appendix B and Appendix C respectively.

In the same format of Section 5.1.4., the different barriers and facilitators mentioned are briefly described. First, the matching barriers and facilitators of 5.1.4. are presented, after which the new factors follow.

5.2.1. Barriers Identified through Direct Observations

The barriers with an asterisk (*) are new barriers relative to the ones found in Section 5.1.4.1.. Some of these barriers were briefly mentioned in the articles, but not stated as an actual barrier (or addressed in the positive form as a facilitator).

Eligibility of Patients

Whereas Reducept is currently provided by the practitioners to all patients who are willing to try, it is currently unknown which type of patient actually benefits from the application. At the hospital, practitioners struggle to estimate if a patient can benefit from a VR application or not.

Reliability of Hardware

The practitioners mention the hardware needs to improve. Currently, the battery dies quickly and not many patients can be treated right after one another. Moreover, technical issues do occur.

Self-Efficacy

The practitioners do not mention their self-efficacy regarding technology, but they mention another dimension of this barrier: they find it difficult to explain the exact theories and strategies used within Reducept to their patients. They require additional support to ensure they can explain the correct knowledge to their patients after training with Reducept.

Practitioner - Patient Relationship

At the hospital, they notice that nurses complain the introduction of E-health applications replace the social team between them and the patient. However, the nurses should spend this time (when E-health is used) with their other patients, whereas now they spend it on administrative issues. Therefore, this barrier can be overcome through reorganising processes.

Costs

Financial issues were also raised as a barrier. Currently, the practitioners can only treat a small amount of patients, but additional headsets and licenses are not affordable for them as a small practice.

Organisational Issues*

Currently, due to space limitations, it requires the practitioners additional time to use Reducept. If more space would become available for patients to independently train with Reducept, the practitioners would be able to spend this time with other patients.

Critical Staff*

At the hospital, the practicing staff can be critical towards implementing new technologies. However, if staff is critical, they can choose not to work with the technology meaning it does not reach the patient. A critical attitude can also influence the willingness of patients to use the technology, as described above.

Unawareness of Patients*

The unawareness of advances made in VR, or of their advances from the perspective of practitioners, is already introduced. However, at the hospital, patients can be unaware of the E-health technologies already available. If practitioners are critical, they might not introduce all the options to the patients. If patients are aware which E-health technologies are available, they could indicate they want to work with them during their treatment.

Outdated Healthcare System*

It is mentioned that the healthcare system itself is outdated. Healthcare still consists of a lot of hierarchy, meaning communication and innovation can be very slow. Technologically, many things are possible, but the system is not yet suited for quick change. Moreover, implementation requires support in the hierarchical chain, meaning it is important to find the right people to support the initiatives. This is a very old-fashioned process.

5.2.2. Facilitators Identified through Direct Observations

The facilitators with an asterisk (*) are new facilitators relative to the ones found in Section 5.1.4.2.. Some of these facilitators were briefly mentioned in the articles, but not stated as an actual facilitator (or addressed in the negative form as a barrier).

Evolving of Technology

If VR technology were to improve (e.g. longer lasting batteries to be able to treat more patients) and technical issues were reduced, the application would be easier to implement.

Technical Support

Providing (continuous) technical support is very important: it reduces the fear of the reliability of the hardware and it allows the practitioners to focus on their speciality in healthcare.

Knowledge Transfer (KT)

Knowledge transfer could help the practitioners support the application and implementing the application within their treatment. Moreover, shareable content could ensure both patients and practitioners know Reducept is available at a practice, meaning the practitioners would receive more referrals and requests.

Better Treatment

An important reason to implement new technology or processes in general, is if the application actually results in better treatment. Therefore, the added benefits for both practitioner and patient need to be explicitly communicated. The application can also be an improvement to treatment if it has adaptive settings (e.g. related to preferences of the patient such as voice, or related to their specific context such as occupation). Moreover, intriguing content is necessary for the application to result in improved treatment.

Independence of Patients

The fact that Reducept can be used independently by the patients is viewed as a facilitator. If organisational support, such as free physical space, allows for this independence, it has added value to the reorganisation of the practitioner's time. Related to this barrier, introducing a mobile version of the application would allow the patient to train at home, meaning they are more independent.

Participation in Research

Participation in research does not only lower cost, it also helps gain hands-on experience with support from the researchers.

Collaboration in Design

Collaboration in design allows practitioners to help shape the application and obtain a sense of product-ownership. This helps shape the application to fit their needs as practitioners.

Stronger Evidence Base*

By gaining evidence, it is easier for practitioners to convince other practitioners, patients and management to use the application. Therefore, if are evidence is available, more people trust in the application and are willing to support implementation. Within practices, implementation cannot be realised through one individual: more parties need to be on board.

Affordable Hardware/Licenses*

Directly related to the barrier of high costs, reducing the price of both hardware and licenses would make it easier for practices to implement the E-health technology or application.

Community*

It is mentioned that a sense of community can help practitioners, since they can discuss issues amongst one another, share advice and motivate each other to implement the technology or application. The community could be realised in the form of a physical location or center, or an online platform.

Raise Awareness*

It becomes apparent many practitioners are not aware of all the possibilities of VR E-health technologies. Moreover, practices do not receive referrals if practitioners are not aware of the possibilities they offer. Raising more awareness for the existence of the product is crucial for the actual motivation to implement VR E-health technology.

5.3. Stakeholder Interviews

Different healthcare professionals are contacted, either through a cold-contact method through LinkedIn or through the researcher's personal network. In total twenty-eight different healthcare professionals are cold-contacted through LinkedIn, of which fourteen do not reply, five reply they do not have the time to participate, three reply they do not think the study is relevant for their patients and one stops contact after a few weeks of communication without an apparent reason. In total, five participants are found willing to participate. Through the personal network and the network of the participate, after which one loses contact.

In total 13, healthcare professionals are included in the study. The healthcare professionals consist of physiotherapists, psychologists, general practitioners, healthcare innovation managers, a surgeon, E-health enthusiasts and representatives of the Ministry of Health, Welfare and Sport (VWS).

5.3.1. Informed Consent

In order to comply with the ethical standards of the company and the GDPR regulations, an informed consent form has been designed for the interviewee to sign. Since all participants of the study are of Dutch nationality, the form has been created in the Dutch language. The original Dutch informed consent form is added as Appendix D.

The form consists of the following parts:

- The name of the interviewee
- The name of the researcher
- The title of the research project. The interviewee is informed that they can stop the interview at any time and any information gathered can always be obtained, deleted from the database or destroyed.
- The goal of the research project is explained: to map what healthcare professionals need from companies in order to successfully facilitate the implementation of the E-health technology or product within healthcare institutions.
- The contribution of the interviewee has been stated: they will participate in interviews and answer questions about E-health technologies from the perspective of their profession.
- The duration of the research project is stated: during the course of three months, the interviewee would participate in 1 or 2 interviews lasting 45 minutes to 1 hours each. Depending on the participant, the amount of time could be adjusted. At the end of the research project, the results of the project would be communicated to the interviewees.

- The data obtained throughout the research project is obtained anonymously, meaning none of the data is able to lead back to an identifiable person.
- The data is only used for research purposes.
- The researcher answers all questions regarding the research at all times.

The last part of the form is optional for the interviewee: the researcher asks if they can record audio data. This is only used for the researcher to be able to transcribe parts of the interview after the interview has ended. The interviewee can receive the audio recording at any time, the audio can be deleted from the database at any time and the audio recording can be destroyed at any time. At the end of the research, all audio recordings are destroyed. Here, the interviewee cross out the yes or no to allow or disallow audio recordings. If they disallow audio recordings, the interview still continues but without recording the interview.

5.3.2. Interview Questions

The main objective of these interviews is to gain insights into the general view on E-health by healthcare professionals, as well as virtual reality E-health technology and applications. Since all the healthcare professionals are native Dutch speakers and more comfortable with the Dutch language, the interviews are conducted in Dutch. The questions are translated in English below, but the original questions formulated in Dutch are added as Appendix E.

First, an introduction round is given to explain the researcher's background and the purpose of the interview. In brief, it is explained that many E-health technologies are implemented with a push from technology and companies, whereas the researcher is interested in understanding what the healthcare professional needs from the virtual reality E-health company in order to support the adoption and implementation of the technology in the healthcare institution.

The first section is focussed on obtaining a general opinion on E-health technologies:

1. What is your general opinion of E-health technologies?

2. Do you currently work with any E-health technologies? If so, which ones?

3. Are you interested in any particular E-health technology you have heard of, which you might implement within your practice in the future? If so, which one? And if so, what made you enthusiastic about this technology?

4. Are you interested in implementing more technologies within the healthcare institution?

5. What are main issues technology could fix right now within your healthcare institution?

6. How can companies help to improve the implementation of technologies within your healthcare institution?

Some specific question regarding VR E-health technologies are asked:

4. Have you ever seen or worked with VR headsets before? (Either work-related or personally)

5. Have you ever seen or worked with a VR E-health technology?

6. What is your general opinion of VR E-health applications?

7. Would you implement VR E-health technology within your practice at this point? What are advantages and disadvantages of doing so?

After, a demonstration or description of the product is given. First, it is explained that the researcher works for a company called RelieVR BV and that they are interested in understanding how they can help the implementation of their product Reducept in the market. The demonstration of the product is explained as follows:

"Reducept is a virtual reality application for people suffering from chronic pain. Through game elements in virtual reality, people learn about how pain works in the body and they receive pain eduction. Furthermore, they learn proven psychological techniques they can use in daily life."

It is stressed that the researcher is not marketing the product and that the participants could give feedback on every aspect. If the interview is in person, a demonstration of the project could be given (which is the case in the website - participant group of Chapter 6).

8. What are reasons that will make you consider implementing this technology within your practice?9. What are reasons that are making you hesitant or resistant towards implementing this technology within your practice?

10. What needs to be improved in the product before you would use this within your practice?

11. Which information would you need before you would use this within your practice?

It is also important to focus on the manner in which the information concerning innovative virtual reality E-health applications is conveyed to the healthcare professional. The following section is focussed on this matter:

- 12. In which manner would you like to receive information about E-health technologies?
- 13. Which platforms would be beneficial to you to receive more information?
- 14. Can you think of other approaches that might be efficient?

In some cases, where the interviewee is familiar with Reducept or with virtual reality E-health applications in general, more in-depth questions are raised about their experiences and the actual implementation barriers and facilitators they encountered.

In case of the health innovation managers, the implementation questions are reformulated to fit their occupation. Therefore, questions are formulated on a organisational level more than on an implementation level.

For the interviews conducted with representatives of the ministry of Health, Welfare and Sport (VWS), different questions are asked as well: here, the researcher asks more about the financial support from the government and the overall organisation's views on E-health and its implementation. VR is introduced, but it is not the focus of these particular interviews.

5.3.3. Interview Results

Throughout the interviews, different barriers and facilitators are described by the practitioners. This section provides a summary of the mentioned barriers and facilitators, followed by other relevant comments made. The full interviews with the practitioners can be found in Appendices F, G, H, I, J, K and L.

Since this is a qualitative research study and involves a small group of participants, counting how many times a barrier or facilitator is mentioned is not relevant. Therefore, the barriers and facilitators below are not ranked or ordered based one significance, but they are presented in the order equal to Section 5.2.1. and Section 5.2.2.

Here, practitioners refer to practicing healthcare professionals and the term healthcare professionals apply to all the interviewees.

5.3.3.1. Barriers of VR E-health Applications Implementation

The barriers with an asterisk (*) are new barriers relative to the ones found in the literature review of Section 5.1.4.1. and the direct observations of Section 5.2.1.. Some of these barriers were briefly mentioned in the articles, but not stated as an actual barrier (or addressed in the positive form as a facilitator).

Negative Pre-Misconceptions

During the interviews, some interviewees are skeptical about VR since they had previously experienced VR applications that were not of high quality. Some see VR only as a mean for

entertainment and cannot imagine that VR could be beneficial to the healthcare domain. Even though this is only stated in a few interviews, it shows the barrier is present.

Unaware of VR Advances

Many interviewees only have experience with low-budget VR headsets, which have a different quality and reliability than current state-of-the-art VR headsets. During the interviews, some mention that the reliability of the hardware and the accuracy (where applicable) are important concerns they have regarding the technological aspects of VR. Moreover, most of the practitioners are unaware of the existence of VR E-health applications for the healthcare domain.

Eligibility of Patients

A frequently mentioned barrier is that VR E-health applications are not a one-size-fits-all. Therefore, many practitioners express the concern that they are not sure if their patients would benefit from this technology.

Patient's Unwillingness to Try

Many practitioners express their concern about if their patients would be willing to try. Some believe their patients might not be open to trying VR or might experience negative side-effects. Other practitioners are concerned as well, but mention they should try it out to see the actual result.

Lack of Clinical Evidence-Base

Lack of a clinical evidence-base for Reducept is a barrier to implementation. Practitioners are not willing to provide or refer their patients to a product they do not know the effects of (either short-term or long-term). Therefore, through research, this strong evidence-base needs to be established. However, the interviewees understand the paradox of this statement, since practitioners need to implement the application in order to obtain research and test results. Therefore, practitioners need to be found who are enthusiastic and willing to try a new technology within their practice.

Lack of Transfer

Some of the interviewees express concern about the transfer of knowledge to everyday life for Reducept. They are concerned that the application could rely largely on a distraction-factor, meaning it is not a sustainable solution. Only research and test results can address these concerns.

Standardised Platforms

The issue that VR E-health technology cannot be integrated with current systems is sometimes seen as a barrier. This means that the practitioner would need to work with an additional interface or system. If the application complies with the same security measures as the main system of the practitioner, they sometimes do not mind to use an additional tool. However, if the system does not live up to the same strict security regulations, it is not possible to use the application within the healthcare domain.

Reliability of Hardware

As stated before, some practitioners have had previous experience with lower-quality and less reliable VR headsets. They are, therefore, also concerned about the reliability of Reducept and VR in general. They stress they are not a technical profession and never choose to be. However, since technology is becoming a vital part of the healthcare domain, they are pushed to work with it. If they are going to work with it, the hardware and software must be reliable since they do not want to run into technical issues when providing healthcare to patients. Furthermore, interviewees express their concern regarding maintenance care of the product.

Self-Efficacy

Self-efficacy is mentioned in many interviews, either directly or indirectly. Some interviewees mention their lack of tech-affinity, whereas others express their concerns about not knowing how to implement it, work with the hardware or provide guidance to the patient. Others are concerned the program might be too complex, both for them as well as for the patient. If it is too complex for the patient, they are afraid they need to provide a to of explanation which lies outside of their field of expertise.

Time

Time is a much mentioned barrier, in different aspects. First, concerns are expressed about the lack of time to learn to work with the VR hardware and software. However, if the added benefits are exceedingly high, many practitioners do not mind spending some of their free time to learn to work with the technology. Nonetheless, this is not a sustainable model and time should be available during working hours for implementation of E-health.

Moreover, questions are raised about the time E-health applications would need during consults. For example, some practitioners have long sessions with their patients, whereas others only see their patients for a very short amount of time, meaning the time would not be sufficient to allow patients to train with Reducept.

Practitioner - Patient Relationship

Even though the influence on the practitioner-patient relationship is not raised as an issue in many cases, some concerns are expressed. In general, if the E-health application supports treatment, it should improve the treatment and the relationship. However, this barrier can be present when there are technical issues, resulting in frustrations that could negatively influence this relationship.

Incompatibility

Incompatibility is raised several times as a barrier, although in a different aspect than previously found. Of course, incompatibility with current treatment processes and systems is an issue, although these processes can (and, sometimes, should) be adjusted. The main issue here lies in the vision and story provided by Reducept: if the education does not completely match the vision and story of the practitioner, introducing this VR E-health application to patients could be counterproductive since it would confuse them. Therefore, the content of the application needs to match perfectly.

Overabundant Offer

The exceedingly amount of E-health applications on the market can make a healthcare professional feel lost: which applications are effective, right for their patients and easily implemented within their practice? It is difficult for healthcare professionals to keep an overview of the offer of E-health applications and this can make them hesitant to make a choice.

Costs

The issue of costs is raised in almost every interview. It is usually also the first barrier to come to mind. Healthcare professionals do not have much wiggle-room for adding additional expenses. Therefore, any additional costs are a crucial barrier to purchasing and implementing E-health technologies. This is also true for VR, since both the headsets and software need to be purchased. However, it is explained that purchasing E-health should not be seen as additional costs: healthcare professionals need to look at how they organise their finances and see which cost items are reduced if the E-health application is implemented. Then, healthcare professionals can re-organise their spending budget. This is not an easy task.

Moreover, companies who sell VR E-health applications usually sell closed-system VR headsets, meaning no other applications can be added to the headsets. This limits the headsets to be used for different purposes, making the purchasing of such devices less attractive.

Also, there are many questions raised about how will pay for this device. For example, do practices purchase the device or does the patient pay? Also, in case of hospitals, if patients use this device resulting in less hospital visits, it is morally a good outcome. However, for the hospital in question, they would invest money and receive less income since they have fewer patients. In the healthcare sector, the investment and returns are crooked.

Additionally, there are questions concerning reimbursement. Can the patient reimburse the costs they make, or can practitioners? If the patient cannot reimburse the costs, practitioners are less likely to refer them for the treatment. The complex world of finances of the Dutch healthcare sector can make it difficult for practitioners to obtain an overview of financial possibilities stimulated by the government.

Organisational Issues

The healthcare professionals are curious about how to implement such VR E-health technology within their treatment. Some wonder about spacial issues, whereas others see logistical issues of which staff members can add this to their workload without their workload exceeding their time limitations.

Critical Staff

The mindset and criticalness of practitioners and staff is mentioned throughout the different interview. Some fear for the conservativeness of some healthcare professionals (most likely applicable in the older generation), whereas others express some criticalness themselves. As stated before, critical staff could lead to ineffectiveness as it will influence the mindset of the patient as well: patients trust practitioners and can easily adopt the practitioner's views on medical matters.

Outdated Healthcare Systems

The outdated healthcare systems, sometimes referred to as a bankrupt system, is mainly mentioned by the ministry. They explain that technology implementation is still very low in the healthcare sector. Moreover, changing existing processes is an extremely difficult thing to do, since there is still a lot of money in the system which diminishes an urgent need to change.

Furthermore, the current system has a production culture, meaning healthcare professionals need to produce the most they can in the shortest amount of time. This leaves little time and room for thoughts about the implementation of E-health that could improve efficiency in the long run.

Fear of Replacement*

While not mentioned often, practitioners can have a fear of being replaced by technology. Therefore, they only support E-health technologies that will support them in doing their job. One practitioner does make the remark that, if the technology provides much better treatment than a practitioner, it is only fair to let technology replace you. However, practitioners are crucial within treatment processes. Moreover, due to the increasing issue of lack of staff, having technology take over some tasks can decrease the overbearing workload of healthcare professionals.

Absence of Ownership*

As has been the case many times before, the implementation of E-health within healthcare institutions could be the result of a push-culture. This means management will push healthcare professionals to implement technology within their work processes. However, if this requires additional effort and energy without clear return, using this technology does not become attractive. Due to the push-culture, practitioners do not have a sense of ownership over the product: creating a sense of ownership could make them feel more affiliated with the product, it could help them see the added benefits and it would allow them to help improve the product to meet their needs.

Not Solving Problem*

Another barrier is that the solution does not actually solve the problem. This is mostly the case if the company develops E-health technology from a business perspective without having much knowledge in the medical domain.

Hygiene*

In the medical field, hygiene is extremely important. However, VR devices can have some hygiene issues if they are used by multiple patients. Especially closed-headsets can carry lots of bacteria and form health hazards. Especially in larger healthcare institutions, such as hospitals, hygiene concerns can be a crucial barrier to the implementation of technology.

Liability*

Nowadays, the issue of liability regarding technology is an on-going discussion. If the patient is harmed by using the E-health technology, who is responsible? Are the healthcare professionals who choose to implement or refer the technology responsible, is the patient responsible or are the developers responsible? Since harm in the healthcare domain can have disastrous consequences,

healthcare professionals could be hesitant to implement new technology that might be harmful in one way or another to their patients.

5.3.3.2. Facilitators of VR E-health Applications Implementation

The facilitators with an asterisk (*) are new facilitators relative to the ones found in the literature review Section 5.1.4.2. and the direct observations of Section 5.2.2.. Some of these facilitators were briefly mentioned in the articles, but not stated as an actual facilitator (or addressed in the negative form as a barrier).

Evolving of Technology

The interviewees mention that improvements in the VR technology could help facilitate them to implement the VR technology within their practice. They require fast technology, but most of all accessible and user-friendly technology, both in the hardware and the software of the application. Moreover, if the practitioner would be able to see what the patient is seeing through the VR headset, they would be able to provide real-time guidance which they feel could be beneficial to their treatment.

Training

Many practitioners express their need for training if they were to implement this technology within their practice. They would prefer a physical training at location. One interviewee suggests that this can be avoided if the product is intuitive enough to use. Otherwise, it would be interesting to provide this training in the VR environment, since the VR technology is suitable for educational purposes. Additionally, the training would then be in the same medium as the application, instead of on paper. This is further explored in 'Knowledge Transfer'.

Technical Support

Practitioners feel more comfortable knowing there would be continuous technical support from the company. Then, they could focus on providing healthcare and not worry about technical issues. This can be in the form of a helpdesk or actual in-house technical support provided by the company (at least for the set-up phase). Furthermore, the company should provide maintenance care, including updates and replacements if hardware breaks down.

Organisational Support

The organisation can help facilitate the implementation of (VR) E-health by allowing practitioners time within their working hours to learn to work with the technology and how it works. Since this is crucial for practitioners to be able to work with the technology, this facilitator is crucial.

Moreover, the organisation could explore if certain activities regarding the use of E-health technologies can be outsourced to other staff members without exceeding their existing workload. For example, if a practitioner has very short consults, it can be explored if assistants could help with the use of the technology outside of the consult time. However, this should not lead to an exceeding workload for the staff member. Otherwise, the acquisition of additional staff can be considered.

Besides time and the possibility of outsourcing, the organisation could consider freeing up physical space to allow the patient to use the VR E-health application independently outside of the treatment room. This way, the practitioner can help other patients whilst the user trains.

Knowledge Transfers (KT)

Knowledge Transfers are necessary in order to help the practitioner understand the content of the application as well as the technology. As mentioned before, this could be provided through the medium of virtual reality.

It is important that KT include explicit implementation instructions so healthcare professionals understand how to implement the application within their treatment processes. The KT needs to contain clear information, possibly in the form of visuals rather than large amounts of text.

Shareable content can be created in order for the practices to advertise their use of VR E-health technologies. Also, shareable content can be given to the patient to prepare themselves at home prior to the treatment and share their treatment with possible partners, family and caretakers.

Independence of Patients

Having patients be more independent is the future of healthcare. Therefore, allowing patients to train or stay more at home through E-health technology is a big facilitator for implementation. Here, developing a mobile version of the application could be a realisation of this facilitator. Moreover, if a patient receives treatment at home, the actual behavioural change might be more effective. Humans always behave differently when they are being observed than if they are in the comfort of their home. Therefore, treatment performed at home could have more effect on the actual result since it is obtained in a real and comfortable situation.

Motivation of Patient

Having patients become motivated due to using innovative technology is another motivation to implement such innovative technology within a practice. Moreover, specifically in the case of Reducept and chronic pain, patients suffering from chronic pain do not have many effective treatment options yet: therefore, if this application proves to be effective, it could help enthuse the patient to work with it.

Participation in Research

If healthcare professionals are allowed to participate within research, they gain a sense of product ownership since they can provide improvements, receive help with implementation and gain handson-experience with the application. This can be a big facilitator for full implementation of the finished product in a later stage.

Recommendations

Healthcare professionals highly value the opinions and recommendations of their colleagues and peers. These recommendations create a first filter on which new E-health technologies are good to use within practices. Furthermore, it gives the practitioner the impression they can ask said peer or colleague for help during implementation.

Novelty

Implementing E-health can distinguish their practice from other practices. This could lead to more patients who wish to be treated at their practice.

Collaboration on Design

When practitioners are involved in the design process, they gain a sense of product-ownership since they are asked to share their needs and the product is adjusted to them.

Stronger Evidence Base

Gaining strong clinical evidence is a strong facilitator: not only do the healthcare professionals gain trust in the application and are they more likely to provide it for their patient or refer their patient, but it is also easier for them to convince management or to agree on reimbursement possibilities with financial institutions.

Affordable Hardware/Licenses

If the costs of the VR hardware and the license costs would decrease, it would be easier to implement it within healthcare institutions. Additionally, it would be nice if the product could be reimbursed for either practice or patient. One interviewee advices to lease products instead of selling them: not only does this spread the costs of the product, the healthcare institution can then also receive maintenance care and the latest updated. Therefore, leasing the product can also include providing technical support.

Better Treatment

One of the main facilitators is that, if the E-health technology is effective and causes treatment to improve, healthcare professionals are eager to implement it. Here, the E-health application should have an added benefit for both patient and practitioner if it is implemented within a practice. The explicit added value needs to be communicated to the practices. For example, if Reducept helps the patient understand the complex concept of pain and practitioners can work more efficiently, this would improve treatment for both.

There are more ways in which treatment could improve. For example, the VR E-health application could provide a different learning strategy since it provides visual content. Also, interactive gaming elements could be included to introduce gamification to the treatment. The application is also more consistent in the way it presents knowledge compared to a practitioner. The application can also provide feedback to the patient and it can be patient-tailored if it has adaptive functionalities.

The application should transfer knowledge from the virtual environment to real-life activities, in order for it to be a sustainable treatment.

Community

Establishing a community of colleagues working with the product would help facilitate implementation. Not only would it motivate practitioners to use the E-health applications if their colleagues are using it as well, it also provides close-to-home since colleagues can help one another if issues arise.

Raise Awareness

By raising awareness for the existence of the VR E-health applications, healthcare professional can become aware of their existence, which is crucial before they can implement them. Also, by doing this, other practitioners could become aware they can refer their patients to these practices, resulting in more patients for the practice using the technology.

Compatibility of Content*

It is crucial that the content of the application completely matches the vision of the practitioner in order to avoid confusion for the patient. Therefore, the application should be fine-tuned per healthcare institution. It is also expressed that the application should be in the native language of the patient, since another language could make it difficult for the patient to fully grasp the content of the application.

Background Company*

The background of the company is an important facilitator. The motivation behind the product creates an impression of the quality to the application: is the idea created from a medical perspective and need, or is this product the result of a business initiative? If it is created by a team with medical expertise, healthcare professionals have more trust in the product. Also, it would help if the application or team had a form of accreditation, either through legal measures (certification) or through support (by famous people in the industry).

Gather Data*

E-health technologies have the ability to gather data. This gathered data can be used to improve the treatment of the patient, as well as provide improvements for healthcare in general. Data can be used for research to develop more innovative applications. Regarding research, this is mostly a facilitator for larger institutions who are also conducting research.

However, not gathering any data can be seen as a facilitator as well: if the application does not gather any data, the application is much easier to implement since it does not have any privacy and security issues. If data is being gathered, the privacy and security issues not to be addressed thoroughly.

Decrease of Medicine*

Due to the increasing opioid crisis, it is important to start prescribing less medicine and finding other solutions for health issues. Since this is a current need and applications such as Reducept could

provide an alternative solution, this is a motivator for implementation. In general, find the need or develop based on the need in the healthcare domain.

Reorganisation Healthcare Services*

A complex facilitator is the reorganisation of healthcare services. Even though it does not feel urgent, the system is currently bankrupt and needs to change. If the system were reorganised, it could help facilitate the implementation of E-health technology.

Currently, the fact that patients would need less hospital visits and that practitioners can work more efficiently are already facilitators. If a central place for questions about the possibilities and experiences with E-health would exist, it could help motivate implementation. Also, the incorporation of assistants, coaches and innovation managers could shift the focus to implement more E-health technologies and are organisationally supported.

In the end, processes of practitioners will need to change. This is not stated because it could help implement E-health technologies, but because the current processes are not efficient and outdated. By being open to change processes, money can be redistributed to also include E-health to make processes more efficient. Also, a general economic board could help resolve financial issues around the implementation of E-health.

Smooth Distribution*

Companies need to learn that the first impression of the E-health application starts with the distribution channel: if this runs smoothly, the company seems well organised which generates a sense of trust with healthcare professionals. Moreover, it could enthuse practitioners to want to start working with their new innovation.

The supplier could also provide hygiene masks with the purchase of the product, which would directly diminish the barrier of hygiene concerns.

Demonstrations*

This facilitator is very relevant for VR E-health applications: VR is all about an experience which cannot be easily conveyed through images or videos. Someone has to experience the VR application in order to understand what it is about and to get a feeling of the quality of the product.

5.3.3.3. Reaching Healthcare Professionals and Other Suggestions

During the interviews, interviewees are asked about how they would like to be approached abut new VR E-health technologies. Moreover, other interesting comments and suggestions are made that are summarised below.

All interviewees express that they use some E-health, but not enough. This expression indicates that they are interested in E-health technologies and are enthusiastic about implementing it more within their practices.

The interviewees explain they learn about new technologies in different ways. The most frequently mentioned as both effective and desirable is learning about new E-health technologies and applications through their personal network. Some find new technologies through social media platforms, the most popular being LinkedIn and Twitter. On these platforms, they follow influential people who sometimes post about new innovations. They usually do not follow companies. Therefore, it might be interesting to collaborate with an influential person in the specific domain of the E-health application who can share the company's innovation.

Facebook is sometimes used, more specifically Facebook groups. Interviewees can join closed groups that share information about everything related to the topic of the group. Sometimes, new innovations are highlighted here. LinkedIn groups work in the same manner and are also effective ways to find new innovations.

Other frequently methods mentioned are through congresses, events, news, newsletters, advertisements or articles in magazines and advertising leaflets. E-mails are also possible, although personal e-mails or e-mails from other practices are preferred rather than company mails. If it is a company mail, include a PDF of a factsheet that contains the most important information: attachments are more frequently opened than links in e-mails.

No one usually searches for new innovations: one interviewee expresses their specific interest in virtual reality which leads them to search for innovative applications using virtual reality. However, due to an overabundant offer, it can be difficult for companies to be found through generic searches,

Some practices still prefer paper mail (preferably from practices rather than advertisement) which they can read and physically share with co-workers. The suggestion is made to create sample letters which Reducept practices can send to referral-practices: they can forward this letter in order to raise awareness and obtain more patients.

It can also be a strategy to target patients instead of practitioners: if patients raise awareness for the practitioner about a specific application, practitioners might be more inclined to implement it. It can also be an idea to make the E-health application a consumer product altogether.

Where some practices disallow visits, others prefer it. This way, they can receive a demonstration and learn more about the product. During the interviews, it is also apparent that professionals who receive a real-life demonstration are more impressed with the product than the professionals who receive a verbal explanation only. If physical visits are not possible, an experience-video could also provide an impression of the application.

Another tactic can be executed by the healthcare institutions, who can express their needs towards external parties. Companies can then contact them if their product matches the healthcare institution's needs.

Interviewees express the need for more overviews, both for the available financial possibilities as well as for the available E-health applications. The ministry has recently released an overview of financial possibilities, which could help healthcare professionals understand the possibilities. A platform containing all E-health applications with ratings, reviews and a validation-status could help healthcare professionals chose which application is most suitable for their specific healthcare institution.

5.4. Implementing Facilitators to Decrease Barriers

In the previous sections of this chapter, barriers and facilitators are identified. The complete list of barriers and facilitators has been added as Appendix M. This section focusses on implementing facilitators to decrease barriers to implementation.

After identifying these barriers and facilitators, it is interesting to see how they can be used to improve the implementation of VR E-health technologies and applications in healthcare institutions. As stated by Villalba et al. (2013), barriers are aways present during implementation processes. However, introducing the right facilitators can reduce the barriers significantly and help the implementation of Ehealth. Therefore, as a company, incorporating as many facilitators as possible can help reduce the barriers that are associated with the implementation.

Through the literature review, direct observations and the interviews, it is apparent that all barriers are related to one another. This means that barriers influence and strengthen one another. They are also dependent on one another. Due to these complex relationships, it is difficult to diminish one single barrier. However, this also means that incorporating facilitators decrease multiple barriers at the same time.

Therefore, the identified facilitators are analysed. The facilitators are shown followed by the barriers they positively influence. Depending on the amount of barriers they positively influence and the amount of time or money needed to endorse them, a cost-efficiency can be estimated. Since this research focusses on companies conforming to practitioners, only the facilitators companies can incorporate are included. The other facilitators need to be incorporated within the practises themselves or in the broader healthcare system. Therefore, 'Organisational Support', 'Decrease of Medicine' and 'Reorganisation of Healthcare Services' are not included in this overview.

The overview of cost-efficient facilitators is shown in Table 4, rating from most cost-efficient to least cost-efficient. Table 4 can be used by companies to decide which facilitators they want to incorporate within their businesses.

Facilitators	Affected Barriers
Collaboration in Design	Negative Pre-Misconceptions, Unaware of VR Advances, Lack of Clinical Evidence Base, Self-Efficacy, Incompatibility, Critical Staff, Absence of Ownership, Not Solving Problem This is a highly effective facilitator and low in cost: from the beginning of development, practitioners need to be involved throughout the development process. However, only if this facilitator is incorporated at the beginning, the costs are low: otherwise, many alterations might be needed that cost a lot of money.
Compatibility of Content	Lack of Transfer, Self-Efficacy, Practitioner-Patient Relationship, Incompatibility, Critical Staff, Not Solving Problem It is important to ensure that the content actually is compatible with the treatment of practitioners. This should be done at the beginning of the development phase and can be combined with 'Collaboration in Design'.
Better Treatment	Patients Unwillingness to Try, Lack of Transfer, Realism, Practitioner-Patient Relationship, Not Solving Problem Depending on the improvement of the treatment, different barriers can be overcome. However, these improvements usually require software alterations, that are quite expensive. Of course, the E-health application should already be of an added benefit in order for it to be successful. Therefore, this facilitator should always be endorsed by companies.
Raise Awareness	Negative Pre-Misconceptions, Unaware of VR Advances, Patient's Unwillingness to Try, Practitioner-Patient Relationship, Overabundant Offer, Critical Staff, Unawareness of Patients By raising awareness for the existence of the application, many barriers can be overcome or at least diminished. The effect on the barriers is not always very high, but this facilitator is crucial for the implementation. Moreover, if patient become aware of possible E-health solutions, they can also let their practitioners know. Also, being more aware of the application and its added benefits could increase the motivation of the patient.
Motivation of Patients	Patient's Unwillingness to Try, Practitioner-Patient Relationship When a patient is excited to work with the technology, their treatment results can improve. As VR is an innovative and exciting tool, it depends on the quality and concept of the application, as well as on the awareness of the patient as described in the facilitator "Raise Awareness".
Background Company	Lack of Clinical Base Evidence, Incompatibility, Overabundant Offer, Critical Staff, Not Solving Problem Having applications build from a medical motivation instead of a business motivation can improve the level of trust and accreditation of the application. Costs can be non-existent if the team has this background. Otherwise, it could be of added value to add a practitioner to the team. This can be low in costs or high in costs depending on the situation.

Table 4: Facilitators and their effect on barriers, ranked from most cost-efficient to least cost-efficient.

Facilitators	Affected Barriers
Community	Negative Pre-Misconceptions, Unaware of VR Advances, Self-Efficacy, I Critical Staff, Fear of Replacement, Not Solving Problems The same barriers are overcome as with 'Recommendations'. However, by establishing a community, more practitioners can help each other. This can also be a self-sustaining facilitator. The costs require time to build a community, but the return is high and it is a very cost-sufficient facilitator.
Recommendations	Negative Pre-Misconceptions, Unaware of VR Advances, Self-Efficacy, Critical Staff, Fear of Replacement, Not Solving Problem The same barriers are overcome like with 'Community'. As practitioners state, they highly value the recommendations of their colleagues. A recommendation can take away some doubts. Since this could have a snowball effect, the company only needs to invest time in the beginning, making it a low-cost facilitator.
Novelty	Patient's Unwillingness to Try, Unawareness of Patients When properly marketed, a practice can distinguish themselves and acquire more patients. The costs are low but the efficiency is also not very high. It can also be combined with other facilitators.
Knowledge Transfers	Eligibility of Patients, Self-Efficacy, Time, Practitioner-Patient Relationship, Incompatibility, Critical Staff, Fear of Replacement By providing KT, practitioners earn about how to implement the application within their treatment. Since KT only has to be created once after which many practitioners can use it, it is relatively low in costs.
Demonstrations	Negative Pre-Misconceptions, Unaware of VR Advances, Lack of Clinical Evidence base, Self-Efficacy, Incompatibility, Overabundant Offer, Critical Staff, Fear of Replacement, Not Solving Problem Providing demonstrations to companies can diminish many barriers early in the implementation process. Therefore, the return is very high. Since demonstrations cost a lot of time and it is not certain if the product is purchased, the costs are also high and risky. It could be explored if demonstrations of VR can be done in an online environment to reduce costs.
Training	Negative Pre-misconceptions, Unaware of VR Advances, Self-Efficacy, Practitioner-Patient Relationship, Incompatibility, Critical Staff, Fear of Replacement By providing training to the practitioners, they can become aware of the way it should be implemented. The costs are dependent on salaries of trainer.
Participation on Research	Negative Pre-misconceptions, Unaware of VR Advances, Eligibility of Patients, Lack of Clinical Evidence Base, Self-Efficacy, Incompatibility, Critical Staff, Absence of Ownership, Not Solving Problem Participation of practitioners can overcome a lot of crucial barriers. However, conducting research takes a lot of time and effort, also obtaining funds is part of this process. It is highly advised, but also costly.
Technical Support	Reliability of Hardware, Self-Efficacy, Time, Practitioner-Patient Relationship, Incompatibility, Critical Staff By providing continuous technical support, either in-house or online, practitioners gain confidence since they don't need to worry about technicalities. Costs are dependent on mean (in-house = high, online = lower).
Smooth Distributions	Negative Pre-Misconceptions, Patient's Unwillingness to Try, Critical Staff, Hygiene Implementing this facilitator could be highly beneficial, since it provides the first impression to practitioners. Ensuring the entire process runs smoothly is costly due to logistics and services, but also has a high return.

Facilitators	Affected Barriers
Evolving of Technology	Eligibility of Patients, Realism, Standardised Platforms, Reliability of Hardware, Incompatibility By evolving the technology, technological issues can be avoided. However, this is a costly facilitator.
Independence of Patients	Patient's Unwillingness to Try, Time, Organisational Issues, (Costs, Liability) Since the patient can train more at home, this is advantageous to both practitioner and patient. Depending on the organisation of this, costs for practitioners can decrease and liability issues could be avoided. This is mostly possible when a mobile version is created. This is high in costs.
Stronger Evidence Base	Negative Pre-Misconceptions, Unaware of VR Advances, Eligibility of Patients, Patient's Unwillingness to Try, Lack of Clinical Evidence Base, Overabundant Offer, Critical Staff, Not Solving Problem A stronger evidence base diminishes a lot of barriers. However, generating this takes a lot of time and a lot of money due to research needing to be performed. These barriers could also be tackled with other facilitators. However, it has a lot of added value and should be seriously considered.
Gather Data	Eligibility of Patients, Patients Unwillingness to Try, Lack of Clinical Evidence Base, Practitioner-Patient Relationship If applicable to the application, gathering data could be very beneficial and attractive for practitioners. However, it does require high implementation costs. For this particular application, the costs could outweigh the actual added value.
Affordable Hardware	Costs Making the hardware more affordable, could diminish the barrier of cost. Even though this barrier is crucial, the costs for the company are also high. Eliminating other barriers and focussing on the application could make the costs less relevant since the return for the healthcare institution is very high.

Table 4 above provides an overview of the cost-efficiency of facilitators that can be implemented or executed by the company. RelieVR BV is currently working on many of these facilitators. One of the most cost-efficient facilitators estimated by the researcher is to raise awareness for the application. This is something that can be improved for Reducept. Therefore, the researcher is designing a website for Reducept to raise awareness for the application. They will integrate and address as many facilitators as they can on this platform, of which the process is described in Chapter 6.

6. Realisation of Website

As described in Section 5.4., raising awareness for Reducept is a highly cost-efficient facilitator. Since there is not much awareness-raising marketing available for Reducept yet, the researcher designs a website with the goal of raising awareness for Reducept, providing information on the application and addressing as many facilitators as possible that are identified in Chapter 5. This website is developed through a user-centred design process, visually depicted in Figure 7.



Figure 7: Visual presentation of methodology, where the purple color indicates which blocks are relevant for Chapter 6.

As described in Section 3.5., a project consists of different phases in which different stakeholders are involved. The stakeholders are identified in Chapter 4. In order to keep an overview, the 'Practitioners', 'Potential Buyers' and 'Potential Promoters' are merged as 'Healthcare Professionals'. The 'Developers' are split up into separate categories, namely 'Graphic Designers' and 'Website Developers', since these specific parties are involved in different stages of the project. The division of stakeholder involvement is shown in Table 5.

Currently, many practitioners get lost in the abundant offer of information provided on websites and, due to previous negative experiences, they are not motivated to investigate every VR E-health application they come across. Therefore, by conforming the website to the needs of the practitioner and addressing the facilitators for implementation, this helps provide useful information to healthcare professionals. Moreover, this could result in creating more awareness and enthusiasm for the product amongst healthcare professionals. In turn, this could facilitate the implementation of Reducept in healthcare institutions, meaning Reducept would actually reach the patient. Of course, this is the ultimate goal of both the company as well as the practitioner.

Design Phase	Activity	Parties		
User Context 1	Interviews	Healthcare Professionals		
Requirements 1	Determining Requirements	Researcher		
Prototype 1	Creating Wireframes	Graphic Designers	Company	Researcher
Evaluation 1	Interviews	Healthcare Professionals		
Requirement 2	Determining Requirements	Company	Researcher	
Prototype 2	Creating Wireframes	Company	Researcher	
Evaluation 2	Approving Wireframes	Website Developers	Company	Researcher
Requirements 3	Determining Requirements	Website Developers	Company	Researcher
Prototype 3	Creating Website	Website Developers	Company	Researcher
Evaluation 3	Evaluating Website	Healthcare Professionals	Company	Researcher

Table 5: Parties involved in the user-centred design process

6.1. User Context

First, it is important to understand the user of the product and their needs regarding websites. This is done through two different methods, namely a literature review and stakeholder interviews. Since the stakeholders most likely do not have experience designing business-to-business (B2B) websites, it is important to consult literature on this matter. Moreover, since the interviews provide qualitative information, the literature could provide more quantitive claims. By merging the two methods together, a better understanding of the user is made.

The users of the B2B website of Reducept are practitioners, potential buyers and potential promoters. Patients can also find the website: even though they are not the target group, some elements need to be incorporated so patients do not lose interest in Reducept, but might be triggered to ask their practitioner about it. This is also important because a consumer version of Reducept is coming to the market later this year. Patients are not interviewed for this particular website, since the features relevant to them are limited.

The users of this website mostly look and search on websites at their practice on computers (desktops) or laptops. Therefore, the design of the website is largely focussed on desktop. To comply with accessibility guidelines, the mobile version is also created, but it is not the main focus during the design of the website. Moreover, it is important to understand that healthcare institutions sometimes block websites or multi-media content to be opened. These issues are taken into account when designing the websites.

The first four interviewees of this research study also answer specific questions regarding the usage and design of a website. These interviewees are interviewed again after the first prototype is finished in order to provide feedback for adjustments. Moreover, these participants receive a survey once the website is finished: this feedback is added as potential future improvements for the website. The interviewees who participate within this user-centred design process are a physiotherapist, psychologist, general practitioner and an E-health enthusiast. Moreover, the company provides input and feedback for the website on which they have high influence as determined in Chapter 4.

6.1.1. Literature Review on B2B Websites

Prior to conducting the interviews with the participants, a brief literature review is performed to get basic insights into generating business-to-business (B2B) websites. These insights could support statements made by the participants as well as provide investigated insights on different areas of expertise, such as technical features.

First, providing up-to-date information on a website can be an important source of confidence (Golik & Cukovic 2010). When a website is frequently updated, it shows the company is still active. Moreover, the company could provide updates that encourage the confidence level of visiting businesses. Also, Golik and Cukovic claim that customising information on a website seems to help gain a better understanding of what is being offered. Customisation can influence the business' perception of the seller's appreciation for them as well, since they must be an important customer if the website customises or adapts to them. Last but not least, the study also states that multimedia content, such as pictures and video, can help understand the product as well as inspire potential buyers.

Another study also concludes that the quality of the information, measured in accuracy, relevance, usefulness and recentness in combination with the credibility of the website, has a positive influence on business customers. Here, the website's credibility is set by contact options, accreditation, brand of website, company credentials and website aesthetics. Time stamps, date stamps and links to sources also has a positive influence when integrated within B2B websites (McLean, 2017).

A different study recommends to provide downloadable content for information, such as factsheets, manuals and pricing information. Moreover, shareable or marketing content, such as screensavers and gameplay, could also be a good way to grab potential buyer's attention (Yeung & Lu, 2004).

Furthermore, navigability and security are found very important factors in B2B websites. Another distinguishing factor is to create high quality service, which is common in business-to-customer websites (B2C), but not in B2B variations. Therefore, this could positively differ the website from competitors (Lee & Kozar, 2006). This complies with McLean's findings mentioned before.

Chakraborty et al. (2002) defines seven factors that are rated as relevant by businesses on B2B websites. Here, the organization, interactivity, privacy and security are rated as the most important factors. Organisation is rated the highest, showing how important it is to depict the organisation of the company in a professional manner.

After reviewing the literature, several factors are identified that need to be incorporated within the new website of the company. These factors are considered throughout the design of the wireframes and the development of the website.

6.1.2. User Interviews

In the first interview sessions, interviewees are asked about their general opinion and usage of websites, as well as the content they would expect to find on different webpages. The results of these user interviews form the foundation of the first iteration of the requirements engineering found in Section 6.2.. The full interviews are added in Appendices F, G, H, I, J, K, L and N.

The users are asked about the content regarding specific webpages, but they are free to call the page irrelevant or provide suggestions for different or additional pages. However, by providing pages deemed relevant through literature research, it gives the interview structure and it provides a first inspiration and foundation for interviewees to provide feedback on. The pages are called homepage, product, price, blog and FAQ. The homepage is also the landing page of the website.

All the practitioners mention that they would want to know how to implement the VR E-health application within their practice and their treatment. This information should include the time it takes to understand it, how Reducept can fit within their session, who would be involved in using the

application and how to refer patients for Reducept. The focus of implementation should not be on the technological aspects, but on the practical implementation and the content of the application. Here, practitioners want to feel a match between the application the company offers and the world of the practitioner: the implementation described should feel logical.

A suggestion is made for the homepage: it should show what the application entails, what it can do, how it helps the patient and how it helps the practitioner. These elements are important for practitioners to consider the implementation of the VR E-health application. More specific suggestions related to this are creating a movie on how the application works, to show the pros and cons of the application for both patients and practitioners (focus on the added value), the content of the educational training and how to use the VR headset and application. Moreover, one practitioner mentions that having a dashboard would be a plus. Since this is the case, it needs to be mentioned on the website. Additionally, a suggestion is made to provide a section where patients can find more information which practitioners can refer to.

Another important feature to include are experiences of both patients and practitioners. Practitioners want to understand what Reducept means for the patient and how it is of added value to them. Here, they do not want the business story, but the personal story should be highlighted. The company adds that it should be a balance between both patients and practitioners, since practitioners are influenced by recommendations of their colleagues.

Practitioners are not interested in the blogposts, since they have no time to read it. They do stress that research is very important to mention: which research the product is based on, what the results are and what the evidence is for Reducept. This can be supported by the educational background of the people behind the product: is the product created from a business perspective or from a medical perspective? Since the latter is the case, and this is seen as added value (people with medical knowledge and experience have developed the application), this needs to be acknowledged on the website. Here, the focus should be on "created by healthcare for healthcare". Additionally, it should be easy to contact the company.

The practitioners are divided on the FAQ page: some would use it extensively (if well-structured), whereas others would not. However, adding an FAQ section cannot hurt the website. The same is true for the pricing page: practitioners are not directly interested in the price, since they are usually not the buying party. Nonetheless, they mention pricing information is crucial since high costs are a barrier for implementation and, therefore, pricing information is crucial to base purchasing decisions on if forwarded to management. It is made apparent that the actual pricing information should not be mentioned on the homepage, but should be easily found on the website. Reimbursement possibilities, or what the patient would have to pay in case of referrals, needs to be mentioned as well.

General remarks about the website are made as well: one practitioner mentions they would like to know where they could ask for a demonstration of the product and if they could visit the company at a congress or event. Multiple practitioners mention that the website should be short and practical without too much text, since they have no time to read much. They usually scan a website quickly, but want to find deeper layers of more information if they choose to. Colours and visuals are frequently used within the healthcare sector, thus embedding them into the website could be more attractive to the practitioner since it matches with other healthcare content. Nonetheless, the website should keep a professional look and feel.

A concern that is frequently mentioned throughout the interviews is that E-health technologies could replace the professional or not add value to the practitioner's work. Reducept is meant to be an addition to the treatment, meaning the practitioner is still highly involved in the treatment and Reducept is meant to support their work. This is seen as highly positive and should be explicitly made clear to practitioners: Reducept is an addition, not a replacement. There should also be a focus on the importance of the relationship between practitioner and patient within treatment.

Moreover, the practitioners mention that not all practitioners are familiar with the mental aspect of pain. Somewhere, the practitioner should be be able to find information on this phenomenon and the specific pain education Reducept is based on. Also, it should be made clear that Reducept provides both pain education as well as strategies to manage pain. These are two different aspects that can be of added value to the patient, practitioner and the treatment. This should be explained and implementation for both aspects should be clarified.

Many saw the recording of data and the monitoring of patients as an added value. The inclusion of a dashboard and the possibilities for the practitioners need to be made clear. Some practitioners stress they do not have a high affinity with technology in general. The ease of use of the virtual reality headset needs to be amplified and practitioners needs to gain confidence in being able to use the technology within their practice. Having a mobile version of the application, so patients can use Reducept at home would be a big advantage. Since this eliminates organisational barriers such as limited space, technical support and the high costs factor, this should be highlighted.

The suggestion is raised that the website could adapt to the professional by making a distinction between the specific work domains (e.g. GP, psychologist, physiotherapist, etc.). The company wants an active website where it is dynamic and changes, so visitors see the company is active and progress is being made. Both practitioners and company express that recommendations from colleagues are regarded as important and experiences should be added to the website.

6.2. Requirements Engineering, First Iteration

Based on the literature and the user interviews, different requirements are created. These requirements are altered, removed or new ones are added after prototype evaluations. In this section, usability heuristics and accessibility requirements are introduced: these are not included in the user requirements, but they are delivered to the developing parties as additional general requirements.

6.2.1. User and Literature Requirements

As described in Section 3.5.2.5., the user requirements are presented in a MoSCoW structure. The division of requirements into the MoSCoW structure is based on the interviews and literature. Some features are mentioned as being absolutely necessary on the webpage: these are translated into 'Must' requirements. Statements that are made multiple times and that are deemed relatively important are translated and added as 'Should' requirements. Some suggestions are made that can be a nice addition to the website, but that are not essential and are not mentioned multiple times. These are added as 'could' requirements and are implemented if time and the design of the website allows. 'Won't' requirements include suggestions made that are not implemented in this version of the website due to wishes of the company, but can be considered for future iterations of the website.

As stated before, the homepage is also the landing page of the website and, therefore, has requirements of their own. The different requirements are as follows:

Must:

- 1. The website must contain contact options
- 2. The website must contain links to sources
- 3. The website must contain company information
- 4. The website must contain information about the organisation (team)
- 5. The website must contain privacy information
- 6. The website must contain information about the implementation of Reducept
- 7. The website must contain information about the dashboard
- 8. The website must contain experiences of patients with Reducept
- 9. The website must contain experiences of practitioners with Reducept
- 10. The website must contain research Reducept is based on
- 11. The website must include research results obtained with Reducept

- 12. The website must include pricing information
- 13. The website must include reimbursement possibilities
- 14. The website must mention that Reducept is an addition to treatment, not a replacement of the practitioner
- 15. The website must contain information about the ease of use of the VR technology
- 16. The website must contain information about Reducept providing both pain education and management strategies

Should:

- 17. The website should contain information that is actively updated
- 18. The website should include multimedia content
- 19. The website should contain downloadable content for information
- 20. The homepage should contain information about what Reducept is
- 21. The homepage should contain information about how Reducept works
- 22. The homepage should contain information about how Reducept helps patients
- 23. The homepage should contain information about how Reducept helps practitioners
- 24. The website should include the educational background of the team
- 25. The homepage should not contain pricing information
- 26. The user should be able to request a demonstration through the website
- 27. Large texts should be expandable to show more details
- 28. The website should contain visuals
- 29. The website should contain information about the mental aspect of pain
- 30. The website should contain information about Reducept for mobile

Could:

- 31. The website could include timestamps
- 32. The website could include downloadable shareable content
- 33. The website could contain a movie about how Reducept works
- 34. The website could contain the pros and cons for patients and practitioners
- 35. The website could contain information about the content of the educational training
- 36. The website could contain a section for patients to receive information
- 37. The website could include a blog
- 38. The website could include an FAQ page
- 39. The website could include events where RelieVR BV will be present

Won't:

40. The website won't adapt to the visitor for specific work domains

Overall, including a professional look and feel with good aesthetics should be included in the website. Moreover, the website should not have too much text. However, since these are subjective statements, they cannot be translated into requirements.

After discussion, it is decided that the website will not adapt to specific professions. If the website would adapt, the information would duplicate over different webpages, leaving less space for distinctive information. The alternative would be that multiple websites would need to be created, which does not fit within the budget. Therefore, it is decided to look creatively at displaying information in such a way that multiple professions would feel as if the website is created for them specifically, without altering the content to fit specific professions. Moreover, you don't want people to feel excluded if they are not specifically mentioned if you make separate pages.

6.2.2. Usability Heuristics

The usability heuristics by Jakob Nielsen (1994) included in Appendix A are used in order to create a more usable website. Based on the heuristics, the requirements are created that deemed relevant to the content and goal of the webpage:

- 1. Links are identifiable as links (mentioned, underlined, different colour)*
- 2. Links are clickable**
- 3. Link phones automatically to mobile websites**
- 4. Familiar icons*
- 5. Menu titles readily have understood meanings***
- 6. Menu titles are parallel grammatically***
- 7. Terminology used in accordance with user's task domain***
- 8. Menu shows location of user on the website**
- 9. System waits for user response before submitting a form**
- 10. System asks users to check data before submitting a response**
- 11. Four colours used within design (additional colours for occasional use only)*
- 12. Menu items are consistent in title***
- 13. No use of all uppercase letters*
- 14. User actions named consistently across screens***
- 15. Only vertical scrolling is used**
- 16. Information does not need to be remembered across screen**
- 17. Text-areas have breathing space*
- 18. Colour is not the only indicator of cue*
- 19. Contrast between colour is sufficient (WCAG 2.1. standards)*
- 20. Website includes a search bar***
- 21. Links describe where they lead (which webpage and new tab)**
- 22. Images are not larger than the screen*
- 23. Textual description of video provided***
- 24. Have multiple ways to navigate through the website***
- 25. User can indicate the level of details by expanding options in large texts**
- 26. Personal data protection is explained***
- * Requirements relevant for (graphical) design of webpages
- ** Requirements relevant for developers of webpages
- *** Requirements relevant for content-creators of webpages

6.2.3. Accessibility Requirements: Designers

While designing the wireframes for the website, different accessibility guidelines must be kept in mind in order to comply with the Web Content Accessibility Guidelines (WCAG) 2.1. These guidelines form recommendations in order to make web content more accessible. If these guidelines are implemented, people of a broad range of functional diversity are able to interact with the web content.

None of the participants of the design session have previously heard of these guidelines, but they are eager to implement them within the design. Therefore, whenever different aspects are discussed (e.g. multimedia content, footer, menus, etc.), the accessibility guidelines are consulted. As there are 76 different guidelines, it takes an excessive amount of time to check all of them during the design process. Therefore, the relevant accessibility guidelines for the specific design session are selected and presented to the designers as shown in Appendix O.

As explained in Section 3.5.2.4., there are different levels of accessibility guidelines. As complying with level A and level AA of the guidelines leads to a mostly accessible website, and this allows for more freedom in incorporating different functionalities, it is strived to include both these levels within the website. Level AAA is also considered throughout design and development of the website, but these guidelines are not incorporated if they require too much compromise on the development side.

6.3. Prototype, First Iteration

After gathering the requirements, a brainstorm session is held with two graphical designers, a representative from the company and the researcher to design the homepage. The other wireframes

are designed by the researcher after this brainstorm session. The requirements are translated into the wireframes depicted in Figure 8. Based on the gathered literature and user requirements, it is decided to create five different pages. The homepage focusses on the implementation of Reducept within a practice. There is one page dedicated to research, one page dedicated to the team of Reducept, one page dedicated to the pricing of Reducept and one FAQ page.

6.3.1. Homepage, First Iteration

The homepage, also the landing page of the website, starts with a statement on the product (translated: Reducept is the new E-health training for people with chronic pain) followed by a contact button. Here, the product is briefly introduced and people who want to instantly ask for a demonstration or want to get in touch have an immediate option to do so. Next to this, a video of explaining Reducept is shown.

The most important part of the homepage is the infographic. This infographic explains to the practitioner how Reducept can be implemented within a practice, how it can be added in a treatment, what the benefits are for patients and what the benefits are for practitioners. The title of the infographic puts emphasis on Reducept being an addition to the treatment instead of a replacement (translated: You are the healthcare specialist, we are the addition). The four steps are as follows:

- 1. Patient with chronic pain
- 2. Pain education with Reliviate³
- 3. Your treatment with Reliviate²
- 4. Translation to home

The first step explains which patients are eligible and it is meant to create a sense of understanding of the situation of the practitioner. Here, the practitioner reads the steps and additional explanation, which can help them feel that the company understands their situation. Also, it is mentioned that there are not many treatment options yet for people suffering from chronic pain. Therefore, Reducept is a unique form of treatment for people with a difficult-to-treat condition.

The second step is dedicated to explaining how Reducept provides pain education and how it can visually support the general pain education provided by the practitioner. Here, the focus is on the added benefit for both patient and practitioner of having a visual tool to explain complex content. Moreover, it is stressed that it is an addition to the current treatment form, meaning practitioners do not have to adapt. Also, it clearly says that the virtual reality headset is easy to use and a manual for practitioner is provided to guide the practitioner through all necessary steps to start Reducept.

The third step explains how Reducept can also be added to the subsequent treatment sessions, since the different gameplay modules can be played individually. Here, the focus is on the strategies these gameplay modules teach the patient and the ease of adding them to current treatment options. Moreover, it is mentioned that the practitioner can view data from the patient through a dashboard.

The fourth step is the translation to home, meaning the patient can transfer their knowledge gained in virtual reality to daily life situations. This is another benefit to both patient and practitioner.

Through these steps, the infographic highlights how to implement Reducept within their practice as well as the added value for both patients and practitioners. After the infographic, experiences of both patients and practitioners are shared through a picture, quote and name of the patient or practitioner. Moreover, it is mentioned if they are a patient or practitioner.

At the bottom of the page, there are two call-to-actions: first, the user can choose to purchase Reducept, or they can choose to refer their patients to a practice with Reducept nearby. This is

 ³ At this point, the name RelieVR was being changed. The option was Reliviate, which later turned into Reducept.
Maria Helena Dokter
Page 62
Master



Figure 8: Website wireframes, first iteration. Order from top left to bottom right: homepage, research page, team page, pricing page, FAQ page

followed by the footer, which includes a brief description, contact information, an additional menu and social media icons for the website. The footer and header are repeated on all webpages.

6.3.2. Research Page, First Iteration

The goal of the research page is to show practitioners the evidence-base for Reducept. Here, the research is divided into three different sections, namely research (background), business research (performed with Reducept) and Reducept in the media.

This complies with different requirements, namely showing what Reducept is based on, providing research results performed with Reducept and providing an active page where new media articles can be posted and shared.

The idea is to provide a prominent place for Lorimer Moseley, an Australian researcher who is the author of 'Explain Pain Supercharged (Moseley & Butler, 2017), which is the underlying theory Reducept is based on.

6.3.3. Team Page, First Iteration

The team page contains all the team members, showing practitioners who build the application. As the requirement states, the educational background of the individuals are also mentioned to indicate the background and motivation of the team.

The page starts with a team photo, which shows the team spirit behind Reducept. Following, individual team members are introduced with photo, function and educational background. Moreover, the visitor of the website can choose to contact a specific individual.

6.3.4. Pricing Page. First Iteration

The pricing page has two main functionalities: providing pricing information and reimbursement information. At the end of the page, the visitor can choose again to either purchase Reducept or to refer their patients to a practice with Reducept nearby.

6.3.5. FAQ Page, First Iteration

An FAQ page is not always deemed necessary, but it never hurts and some practitioners do prefer it. The FAQ page starts with the question asking if the company can help the visitor find what they are looking for, followed by a search bar. Following, the FAQ questions are presented with expandable answers. Below the FAQ's, manuals are provided, which are downloadable: here, the practitioner can easily find practical information regarding Reducept. Furthermore, the section "in the practice" is added, which contains blog posts and videos of how Reducept is being used in different practices. At the end of the page, a contact form is presented. Several pages refer to this contact form when clicking on the options of contact or purchasing presented on the other webpages of the website.

The sequence of webpages is not determined at this stage. During the evaluation of the wireframes, practitioners are asked to rate the webpages on importance and their preferred sequence of webpages online.

6.4. Evaluation, First Iteration

The wireframes are evaluated by the four stakeholders. Moreover, the researcher evaluates the usability requirements and accessibility requirements implemented within the wireframes.

6.4.1. User Evaluation, First Iteration

The four interviewees are interviewed again to ask their opinion about the designed wireframes. Here, every page is discussed. Their feedback is recorded and summarised below. The full interviews are added as Appendix P.

For the homepage, several suggestions are made. In general, the interviewees like the layout of the page and the idea of the infographic explaining the implementation of Reducept within the treatment of the practitioner. For the infographic, it is suggested to make clear titles that describe a journey and to ensure it is clear that Reducept is an addition to the treatment and not a replacement. They like the idea of supporting visuals and the option to expand for more text. This way, you can get a quick overview, but they can obtain more information if desired.

Within the text of the infographic, every step should contain a unique selling point (USP) of Reducept. Moreover, the text should contain both the pain education and the training modules as well as the journey through the nervous system. Also, practical examples should be provided wherever possible (e.g. increased range of motion for patients at physiotherapist practice). It is also suggested to add an additional step between pain education and combining Reducept with treatment, namely the step of creating more therapy compliance.

A couple of things are missing. The fact that Reducept is evidence-based needs to be mentioned on the homepage. Also, practitioners want to see the option to request a demonstration and that it is possible to purchase Reducept. Not unimportant, it needs to be instantly clear that Reducept is a VR application.

At the top, there is a contact button. There is a difference of opinion on whether this should stay a contact button, or become a request demonstration button or a purchase button. This is later discussed with the developers and the company in order to make a decision. For the footer, the description of Reducept needs to contain all the important elements Reducept offers and keywords that could help increase the visibility when using search engines.

The interviewees would change the name of the team page, either to community or contact. Moreover, a general mail address should be provided and could be located on top of the team photo. Also, the board of quality assurance should be renamed to something that explains their role more, such as influencers or board of advisors. The suggestion is made to create different pages for the background of Reducept (explaining the roles of the team members in the development of the application) and the team.

The science page should be named differently in Dutch, since this is an English word but everything else is presented in the Dutch language. Furthermore, several interviewees do not think that the media-articles fit with the topic of the Science page. A prominent place for Lorimer Moseley on this page should only be included if he becomes a part of the board of advisors. Last but not least, it is suggested to add further development (with partners) to this page to show Reducept is being tested.

For the FAQ page, the "in the practice" module does not fit with the rest of the content. Either this module should become a separate page, or it should be left out. Since the users are not enthusiastic about this section and the company acknowledges it requires a lot of time to keep it updated. Therefore, this section can also be removed from the website. Additionally, it is suggested to include an FAQ about what the patient would pay if they are to receive a referral for Reducept.

For finding practices to refer to, it could be added to the contact page, or become a page on its own. It can also be added to the header of the page. Together with the developers, a design is made later.

Last but not least, the pricing page should also contain information about what the patient would pay if they were to receive a referral for Reducept. Practical example or calculations of actual prices and reimbursements could be added. One call-to-action should be present at the pricing page to avoid confusion. The pricing packages could also contain information on what type of healthcare practice the package is suitable for and how many patients can be treated.

6.4.2. Usability Evaluation, First Iteration

The usability guidelines focus on functionality included in the website. Due to the low-fidelity of the wireframes and the absence of functionality, the usability heuristics are evaluated for the second iteration of the wireframes.

6.4.3. Accessibility Evaluation, First Iteration

When evaluating the design of the wireframes on accessibility, the accessibility guidelines for design of Appendix O are consulted. The researcher checks if each guideline is present in the current design or not. Since the aim is to include both level A and AA, these guidelines are evaluated. Table 6 provides an overview of these guidelines, states if they are met in the design or not and explanations regarding their status.

Table 6: Evaluation of the satisfaction of accessibility guidelines in the wireframes, first iteration.

Accessibility Guidelines	Met/ Not Met	Explanation
Video: text alternative available (A)	Met	The video does not include audio
Audio: if audio automatically plays, users have to be able to stop or pause (A)	Met	The video is not played automatically
Images of text: images of text do not convey important information (AA)	Met	Illustrations are for decoration purposes
Timing adjustable: if there is a time limit, it can be adjusted (A)	Met	No time limit included on this website
Pause, stop, hide: for blinking or moving media (A)	Met	Video can be paused
Three flashes: nothing flashes more than three times per second or is below flashing threshold (A)	Met	No flashes included in the design of the website
Multiple ways: more than one way to locate a webpage within a set of webpages (AA)	Met	The menu is included in both the header and the footer
Consistent navigation: consistent order of menus (AA)	Met	The menu in the header and footer have the same order
Consistent identification: same functionality has same name (AA)	Met	Buttons with same functionality are named consistently

At this point, the researcher concludes the design of the wireframes comply with both level A and AA of the accessibility guidelines.

6.5. Requirements Engineering, Second Iteration

Based on the evaluation of the first iteration described above, some adjustments to the requirements are made. Within this section, only the changes in the requirements are mentioned. Since the wireframes are still on a design level and not on a developing level, the accessibility guidelines are not changed and the usability heuristics do not change.

6.5.1. User Requirements, Second Iteration

The complete list of user requirements for the second iteration can be found in Appendix Q. Below, only the alterations are described. Again, their MoSCoW categorisation is based on the interviews.

Must:

14. 'The *website* must mention that Reducept is an addition to treatment, not a replacement of the practitioner', becomes 'The *homepage* must mention that Reducept is an addition to treatment, not a replacement of the practitioner'

Should:

26. 'The user *should* be able to request a demonstration through the website', becomes 'The user *must* be able to request a demonstration through the website'

Could:

37. 'The website *could* include a blog', becomes 'The website *won't* contain a blog'

38. 'The website *could* include an FAQ page', becomes 'The website *must* contain an FAQ page'

Also, some requirements are added:

Must:

'The homepage must mention that Reducept is evidence-based'

'The homepage must mention that Reducept is a virtual reality E-health application'

'The footer must contain important keywords related to Reducept'

'The pricing page must contain information on patient's costs after referral'

Should:

'The infographic should contain descriptive titles containing an USP'

'The website should contain practical examples'

'Titles should reflect the purpose of the related text'

'Titles should be in the language of the page'

'Media articles should not be mentioned on the science page'

'Lorimer Moseley should not be prominent on the science page if he is not on the board of advisors'

Could:

'FAQ could include a question about patient's costs in case of a referral'

'Referral section could be added to the contact page'

'Referral section could be a separate page'

'Pricing packages could contain information on type healthcare institution or amount of patients it is suitable for'

Won't:

'Different pages for background and team won't be created'

'Referrals won't be added to the header'

'Calculations of prices with reimbursements won't be added to the website'

'The website won't contain a blog'

In order to create a clear website, it is decided to keep the amount of pages to a minimum. Therefore, together with the developers, solutions for the structure of the webpages and the modules are designed.

Moreover, since the goal of the website is to have practitioners purchase Reducept, the referral option is not added to the header. However, it is important to have the referral option included on the website. The decision is made to include referrals on multiple pages instead of having it be prominently present in the header.

It is decided to not include practical calculations for the actual prices of Reducept including reimbursement options, because the reimbursement options are different per sector and country. Also, it is difficult to provide general examples suitable for different practices and practitioners. Therefore, it is decided to explain practitioners can come in contact with the company and calculations can be made together. If, in the future, it is easier to create general calculations, these can be added to the pricing page.

6.5.1. Usability Requirements, Second Iteration

Based on the evaluation of both the interviewees and the company, it is decided to remove a requirement from the usability requirements described in Section 6.2.2..

Requirement 12 (User actions named consistently across screens) is removed. In the wireframes, the call-to-action buttons all lead to the contact page, but including different names on the buttons could help visitors understand different actions can be pursued by filling in the contact form. Therefore, while buttons lead to the same contact page, they have different names.

6.6. Prototype, Second Iteration

A second set of wireframes is designed based on the feedback gathered and the changes in requirements. Together with the company, some changes are implemented and others are not. Per page, the changes are briefly described and the decisions made are discussed.

Since the homepage is designed in Dutch and cannot be translated due to the export format, more textual explanation is added. The other pages have been translated for the purpose of this research and are presented with comments to explain the changes made. The original wireframes are added as Appendix R.

All the wireframes are designed for desktop. The top of the page is visible when viewing the website in the browser, after which the rest of the webpage can be accessed through vertical scrolling.

6.6.1. Homepage, Second Iteration

The graphic designers have further designed the homepage in order to decide on a style for the website and to incorporate the previous suggestions. The homepage is split in two parts in order to zoom into the page.

Figure 9 shows that the homepage now starts with a large image of the gameplay with a title layered on top. The title includes keywords such as E-health, training and chronic pain. Right below the title, the visitor can choose to contact the company.

Below the picture, the infographic is included with five points explaining the treatment and how Reducept can be implemented. The titles of the step are made more descriptive (e.g. Step 2 was "Pain education with Reliviate⁴", and has become "Start Reliviate at the beginning of the treatment for chronic pain"). When clicking on the "read more" button on the right, additional information is shown in the form of a pop-over. This includes important information such as that the pain education Reducept provides complies with the IASP guidelines and examples of practical results that occur at different healthcare institutions.

The visuals support the five different steps. The visuals and step-titles provide an overview and the "read more" options provide additional information. This way, the practitioner can fully understand how to implement Reducept within their practice and treatment, what the benefits for the patient are and what the benefits for the practitioner are.

Below the infographic, the experiences with Reducept are included, both from the perspective of the patient and the practitioner.

At the bottom of the page, a call-to-action is introduced. Here, the question is asked if you (the practitioner) would like Reducept for your (the practitioner's) patient. Below, two options are provided: the visitor can choose to discuss the purchasing options with Sven, the account manager, or the visitor can choose to refer their patient and visit an overview of practices that use Reducept nearby.

The homepage design is completed before all the alterations are integrated. Therefore, the contact button in the header is 'request a demonstration' and the title of the infographic is adjusted to include that Reducept is an E-health application. The title at the top is also changed to include virtual reality, ensuring it is clear from the beginning that Reducept is a virtual reality application. Furthermore, Reliviate is still the rebranding option at this point in time, which is now Reducept.

In comparison to the wireframe of the first iteration, the top of the page is adjusted, the infographic is expanded and the last module of purchasing/referring is added.

⁴ At this point, the name RelieVR was being changed. The option was Reliviate, which later turned into Reducept.



Figure 9: The homepage, left shows the top part and right shows the bottom part of the page



Board of Advisors



In the practice

Would you like to refer your patient for Reliviate? Find a practice in your neighbourhood to which you can refer your patient. There are no additional costs for the patient.

Zip Code Finder	

You can find us at the following events:

Upcoming Events		
Congress		
Footer		

Figure 10: Community page, second iteration

Page 70

6.6.2. Community Page, Second Iteration

The wireframe for the community page can be found in Figure 10.

The community page (previously the team page) is renamed. Since it now includes the team, the board of advisors as well as the practices that offer Reducept, renaming the page "community" is perceived as more appropriate and comprehensive.

Besides the renaming of the page, the renaming of the board of advisors and the addition of the practices to this page, a functionality is added compared to the first iteration of the wireframe: instead of having small pictures, larger pictures are added. When clicking on the picture, a biography of the team member is shown. This is done from an aesthetic point of view and is further discussed with the developers and the graphic designer.



Professor Lorimer Moseley focusses on the role of the brains and soul in regards to chronic and complex pain symptoms. Together with clinicians, researchers and patients, he researcher how the brains, their representation of the body, change when pain persists.

Reliviate contains three educative interventions based on Explain Pain Supercharged. These interventions care for conceptual change, an increase of knowledge of pain-related biology, a decrease of catastrophic consequences due to pain and a reduction of pain and immobility. Reliviate present, based on Explain Pain Supercharged, the biological information which constitutes the justification of a biopsychosocial approach to rehabilitation.

Read more information about Explain Pain Supercharged here (link)

Additional Research



Figure 11: Research page, second iteration

6.6.3. Science Page, Second Iteration

The wireframe for the science page can be found in Figure 11.

The science page wireframe's layout has changed relative to the first iteration. Since the top of the homepage has changed, there is no place where the description of the application can be found.

Now, at the top of the science page, the whitepaper describing Reducept and the video on how Reducept works are shown first. Then, a summary on the theory of "Explain Pain" by Butler and Moseley (2003) is provided, but only if Moseley agrees to be part of the board of advisors.

Following is the additional research Reducept is based on, followed by the further development conducted with external parties, which describes ongoing research.

Header

Pricing

On this page, you will find how Reliviate can be reimbursed and in which packages Reliviate is offered.

Reimbursement for the practitioner

There are different possibilities to declare e-health products for healthcare institutions. The Dutch Healthcare Authority (NZA) has created a document to provide an overview of the possible declaration methods per healthcare sector. You can find the document here to see if you are allowed to reimburse e-health products.



When you refer a patient, there are no additional costs for the patient. Reliviate is part of the normal treatment costs used by the practice.

Packages

Reliviate is offered in three different packages. Below, you will find an overview of these packages including their content and the associated price. If you are interested in purchasing, you can contact us through the contact form.



Figure 12: Pricing page, second iteration

6.6.4. Pricing Page, Second Iteration

The wireframe of the Pricing page is added as Figure 12.

The wireframe of the pricing page has not been changed in the second iteration.⁵ The pricing information now mentions costs concerning patients when they receive a referral for Reducept.

Moreover, the pricing packages contain specific information on the suitability per type of healthcare institution.

⁵ The removal of one of the call-to-actions has not been completed, since it is discussed how to properly design this page with the website developers in a later phase
Header

FAQ: Frequently Asked Questions

	He	ow can we	e help yo	u?	
Search.					
Category A		Category B		Category C	
Question A	\sim	Question F	\sim	Question K	\sim
Question B	\sim	Question G	\sim	Question L	\sim
Question C (more space if question is longer)	the	Question H	\sim	Question M	\sim
Question D	\sim	Question I	\sim	Question N	\sim
Question E	^	Question J	\sim	Question O	\sim

Answer to question E

Manuals





Footer

6.6.5. FAQ Page, Second Iteration

The wireframe of the FAQ page is added as Figure 13.

For the FAQ page, only the "in the practice" module is removed. The remainder of the wireframe is not changed compared to the first iteration.

Based on the interviewees and after a discussion with the company, the sequence of the pages in the header is determined as follows: homepage, science, community, pricing and FAQ. Since lack of clinical evidence and research is one of the main barriers, it is decided to make this page the most important. Also, since the people behind the product are deemed important by the stakeholders and is an easy facilitator to incorporate, the community page is third. Pricing information is a main barrier, but not important at first glance for the stakeholders. Therefore, this page follows as the fourth page. The FAQ page, while deemed important and relevant, is mostly rated as the fifth page since it does not have priority over the other pages.

6.7. Evaluation, Second Iteration

The wireframes of the second iteration form the foundation for the development of the website. It is agreed that, during the development phase, there are three meetings scheduled to discuss possible changes of these wireframes. These changes are based on changes in content (supplied by company and researcher) or due to styling and functionalities (supplied by website developers).

During the meetings, several issues come to light that lead to changes in the wireframes: first, the issue is raised that the contact form is now on many webpages. However, this increases the length of each webpage. It is suggested to make a separate webpage with a contact form, to which the events Reducept is present at can be added. This seems like a more logical location for an agenda concerning events than a community page.

Also, when someone wants to refer a patient, they could be redirected to a specific page dedicated to this. This way, the partner practices are not explicitly mentioned on any of the webpages. Also, only practices within a certain range from the entered zip code or city should be shown in order to keep an overview of results and to keep the complete list of practices more private.

Also, there is no actual description of Reducept on the wireframes. Somewhere, preferably on the homepage, information about Reducept should be provided. Therefore, requirement 26 (see Appendix Q) is not yet met.

There is also no sign-up for a newsletter. However, RelieVR BV wants to build a list of subscribers to the newsletter. Also, RelieVR already uses a service to send these newsletters. The developers are able to build this into the website. It is logical to add a newsletter sign-up form to the homepage.

Furthermore, the company has decided to spend more attention on all the additional research instead of focussing on one specific research. This does leave space in the webpage. After discussion, it is decided to add a timeline showing how Reducept will grow in the upcoming months. This does not only show that the company is currently active and working to achieve this goal, it also highlights a facilitator, namely that a mobile version of Reducept is in the works.

During discussion it comes to light that it should be clear that the website's main goal, other than providing information, is for practitioners to purchase Reducept. This should be clear from the way the website is designed. Therefore, the developers, company and researcher are going to look closely at the content of the webpages to see if more referrals to the pricing page can be made.

During the content creation phase of the researcher and the company, it becomes apparent not many manuals can be shared on the webpage: if you share manuals, you also share your product which could be dangerous if competitors find this. Since the website is linked to a dashboard which practitioners can use to gather data from Reducept, it is decided to add the manuals here. Practitioners first need to login and, thus, be customers, before they gain access to the dashboard and manuals. This means the existence of the manuals need to become apparent in the content on the different webpages.

There is no place yet for practical information such as privacy policy and the terms and conditions. A logical place for this information would be in the footer. However, the footer already contains many different links and both developers and company are not keen on having a large footer at the bottom of the page. Therefore, the footer should contain this information whilst not becoming too large.

The design of the new wireframes does not change any accessibility guidelines from being met.

6.8. Requirements Engineering, Third Iteration

Based on the evaluation by the developers, company and researcher, adjustments are made in the requirements. Since the wireframes are now being developed to actual coded webpages, some usability and accessibility requirements are also adjusted.

6.8.1. User Requirements, Third Iteration,

The complete list of user requirements is added as Appendix S. Below, only the alterations to the list user requirements of the second iteration (Appendix Q) are described. First, the altered requirements are listed:

Should:

41. 'Lorimer Moseley should not be prominent on the science page if he is not on the board of advisors', becomes 'Lorimer Moseley won't be prominent on the science page [if he is not on the board of advisors]'

Could:

51. 'Referral section could be added to the contact page', becomes 'Referral section won't be added to the contact page'

Also, some requirements are added:

Should:

'The website should contain a separate contact page' 'The website should contain a newsletter sign-up option' 'The footer should contain a privacy policy' 'The footer should contain the terms and conditions'

Could:

'The website could contain a timeline of future development of Reducept'

'The website could mention the development of a mobile version of Reducept'

Won't:

'Manuals won't be added to the website'

6.8.2. Accessibility Requirements: Developers

When the wireframes of the website are delivered to the website developers, they are accompanied by accessibility guidelines of WCAG 2.1. The developers have not used the accessibility guidelines before, but want to include as many guidelines as they can. The list of accessibility guidelines has been decreased to only include guidelines relevant to the developers. This list has been added as Appendix T.

During the development phase, feedback on the implementation of the accessibility guidelines is provided by the researcher. This is done for the design accessibility guidelines, since the development accessibility guidelines are incorporated into the code and cannot be checked during the development phase.

6.8.3. Usability Requirements, Third Iteration

In accordance with the usability heuristics, the user should be able to undo actions or to check before submitting their response (requirement 10). However, it has been decided to not use this function within the contact form: the company would like to know who wants to contact them. Moreover, by submitting the contact form, no undoable financial action is done. Therefore, it has been decided to submit the form automatically, after which the company can contact the submission mail address.

Also, requirement 24 (Have multiple ways to navigate through the website) is removed. First, a second version of the menu is added to the footer. However, after discussing, the menu is removed so it left more space for the description, contact information, social media and additional information not previously mentioned on the website (terms and conditions and the privacy policy). Adding the menu would make the footer too crowded. Moreover, the different items of the menu were integrated within the text of the homepage through buttons or links in the infographic.

6.9. Prototype, Third Iteration

The prototype of the third iteration is the actual website developed by professional developers. Due to this, the website has a high-fidelity, meaning functionalities are integrated and the user can use the website to its full extend.

Based on the new requirements, two pages are added to the website. The first page is a contact form. By creating a separate page for this, it can always easy be found in the header. Also, many pages can now refer to the contact form instead of it being present in multiple webpages. The second new addition is the referral page. The user reaches this page when they click on the button to refer their patients. Here, they can search for practices nearby that use Reducept.

The website is created for desktop and a mobile version is created as well. However, the figures of the developed website included in this section are the desktop versions. The top of the figure represents what the user can see when opening the webpage, after which they can scroll vertically through the rest of the webpage.

There is a sight change in sequence of the webpages. Research is still the first link in the header, but is now followed by pricing. Since the goal of the website is to stimulate purchasing, this link as switched with the community page (now named 'About us'). The community page is followed by the FAQ page, after which the contact page follows. As described before, the referral page is not added to the header and can be found through multiple referral buttons integrated into the website.

Below, every page is briefly described in regards of changes made relative to the previous iteration of the wireframe.



6.9.1. Homepage, Third Iteration

The homepage, or landing page, is shown in Figure 14 and Figure 15. It has some significant changes in regard to the second iteration wireframe presented in Section 6.3.1.. First, since a separate contact page has been added to the website, the button in the header now refers to the pricing page to stimulate the practitioners to purchase Reducept.

Figure 14: Top of Homepage page, third iteration



Experiences with Reducept





Figure 15: Bottom of Homepage page, third iteration

Below the header, Reducept is explained in three short statements accompanied by icons. This explains what Reducept is in the briefest form. Through more evaluations from people unfamiliar with Reducept, it has to become apparent if these three statements are sufficient for the homepage.

The title of the infographic is now the subtitle. Otherwise, the title is too long for the design of the webpage.

The infographic remains the same apart from textual changes. When clicking on the 'read more' button, a white block slides under the selected step with more textual information and relevant links. When clicking on the new 'read less' button or by clicking on the 'read more' button of another step, the text block slides back.

Instead of featuring Sven as account manager on this page, a bock is formed for purchasing or referring Reducept (the latter leading to the referral page). Below the sign-up for the newsletter is added.

The footer, repeated on all the webpages, does not contain an additional menu anymore. Instead, it now contains a privacy policy and other practical information that was not previously featured on the website. Theoretically, all the other webpages can be found through the different links and call-to-actions embedded on the homepage. However, since this is not a specific menu list, it does not comply well with the accessibility requirement.



Figure 16: Top of Science page, third iteration

6.9.2. Science Page, Third Iteration

The Science page is shown in Figure 16 and Figure 17. It is slightly changed, starting with the name. To keep it equal to its Dutch translation, the title is changed to 'Research'. Moreover, the header is different from the homepage. This is equal for the remainder of the other webpages. The header is also sticky, meaning it slides up or down with the webpage when the user scrolls vertically through it.

As stated before, Moseley has now been added to additional research. Since the section additional research is crucial for this page, its location is moved up on the wireframe. After this section, a timeline is added to show the future development of Reducept. Not only does this highlight that the company is working hard to improve Reducept, it also highlights that a mobile version is currently being developed.

Under the timeline, partners are shown. These partners are involved in clinical research studies, which are briefly introduced. Showing these clinical trials are currently being performed can put trust in an increasing clinical evidence base, which is a strong facilitator for the implementation of E-health applications.

Following the partners are the options of purchasing or referring patients to Reducept. This block is equal to the homepage.

Below, a block concerning getting in touch with the account manager, Sven, is included. This block is repeated on pages that could stimulate the purchasing of Reducept. Here, the user can come into contact with the account manager directly through the 'mail' or 'call' button.



Figure 17: Bottom of Science page, third iteration

		Home F	Research Pricing	About us FAQ	EN - N Contact Q
	Distingu	Pricing ish your innovative practice	with Reducept		der
		Licences			
		Small	Medium	Large	
	Number of new patients per month	10	20	50	
	Reducept on Oculus and Mobile*	\checkmark	\checkmark	\checkmark	
	Online progress measurement	\checkmark	\checkmark	\checkmark	
	Manual for practitioners	\checkmark	\checkmark	\checkmark	
	Training	Online	Online	On location	
	Monthly cancellable**	\checkmark	\checkmark	\checkmark	
	Price per month	€115	€210	€450	
		Request	> Request >	Request >	
	Reimbursement for t There are several possibilities to deci- clearly recognize the potential of dig e-health programs. Consult your org- options. If you have specific question	he healthcare or are e-health products for pro- tal health: over the past deca nisation and national guidel s about the classification of F	ganization ctices. Health systems aro ide, they have invested hea ines for Reducept's reimbu teducept please contact us	und the world wily in national rsement Contact us >	
C S P	Get in touch with Sven wen is happy to help you. Contact him by pind mail so he can answer your questions in the b ossible way.	ne or vest	Hi, i'm S Manage can I hel	nen, account at Reducept. How byou?	

Figure 18: Pricing page, third iteration

6.9.3. Pricing Page, Third Iteration

The pricing page is shown in Figure 18. It is now the third page on the website. Since one of the main goals of the website is to get practitioners to purchase Reducept, the decision is made to first show the pricing packages before the reimbursement options.

The pricing packages now contain the amount of patients that can be treated. Moreover, it includes information on the mobile version, data gathering, knowledge transfers included, training and that headsets can be purchased through RelieVR BV that will include warranty.

The packages each have a purchase option. Currently, they all refer to the contact page where the subject line is automatically filled in with "Purchase Reducept". In the future, it could be made possible that the contact form will already include the specific package the user wants to purchase. Therefore, these buttons are already implemented.

The reimbursement options are described below. Here, both the possibilities for the practitioner and the patient are described. In the Dutch version, a link to the NZA overview is included. Since this overview is in Dutch and it does not apply to other countries, this link is excluded from the English page. At the end of this block, a contact button is integrated: the user is encouraged to contact the company to discuss what the specific reimbursement options are for them.

The page ends with being able to get in touch with the account manager, followed by the standard footer.



Meet the team









de Wit to Game to Tame

Advisorv board



6.9.4. About Us Page, Third Iteration

The community page is shown in Figure 19. It has been renamed to 'About us'. Since this page now only includes the team members, advisory board and contact options, the title covers expected functionalities.

On top of the team photo, a button is placed to get in touch with the company. When clicking this link, the user is re-directed to the general mail address of the company.

The members of the team are introduced with photo, name, function and title if applicable. This provides a nudge towards the educational background of the company. The advisory board follows in the same fashion.

Figure 19: Community page, third iteration

When the user clicks on either the team members of the advisory board members, a pop-up appears with more background information on the specific individual. Here, the user also has the option to contact the individual directly or look on their LinkedIn page for more information on their experience. This is shown in Figure 20.

At the bottom of the page, an additional contact button is added.



Figure 20: Community page, third iteration: biography expanded

R reducept	Home Research Pricin	ng About us	FAQ	EN - NL Contact Q
	Frequently asked questions Find the answers to the most frequently asked questions below			Thi
	What can we help you with?	Search		
	Or choose one of these categories:	Descent		
	Usage Beneins Purchase Support	Research		
	How do other practitioners use Reducept?	Read more		
	How do I use Reducept?	Read more		
	How often does a patient train with Reducept?	Read more		
	How long does the patient train with Reducept?	Read more		
	Who works with Reducept now?	Read more		
	How often should a practitioner see a patient?	Read more		
	Does it also work for other patient groups?	Read more		
	Are there any contraindications?	Read more		

Provide Reducept for your patients ducept to help your patients in your practice, or you can refer your patients to a practice nearby

Reducept in your practice Want to be innovative? Read here how you can purchase Reducept for your practice and the possibilities for reimbursement. Refer your patient to a practice nearby Do you want to refer a patient or are you a patient yoursel? Find the nearest practice where Reducept is used.



Figure 21: FAQ page, third iteration

6.9.5. FAQ Page, Third Iteration

The FAQ page is shown in Figure 21. The page begins with a search bar as is equal to the previous design.

For the actual FAQ questions, a new structure is created in order to create an overview of the questions. The different categories are shown at the top. When one category is selected, the related questions are shown. These questions can be expanded to see the answer.

The page ends with two familiar blocks: the purchase/referral block and the contact the account manager block.

The manuals are deleted from this page as mentioned before. The manuals are now accessible through the dashboard that will be linked to the website in the future. The answers of the FAQ frequently refer to the existence of manuals.



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6.9.6. Contact Page, Additional Page

Instead of including a contact form on multiple webpage, a separate page is created for tis function, shown in Figure 22. Moreover, an overview of upcoming events where Reducept is represented are shown on this page.

This has an added benefit: when people want to request a demonstration, they also reach this contact form. At this point, they can also see the events Reducept will be present at, meaning they might not have to request a demonstration if they are also attending the same event. This could save the company time in organising specific demonstrations for specific practices.



Figure 23: Referral page

6.9.7. Referral Page, Additional Page

If a practitioner wants to refer their patient for Reducept, they can click one of the referral buttons on the homepage, research and FAQ page. They are then re-directed to this page, dedicated to finding practices nearby, shown in Figure 23.

Through the search bar at the top, users can enter zip codes or addresses to find practices near them in a specific radius. These practices are shown on the map and listen below. The practices also include a category, since some patients do not want to visit a specific healthcare professional or are more skeptical of them, which be counterproductive in the treatment.

A patient can also search for practices near them. They can either ask their general practitioner specifically for a referral to this practice, or they can contact the practice directly.

6.10. Evaluation, Third Iteration

The website is presented to the stakeholders who originally participated in this user-centred design process. Through a questionnaire, their opinion on the website is obtained. Feedback and recommendations are provided to the company as possible adjustments in future website development. First, the structure of the questionnaire is explained, followed by the results obtained. Then, the researcher reflects on the usability and accessibility of the developed website. At the end of this section, the addressed facilitators are highlighted.

6.10.1. Questionnaire Structure

The questionnaire consists of five questions per webpage. Each page receives the same question. The stakeholders are asked to evaluate the homepage, research page, pricing page, about us page, FAQ page and contact page. The questionnaire is in Dutch and is included as Appendix U. The translated questions are:

- 1. The page is clear-structured (linear scale 1-5, required question)
- 2. The page contains relevant information (linear scale 1-5, required question)
- 3. The page appeals to me (linear scale 1-5, required question)
- 4. Are there items you miss or can be improved in the future? (open question, optional)
- 5. Additional comments (open question, optional)

6.10.2. Questionnaire Results

Three of the four original interviewees answered the questionnaire. The interviewees comment on some technical difficulties found within the website. These are communicated to the developers, but not further discussed in this thesis. Each webpage is discussed describing the opinion of the interviewees obtained through the questionnaire.

The homepage, or landing page, is generally clear-structured and contains relevant information. Two interviewees respond that the page appeals to them, and one interviewee thinks this can be improved. They mention that the bottom part of the page contains a lot of text, making it difficult to scroll it quickly and scan through the information. Moreover, the icons presented under "How Reducept works" seem clickable, but are not. When continuing to read the page it makes more sense, but this causes confusion when the interviewee first arrives on the webpage.

The opinions of the interviewees on the research page are very divided: where two indicate the research page is clear-structured, contains relevant information and is appealing, one interviewee rates all these aspects low. They comment there is too much information on this webpage.

The pricing page is rated well on being clear-structured, but one interviewee indicates the information and the appeal of this page can be improved. First, the interviewees miss information on how much the actual VR headset costs if purchased through Reducept. Second, the terms used on the page can be confusing: how do practices know if they are small, medium or large? Moreover, the reimbursement nog only seems for healthcare organisations, whereas it also mentions reimbursement for patients. This needs to be explicitly stated.

The about us page is rated well on being clear-structured, containing relevant information and its appeal to the interviewees. Other than technical issues, this page did not receive suggestions for improvements.

The FAQ is also rated well on the three first questions. One interviewee does not see the different categories presented above the FAQ. For them, the questions are all opened and, therefore, the overview is lost. This could be due to the browser, but is communicated to the developers.

The contact page is rated diversely, with overall good ratings. However, one interviewee mentions that the text of the page runs through each other, possibly the result of the browser they are using. Nonetheless, this needs to be thoroughly examined.

In general, the pages were rated well. There are some technical errors that need to be fixed. In order to gain a better understanding of the improvements necessary for this website, it should be tested with a larger test group with a diverse background.

6.10.3. Usability Evaluation, Third Iteration

For the third usability evaluation, the researcher checks the usability requirements of Section 6.2.2. Only the requirements that are not met are stated below:

- 1. Links are identifiable as links (mentioned, underlined, different colour)*
- 18. Colour is not the only indicator of cue*
- 19. Contrast between colour is sufficient (WCAG 2.1. standards)*
- 23. Textual description of video provided***

These usability requirements are also equal to accessibility requirements that are not met, as described in the following Section 6.10.4.. If the links in the header would be underlined or otherwise indicated as links or clickable items, the first two usability requirements can be met. The contrast of color needs to be increased for the buttons. Moreover, a small textual description of the video should be provided. The video contains the same information as the infographic on the homepage, but the user cannot make this connection since the video and infographic are on separate webpages.

6.10.4. Accessibility Evaluation, Third Iteration

The list of requirements of Appendix T should be implemented in the website. The researcher checks all these requirements if they are applicable to the website. The results of the accessibility check can be found in Table 7.

Table 7: Accessibility evaluation of website

Accessibility Guidelines	Met/ Not Met	Explanation
Info and relationships programmed (A)	Not Met	Buttons have the role of link
Meaningful sequence programmatically determined (A)	Not Met	Not all headers are programmatically determined
Information not only provided by sensory characteristics (e.g. color, shape, etc.) (A)	Met	All information is supported with multiple characteristics
Orientation: both landscape and portrait compatible (AA)	Met	Both landscape and portrait mode is supported
Contrast: minimum 4.5:1 (AA)	Not Met	The buttons' text contrast is not high enough with the background
Resize text: able to resize text up to 200 percent (AA)	Met	Text can be increased without information being lost
Reflow: vertical or horizontal scrolling (AA)	Met	The user never has to use horizontal scrolling on the website
Non-text contrast: 3:1 (AA)	Not Met	The icons in the button's contrast is not high enough
Text spacing: programmatically determined (AA)	Met	There is enough space between text lines

Accessibility Guidelines	Met/ Not Met	Explanation
Page titled: every page has a title that describes purpose (A)	Met	Titles are descriptive
Multiple ways: more than one way to locate a webpage within a set of webpages (AA)	Not Met	As stated in Section 6.9.1.
Language of parts: programmatically determined (A)	Met	Language determined in code
Consistent navigation: consistent order of menus (AA)	Met	Menu's are repeated in the same order on multiple webpages
Consistent identification: same functionality has same name (AA)	Not Met	As stated in Section 6.5.1.
Parsing: end tags programmatically determined (A)	Met	Correct usage of tags
Name, role, value: programmatically determined (A)	Not Met	Expanded texts are not programmatically determined
Non-text content: all non-text content has an alternative text (A)	Not Met	Alt text provided does not describe media content
Video: text alternative available (A)	Not Met	Text alternative not available
Images of text: images of text do not convey important information (AA)	Met	Images do not contain text
Color is not the only visual means of conveying information (A)	Not Met	The header links are only indicated through color
Link purpose: link describes purpose (A)	Not Met	Target not indicated
Identify input purpose programmatically determined (AA)	Not Met	Not explained what is the input purpose in correct language
Label in name: name is text visually (A)	Not Met	Labels different language
Error identification: automatically detected (A)	Met	Errors are detected
Labels or instructions: provided (A)	Met	Labels are provided
Error suggestion: suggestions for corrections made (AA)	Met	E-mail suggestions are made when invalid e-mail is entered
Status messages: programmatically determined (AA)	Met	Message when mail has been send
Keyboard: operable through keyboard interface (A)	Not Met	Search function is not operable through keyboard
No keyboard trap: switching focus through keyboard possible (A)	Met	No keyboard trap
Bypass blocks: mechanism available to bypass blocks or repeated content (A)	Met	Skip to content integrated
Focus on order: focus must be in logical order of meaningful sequences (A)	Not Met	Logical order (left to right) has not been followed consistently
Focus visible: focus through keyboard is visible (AA)	Met	Focus is visible
On focus: receiving focus does not initiate change (A)	Met	No actions triggered

16 out of 33 accessibility requirements are not currently met in this website, of which 10 are level A requirements. Therefore, this website is not accessible. The website needs to be iterated again in order to implement the changes necessary to make this website accessible. Six of these requirements are design related, of which two were conscious choices. However, alternatives or compromises should be considered if this website will be fully accessible. The other ten requirements need to be altered in the code of the website and were not detectable prior to this evaluation.

6.10.5. Facilitators Addressed on Website

As described in Section 5.4., creating and endorsing facilitators can help the implementation of VR Ehealth technologies in healthcare institutions. It is therefore important that these facilitators are addressed and highlighted in the communication towards practitioners. Therefore, as much facilitators as possible are integrated in the content of the website. In Table 8, an overview of the included facilitators is provided.

Facilitator	Implemented	Location
Evolving of Technology	No	Some references made in the whitepaper, but not explicit
Training	Yes	Infographic, FAQ
Technical Support	Yes	Infographic, FAQ
Organisational Support	n.a.	n.a.
Knowledge Transfers (KT)	Yes	Infographic, FAQ
Better Treatment	Yes	Infographic, video, FAQ
Independence of Patients	Yes	Infographic, video, FAQ
Motivation of Patient	Yes	Infographic, video, FAQ
Participation in Research	Yes	Research
Recommendations	Yes	Experiences, FAQ
Novelty	Yes	Infographic, video, FAQ
Collaboration in Design	Yes	Whitepaper
Stronger Evidence Base	Yes	Whitepaper, Further Development with Partners
Affordable Hardware/Licenses	No	Prices are known but not cheap
Community	No	Future project
Raise Awareness	Yes	Website
Compatibility of Content	Yes	Infographic, video, FAQ
Background Company	Yes	About us, Whitepaper
Gather Data	Yes	Infographic, FAQ
Decrease of Medicine	Yes	Whitepaper

Table 8: Facilitators addressed and included in the website

Facilitator	Implemented	Location
Reorganisation of Healthcare Services	n.a.	n.a.
Smooth Distribution	No	Future Project
Demonstrations	Yes	'Request Demonstration' Options

Table 8 shows that many facilitators are addressed. The 'Evolvement of Technology' can be highlighted more on the website. The prices of the application are known, but they are not cheap. Therefore, the facilitator of the 'Affordable Hardware/Licenses' are not met, but this facilitator is also rated as least cost-efficient. Therefore, no additional effort is made to include this facilitator.

The facilitators 'Community' and 'Smooth Distribution' are not explicitly addressed on the website. However, establishing a smooth distribution is a current project of RelieVR BV, as they are designing special cases and a starter kit for practitioners. Once this distribution has been established, it is a good idea to mention it explicitly on the website. The company is also working on creating a community. Perhaps, the website could form a medium for this community. This is something that can be explored in future iterations of the website.

6.11. Summary of Realisation of Website

Raising awareness for new VR E-health applications is a necessary and cost-efficient facilitator. Using facilitators as a starting point, a website can be created through a user-centred design process. By including stakeholders throughout the design and development process, the website now provides the necessary information structured in the way the practitioner prefers. By conforming the website to their needs, it can help them find information easier, which could help them understand how Reducept would fit within their treatment. Moreover, many facilitators are addressed on the website, which could help reduce the barriers of implementation.

7. Discussion

Every study has limitations or factors that can influence the results. Within this chapter, these possible influential factors and limitations are presented. In further research regarding this topic, these factors and limitations can be kept in mind whilst analysing the results or they can be overcome when the research itself is conducted again. Moreover, this can provide an understanding of why the results obtained might differ from other researcher's work.

7.1. Literature and Interviews

The results obtained through the interviews agree with the results obtained through the literature review. In some aspects, the results from the interviews build forth on the literature: some new barriers and facilitators come to light, such as the importance of health risks related to hardware devices, liability issues as well as smooth distribution channels.

Moreover, some barriers and facilitators discussed in literature were not mentioned by interviewees. This could have several reasons. During the interviews, stakeholders are asked to come up with barriers and facilitators. However, this requires them to think of a complete list on the spot. The interviewees are inspired by other things discussed during the interviews, which triggers thoughts about barriers and facilitators. Nonetheless, this means that many facilitators and barriers could be forgotten or overlooked and, therefore, not mentioned during the interview.

For the interviews, semi-structured interviews were chosen since they allow for freedom in answers whilst ensuring the most important topics are covered. However, as the researcher would perform the interviews more often, they were inspired by the answers of the previous interviewees. This means that interviewees would cover a topic not originally addressed in the semi-structured interview questions, but the researcher would cover this topic in the subsequent interviews. Therefore, the participants who were interviewed later on during the research study have answered some slightly different questions than the first interviewees. This is allowed in semi-structured interviews, but it could have influenced or altered the results obtained. This does stress that this research study provides qualitative results, rather than quantitative.

The cost-efficiency of the facilitators are estimated based on the claims obtained. In future research, the actual cost-efficiency of facilitators would need to be tested. Moreover, all the claims obtained are categorised in different barriers and facilitators by the researcher. When categorising results, some claims could have been merged that could also have been identified as separate barriers or facilitators. However, most of the categories had been previously identified by multiple research studies, showing the consistency of the identification of these categories.

7.2. Realisation of Website

The participants who are willing to participate are limited on time. At first, the researcher wanted to have four different interviews per practitioner in order for them to provide feedback on the development of the website within each iteration. Unfortunately, this deemed to take up too much time from the practitioners, who declined the offer to participate. The four interviewees contributing to the website are interviewed twice and they filled in a questionnaire at the end. All the other practitioners are asked to interview only once to obtain information about barriers and facilitators. After the request had changed from four sessions to one interview session, more practitioners wanted to be involved within the research study.

During the development of the website, the researcher has made themselves responsible for the implementation of the general usability heuristics as well as for the accessibility guidelines. The accessibility guidelines are predefined by WCAG 2.1, but the usability heuristics are generic

guidelines. Whilst studying these guidelines, the researcher makes decisions on how the guidelines can be translated into objective requirements and then they decide which requirements are relevant for the website. Another researcher can make different decisions, which can have an influence on the outcome of the design.

Regarding the accessibility guidelines, the researcher does not program the website themselves. Therefore, the guidelines regarding coding issues or features cannot be guarded since the researcher does not have access to the code. This means the researcher guards the usability and accessibility requirements during the development phase on a design level.

During the development of the website, there is a continuous discussion between usability, accessibility and aesthetics. The website developers and the company are eager to include as many accessibility guidelines and usability heuristics as possible. However, at some points during the development, the guidelines and design wishes are conflicting. In the end, compromises are made. This is done in agreement with all parties. In the end, there is always a discussion between design, functionality and accessibility, which requires stakeholders to make decisions that influence the end-result.

The same applies to implementing the different claims obtained through user input: where some prefer option A, others prefer option B. Every functionality and design aspect is thoroughly discussed during the project, and sometimes compromises need to be made or claims need to be discarded altogether. These decisions are dependent on the stakeholders involved in the project and the level of influence they maintain.

7.3. Context of Research Study

First, there are strict time constraints during this research study. Due to the deadlines of the university, there is a set time frame in which the entire research study would need to be performed. Therefore, the interviews regarding the barriers and facilitators on the implementation of virtual reality E-health applications are done simultaneously with the development of the website. Due to this, only the first interviewees could be part of both the user-centred design process performed to realise the website as well as identifying the barriers and facilitators. The subsequent interviews would only contribute to the identification of barriers and facilitators. This means there are only four interviewees involved in the website realisation. All four interviewees do represent a different relevant occupation. If this study would be repeated, it would be advised to involve more users within this process. Also, more input from literature findings, direct observations and user interviews help with the foundation of the website. Therefore, it is advised to complete these steps prior to performing the user-centred design process of realising a website.

Furthermore, additional time would allow the researcher to find and interview more practitioners. In this research study, a high amount of participants would allow the researcher to provide quantitative results as well.

7.4. Limitations

There are several limitations in this research study mentioned above. One limitation continuously present during this research study is the difference in work methods of both the startup company and the university. Whereas the university is focussed on research and allowing time for this research to be done, the culture at a startup is based on getting as many things done as fast as possible. Therefore, there is a tension between time pressure from the company to obtain results for the website development and the desire of the university to spend more time on acquiring user input. In the end, the researcher compromises on this matter, which can have an influence on the results. It should be noted that both the company and the university are supportive of the research performed.

Also, this study is performed in the Netherlands, focussed on Dutch practitioners and the Dutch healthcare system. Therefore, the results can be different depending on the geographic location, the culture differences and differences in healthcare systems. Moreover, all the interviews are performed in Dutch to allow for interviewees to respond in their mother tongue and feel more comfortable answering questions. After, the researcher translates these interviews. In every case where results are translated from their original language into another, some claims or subtle references might have been lost in translation.

8. Conclusion

This chapter draws conclusions based on the results obtained in Chapters 4, 5 and 6, and answer the research questions proposed in Section 1.3.. First, the facilitators and barriers on the implementation of VR E-health technology are discussed, followed by conclusions that can be drawn on the realisation of a website designed through a user-centred design method. At the end of this chapter, propositions for future research directions are presented.

8.1. Barriers and Facilitators on the Implementation of VR E-health Applications

The first part of this research study focuses on two research questions, namely:

RQ1: What are the barriers on the adoption and implementation of virtual reality E-health applications within healthcare institutions?

RQ2: What are the facilitators on the adoption and implementation of virtual reality E-health applications within healthcare institutions?

Within this research, an exhaustive list of both barriers and facilitators is compiled based on literature, observations and interviews. Barriers are always present when implementing new E-health applications, but including the right facilitators can significantly reduce these barriers. There are different facilitators that can be used to reduce equivalent barriers, but some facilitators are more cost-efficient than others: whereas some facilitators cost much time and money to support for little return, others are easily achieved by companies and create more added value to practitioners. This research study has compiled a list of facilitators with their estimated cost-efficiency. Companies should implement a combination of (cost-efficient) facilitators in order to reduce barriers even further to support the implementation process of the practitioner.

Furthermore, there is tension between different crucial parties within the healthcare system: the practitioners are waiting for easily implementable products by companies, companies want more funds from the government to develop implementable products and the government wants the mindset of practitioners to change to be able to implement current available products. This tension causes the implementation process to slow, since all parties are waiting for improvements or adjustments from each other.

Throughout the interviews, it becomes apparent the different parties are starting to work together more closely and discuss pressing matters in newly organised groups. However, all interviewees acknowledge implementation processes remain slow. As the healthcare system must reorganise to remain sustainable, the system should be adjusted to fit the fast pace of technological development in order for innovations to improve quality of life of patients instead of remaining on the shelf. Moreover, a large focus needs to be put on solving financial issues of this new system creatively, since healthcare institutions do not want to invest if it results in fewer patients and less income.

The overall view on VR E-health technologies is positive, but interviewees state they remain hesitant to take the risk of implementing new innovations before it has been clinically tested. Clinical evidence for the specific application is crucial; clinical evidence for the generic technology is much less relevant. Companies should put a focus on identifying who the product works well for and for whom it is not suitable: knowing this information could give practitioners confidence to try the product when they know it causes no harm to their patients. Including practitioners and healthcare institutions in both the design and the research of the product also provides this confidence. For this, companies need to target practitioners who have affinity with technology or who are motivated to use more technology within their practice.

8.2. Co-Creation of Website Addressing Facilitators

The second part of this research study focuses on the third research question:

RQ3: How can E-health developers use barriers and facilitators on the implementation of virtual reality E-health applications within healthcare institutions to conform their website?

As was concluded before, facilitators can diminish barriers. Therefore, communicating facilitators to healthcare practitioners can help them understand if the application fits within their treatment.

Raising awareness for new E-health applications is crucial. In order to distinguish themselves from other distributors, companies need to network and use personal approaches to reach the practitioner. Once the practitioner is reached, the information provided must be conformed to the needs of the practitioner.

One way to communicate this information is through a website. When creating a website, the technology should not be the highlighted part: the implementation of the technology in the world of the practitioner is the most crucial factor. If companies shift their focus from the technology they have created to the implementation of this technology in the practice, it becomes instantly clear what the product can add as value for both the practitioner's work as well as for the patient. In order to uncover these added benefits, companies must work together with practitioners: 'Collaboration on Design' is a facilitator for creating relevant innovations, but it also applies to creating relevant websites.

When creating a website, it is important to incorporate both usability and accessibility factors. However, as this research study shows, it is difficult to ensure these factors when they are codebased. Moreover, the desire of a specific design or feature could trump these factors in the mind of stakeholders. In general, usability and accessibility can be easily ignored (though unjustifiably), or incorrectly implemented. Therefore, awareness needs to be created for their necessity and more education needs to be provided on how to properly include these features into code.

8.3. Future Research Directions

In the future, the effect of the conformed website created in this research should be tested in order to determine if the new structure supports practitioners more than 'standard' B2B websites. Also, the conclusions of this study need to be validated through a quantitative approach.

The most prominent problem that needs to be addressed is that the current Dutch healthcare system does not allow for the quick and easy implementation of E-health applications. In turn, this forms many barriers in the minds of healthcare practitioners. Through community-based research including these parties, innovative future-minded systems can be created. Within this process, insurance companies need to be actively involved as well, since they have obtained an important status and influence in the current healthcare system in the Netherlands. This research should conclude on whether these parties should remain active in a new healthcare system. Also, the public needs to participate within this research, since the new healthcare system will rely on the active involvement of the population in their own health and lifestyle.

Moreover, the facilitators identified in this research can be further researched to determine their influence and relation to the model of Rogers (1962) regarding the diffusion of innovations. For example, research can determine which facilitators have the highest influence on early adopters, or if the implementation of these facilitators in other marketing campaigns quicken the general adoption process.

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Appendix A: Ten Usability Heuristics by Jakob Nielsen

Visibility of system status: the system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

Match between system and the real world: the system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

User control and freedom: users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

Consistency and standards: users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

Error prevention: even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

Recognition rather than recall: minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

Flexibility and efficiency of use: accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

Aesthetic and minimalist design: dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

Help users recognize, diagnose, and recover from errors: error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

Help and documentation: even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focussed on the user's task, list concrete steps to be carried out, and not be too large.

Appendix B: Direct Observations at Office RelieVR BV

While working at the office of RelieVR BV, an informal meeting is organised with three psychologists and a physiotherapist. The researcher attends this meeting and observes the conversation between the company and the practitioners. The goal of the meeting is to improve the gameplay of Reducept, but different barriers and facilitators of the implementation of the VR E-health application come to light.

First, the psychologists are in need of manuals and shareable content. During the observation, it becomes apparent that it could be difficult for the practitioner to explain the product and to understand which specific skillset the patient would acquire. Without knowing the specific skillset, it is difficult for them to provide verbal support, which is necessary for good implementation within their treatment process. Therefore, a manual for practitioner is vital.

Moreover, other forms of knowledge transfers (KT), both for them, the patient and other practitioners is lacking. For example, the practitioners rely on the referrals made by general practitioners (GP), but the GP claims they forget the practitioners have Reducept or that they don't have any chronic pain patients. The latter is highly unlikely, as the practitioners explain, but it could be that not all the GP's share the vision on chronic pain in regards to its mental aspects: both GP's and pain centres don't always refer to psychologists when a patient complains about physical pain. Therefore, by having shareable content, practitioners can show the outside world how pain works (both physically as mentally), how Reducept can help in the process and that they can provide Reducept to patients. Moreover, more evidence and research results can help create awareness as well.

However, there has to be a balance. Currently, the practices do not have many headsets, meaning they cannot provide Reducept to many patients. Thus, they do want more referrals, but they do not want more patients than they can handle. The financial barrier of acquiring more headsets is still too high, especially for a small practice. Therefore, if the hardware becomes more affordable, they can also purchase more headsets. The hardware itself needs improvements as well: the battery dies quickly, meaning not many patients can be treated right after one another. Creating a mobile version, which the patient can download themselves, would be a very positive outcome.

One more practical issue is raised: there is no additional space in the practice for patients to use Reducept. The practitioners mention that the patients could use Reducept on their own, which they view as a highly positive factor. However, due to the limited space of the practice, the patient sits in the treatment room with the practitioner. Even though the practitioner now has more time, they cannot spend this time on other patients, since their treatment room is occupied. Therefore, the independence of patients is only a facilitator if the barrier of space is overcome.

The practitioners also have suggestions for improvements, which would make Reducept more suitable for their treatment process. First, the practitioners suggest adaptive settings such as different voices the patient can choose from, different user profiles to which the education can adapt and switching subtitles on or off. The latter is easily implemented, the first two are more extensive requests. The practitioners explain that patients have a preference for female or male voices for explanations and that the wrong voice could create an annoyance with the patient, after which the content would not receive adequate attention anymore. Moreover, if the education adapts to user profiles, the content could fit more in the lives of the patient. In this instance, for example, it could mean creating a profile for people who have physically demanding jobs, resulting in education stressing what patients can do when they need to provide tough labor. Here, a more adaptive approach would be a facilitator for the practitioners.

In addition, the practitioners stress that the interaction between patient and practitioner is necessary. They suggest that Reducept might also be used without audio, so the practitioner can provide auditive feedback whilst the patient plays. If the practitioner would be able to see what the patient sees through the VR headset (e.g. through an additional screen), they could provide real-time feedback specific for the patient.

Also, the application cannot be boring: if the content becomes boring for the patient, they lose focus and might not acquire the necessary knowledge.

Last but not least, the practitioners like to work together with other practices in the form of a community, so they can discuss problems and solutions that might arise. Moreover, working together on research is a great way to become more affiliated with the product and more motivated to use Reducept within the practice.

Appendix C: Observations at Radboud UMC

Whist visiting the hospital Radboud UMC (Nijmegen), a conversation is held with a researcher at the hospital who is working on a research study with virtual reality. The study has just begun, but they mention some barriers and facilitators of implementing virtual reality in a hospital.

From the beginning, the healthcare staff can be critical. The staff stresses the need for patientpractitioner time and feel the virtual reality might replace this. However, currently, while the patient is using the virtual reality, the free time is being spend on administration instead of being social with other patients. Therefore, the nurses feel that the virtual reality is a replacement of their care, while in theory it should open up more time for nurses to spend social time with patients. Therefore, existing processes need to change, but that is difficult to achieve in healthcare.

Having critical staff can be a crucial barrier. Patients do not know about the offer of virtual reality unless the staff tells them. Therefore, having enthusiastic staff could increase the number of patients who become aware of the possibilities of using virtual reality in their treatment. Moreover, patients trust the opinion of the staff: if the staff is not positive about the technology or application, the patient could become hesitant as well. Staff and patients might become more enthusiastic when they understand the true added value for them if they were to make use of the virtual reality E-health application.

Another barrier of hospitals is that they are very hierarchic. Therefore, communication can be very slow. You also need the right people to be positive about what you are doing: with the right support, you can achieve better and faster implementation, but reaching the right people can be a struggle.

Whereas in practices practitioners work closely together with their colleagues, hospitals have many different departments who all do their own thing. While setting up the study, they coincidentally found out that another department had previously done a study with VR as well. It is a coincidence they found out, because there is no structured way to find this information.

They recommend creating one centre that is aware of al technological studies being done at the hospital and where researchers, students and staff can go with technical issues or solutions. This way, knowledge can be structurally shared and hospital staff can know what possibilities there are for their patients.

They currently organise open days where practitioners from other departments can visit and see the study they are working on. Since the hospital is so big, it can take practitioners more than 15 minutes to walk to the location of the open day, which they do not have time for. Therefore, due to location, you could miss reaching some departments. They also present research results and progress at staff meetings of different departments to try and raise the awareness of their study and their offer of virtual reality.

They explain that one big struggle is that there is no current knowledge about which type of VR works for which type of patient. Therefore, it is difficult for practitioners to estimate if the solution could work for their patients in their department.

Appendix D: Informed Consent Form (Dutch)

Versie 1 April 2019 GEÏNFORMEERDE TOESTEMMING

naam proefpersoon

lk

stem toe mee te doen aan een onderzoek dat uitgevoerd wordt door naam onderzoeker Maaike Dokter

Ik ben me ervan bewust dat deelname aan dit onderzoek met als titel *RelieVR: From Product to Patient*

geheel vrijwillig is. Ik kan mijn medewerking op elk tijdstip stopzetten en de gegevens die verkregen zijn uit dit onderzoek terugkrijgen, laten verwijderen uit de database, of laten vernietigen.

De volgende punten zijn aan mij uitgelegd:

1. Het doel van dit onderzoek is

om in kaart te brengen wat een zorg expert nodig heeft van bedrijven om de implementatie van hun ehealth technologie of product mogelijk te maken in zorginstellingen.

2. Er zal mij gevraagd worden om

deel te nemen aan interviews en vragen te beantwoorden over e-health technologieën met betrekking tot mijn beroep.

3. Het hele onderzoek zal ongeveer 3 maanden duren. Gedurende deze periode zal mij ongeveer 3 tot 4 keer

keer gevraagd worden om deel te nemen aan een interview van ongeveer 45 minuten tot 1 uur.

Aan het einde van het onderzoek, zal de onderzoeker de resultaten doorsturen.

4. De gegevens die verkregen zijn uit dit onderzoek zullen anoniem worden verwerkt, en dus niet herleidbaar zijn tot mijn persoon.

5. Het verkregen materiaal wordt uitsluitend gebruikt voor onderzoeksdoeleinden.

6. De onderzoeker zal alle verdere vragen over dit onderzoek beantwoorden, nu of gedurende het verdere verloop van het onderzoek.

7. Ik geef **wel / geen** toestemming voor het opnemen van audio opnames. Deze audio opnames zijn puur bedoeld voor de onderzoeker om terug te luisteren, zodat zij het interview schriftelijk zal kunnen uitwerken. Ik kan mijn audio opname op ieder moment terugkrijgen, laten verwijderen uit de database of laten vernietigen. Aan het einde van dit onderzoek, zullen alle audio opnames vernietigd worden.

Datum:	Handtekening onderzoeker:	
	Maaike Dokter	

Datum:	atum: Handtekening proefpersoon:		

Appendix E: Interview Questions (Dutch)

Introductie:

Ik zou graag willen beginnen met een introductie ronde. Mijn naam is Maaike en studeer Human Computer Interaction and Design met een specialisatie in E-health. Deze master is erg gericht op hoe mensen met technologie omgaan, maar heeft ook een grote business kant. Met mijn afstudeeronderzoek wil ik dieper ingaan op hoe we technologieën ook daadwerkelijk bij de patient gaan brengen. E-health producten kunnen goed ontworpen en gemaakt zijn, ook door met de participatie van patiënten en zorg professionals, maar toch blijft het lastig om het product dan verder uit te zetten. Normaal gesproken geven bedrijven ontzettend veel informatie, en ik wil het nu eigenlijk omdraaien. Ik wil nu van zorg professionals weten welke informatie jullie nodig hebben en willen zodat de implementatie van E-health producten in de praktijk succesvol kan zijn.

Generieke vragen:

Hoe kijk je over het algemeen naar E-health technologieën?

Gebruiken jullie op het moment E-health technologieën? En, zo ja, welke?

Heb je gehoord over E-health technologieën die je in de toekomst in de praktijk zou willen gebruiken? Zo ja, welke? En, zo ja, hoe hoorde je over deze technologie en wat maakte jou enthousiast hierover?

Er zijn ontzettend veel technologieën die geïmplementeerd zouden kunnen worden. Wat is iets wat jullie weerhoud van het implementeren hiervan? (e.g. gebrek aan reclame/marketing, gebrek aan informatie, kosten, etc.)

Zijn jullie geïnteresseerd in het implementeren van meer technologieën binnen de praktijk?

Wat zijn de voornaamste dingen die technologieën zouden kunnen oplossen bij jullie in de praktijk?

Hoe zouden we de implementatie van technologieën kunnen verbeteren voor jullie?

Specifieke vragen rondom Virtual Reality:

Heb je al eens eerder met VR brillen gewerkt? Prive of binnen de praktijk?

Heb je ooit gewerkt met VR E-health technologie? Of heb je ooit een E-health VR applicatie gezien? Zo ja, waar?

Hoe kijk je naar VR E-health technologieën? Denk je dat het interessant is of heb je er nog veel vragen bij?

Zou je VR E-health technologie binnen de praktijk willen gebruiken? Wat zouden op dit moment de voor- en nadelen hiervan zijn denk je?

Ik doe mijn afstudeerstage bij RelieVR en ik wil kijken, vanuit het oogpunt van de professional, hoe we dit product het beste kunnen implementeren in de markt. Ik zou er kort iets over willen vertellen, hoe het werkt en waarvoor het is bedoeld en daarna zou ik graag een demo willen laten zien.

RelieVR is een VR applicatie voor mensen met chronische pijn. Door middel van spelelementen in virtual reality leren mensen hoe pijn werkt, dit is dus een stuk educatie. Daarnaast leren ze psychologische technieken aan die ze kunnen toepassen in het dagelijks leven. Deze technieken zijn gebaseerd op wetenschappelijke psychologische technieken die gebruikt worden in de huidige behandeling van pijn. Ik kan het beste even een demo laten zien, dan kan ik daarna vragen beantwoorden die je wellicht hebt over het product. Ik ben geen verkoper van het product, dus voel je gerust vrij om alles te zeggen.

Zou je dit product wellicht willen toepassen binnen de praktijk. Waarom wel of niet?

Wat zouden redenen zijn die je zouden laten twijfelen over het product?

Welke informatie zou je nodig hebben zodat je meer vertrouwen krijgt in dit product of generieke VR E-health technologieën?

Wat moet er veranderd worden of verbeterd worden in het product voordat je het zou gebruiken?

Specifieke vragen rondom websites:

Ik ben heel erg geïnteresseerd over hoe we het beste in het vizier van zorginstellingen kunnen komen. We zijn nu ook een website aan het ontwikkelen specifiek gericht op zorginstellingen.

Wat zouden componenten zijn of informatie stukken die je graag terug zou willen zien? Wat is jouw ideaal beeld van zo'n website?

- a. Homepage
- b. Product informatie
- c. Prijs informatie
- d. Blog/wetenschappelijke artikelen/etc.
- e. Ondersteuning/help/FAQ/etc.

Zijn er andere manieren die wellicht efficiënter zijn om überhaupt gevonden te worden als Ehealth technologie?

Zijn er andere platformen (e.g. social media) waar we gebruik van zouden kunnen maken?

Appendix F: Interviews Physiotherapists

Physiotherapist 1:

The physiotherapist works at a practice that is completely specialised in spinal-cord related issues. They see patients who have acute back pain, but their main focus is on patients with chronic back pain issues. Within this specific practice, people do not need a referral from their general practitioner and, many times, people contact the practice on their own.

They explain that, when you talk about chronic pain, there are many different issues that are related and that many different factors result in the continuing presence of pain. It is a puzzle to figure out why the pain remains in a specific person, which could be related to restrictive thoughts, emotions, behaviour, etc. They are very interested in the challenge to find out which strategies work specifically for the patient.

They state that the implementation of E-health within physiotherapy practices is still in its infancy. They have read about E-health implementation in hospitals, where the hospital uses technology to see what happens with the patient when returning home. However, they have not heard about much E-health implementation within physiotherapy practices. At their practice, they do offer chats with patients through social media. However, usually people ask a question and they answer it would be good to have a consultation with one of them, so it works more as a tool to obtain more patients.

They use one E-health product during consultations, which is a back-scanner. This device creates a visual representation of the spinal cord in different positions. However, this is a limited product since it is not always reliable or accurate. They do use online questionnaires that are send to patients before their first consultation with a physiotherapist. The results of this questionnaire is automatically entered in an online patient file. Through these surveys, they try to gather data on how the pain-experience progresses over time.

Due to their own interest, they read a lot of studies about chronic pain and using E-health. They follow a group of researchers in Australia that are very advanced on this subject. They find this super interesting, but they have never had the opportunity to see the actual product in real-life. When asked how they found this group, they replied someone had recommended it to them and, after looking it up, they found that the researchers had a very interesting point of view on the subject of chronic pain that they agree with. They notice that too many people look at chronic pain with a bio-medical perspective, whereas they think it is so much more complex with a large role set for the brain.

Usually, someone from the study would recommend them a book or person to follow. Recommendations would mean that it was probably interesting and not a waste of time. They says that, if they quickly found that the views were in line with their own, that is when they would further investigate and spend their own time in diving into the research.

There are already many E-health technologies available in general. However, the large investments required are a real barrier for the practice. In general, the physiotherapists do not have a lot of financial margin and there is a lot of financial pressure. It could also be possible that there is not much known about which technologies are available specifically for physiotherapists. They state that it is also important to remember that patients have an expectation of the treatment they will receive and it is a question if they are open to using specific E-health technologies. Lowering the costs would probably make it easier to implement technologies. If the usage of the product would be reimbursed by insurance companies since it is part of a specific therapy, costs would not be a problem anymore.

If the practice would invest in such technologies, the physiotherapists would also be allowed paid time to learn how to work with the product. Within the practice, the IT technologies have to be fast and reliable. The online patient files are sometime problematic when the internet does not work properly.
Especially when there is a time-pressure (e.g. having to fill in data during a consult), this can be a real issue. Therefore, the technologies need to be reliable and fast. It has to support what you are doing and not create limitations.

They have heard of an E-health technology using virtual reality, because someone in management is working with a college to create such an application. However, they have not seen the actual application or experienced it. They think using virtual reality is super interesting in this field because the role of the brain is crucial in chronic pain. Therefore, such a technology can trick or reprogram the brain in such a way to be able to control it better. Thus, virtual reality holds a lot of potential.

They would like to implement such technology in the practice. Advantages would be that you could simulate a normal everyday environment for the patient to see how the patient behaves in their usual environment. Within a practice, people could behave differently than in their normal environment. They doubts if the virtual reality application could have enough influence on the brain to also show effect after the virtual reality application has ended. This is something that needs to be proven.

When explaining the application, the physiotherapist was super interested in the fact that the virtual reality application would provide education on pain, something they have mentioned before in the interview to be very interested in. After the explanation, they think it could be of added value to the patient when it comes to understanding how chronic pain works. There are platforms online which explain the theory, but these are all text based. VR could provide a different learning strategy to help people understand the complex concept.

What is really important is the structure of the pain education and if it matches with the vision of the physiotherapy practice. The researcher had explained three different levels and the physiotherapist does not know if these three programs or levels are the answer to all chronic pain issues. Moreover, there are more techniques that could help patients. Therefore, it could be limited. It might be more interesting when you could use it on your phone and, therefore, have the patients practice at home.

After testing the demo, the physiotherapist was positive. They did expect that, within the game, it would be more specific about where you are in the body (e.g. leg, etc.). They liked the gaming elements within the application. They were wondering what the actual technique was within the gameplay and if the patient would not wonder too much about what was actually happening.

If they were to use this as a physiotherapist, they would like to know what the actual effect is. They would like to see what the research results are after testing with different user groups (e.g. using the application and not using the application). Some physiotherapists might think it is too much focussed on psychology. They thinks there needs to be more education, especially in the beginning of the application. You could also use the first gameplay (i.e. shooting at pain) for movement therapy, since you move due to the gameplay. Within a gaming environment, it could lure people to make movements they usually would not.

The physiotherapist usually does not search for technologies online. They usually read about new technologies on news websites or social media. LinkedIn is a great example, since you can become a member of groups that posts about such technologies.

On a website, they would expect to see a movie about how the product works. They would like to see information about how you can implement it within the practice. Also, they are interested in seeing the pros and cons of the product. Having patients tell about their experiences could be of added value. Also, research that the product is based on should be visible on the website. Since this product really needs to be experienced, they would also like to see where and when a demonstration would be possible. For example, when the company is present at a congress. They would not be interested in seeing the pricing information, even though it can be a huge barrier: they first want to experience the product before talking about the business side of things. A very brief description of the added value of VR could help.

The background, especially the people who have developed the product, has extreme added value. The fact that the product has been developed by medical professionals with experience, instead of people who are business-oriented, already adds huge value to the product. They never use a help page or FAQ page. They usually search on the website or mail the company if they really need to know more information.

They explain that they sometimes have nights planned at the practice, called peer-reviews, which could be used to introduce such a product to the entire practice. Try to find such moments (instead of creating new moments, which would cost medical professionals more time) and use them to demonstrate the product.

This specific physiotherapist practice is specialised in spines. People find that their back problems are taken care of better at a specialist practice than at a regular physiotherapist. That is how they profile themselves on the market and other medical professionals refer their patients with back-issues to them. It is important to market how you are different from other practices. Therefore, if practices would use RelieVR, this has to be known to patients or medical professionals who reference patients.

Physiotherapist 2:

They work as a physiotherapist at a hospital at the surgery department, at which they are also the supervisor. They have been doing this work for over 25 years. Currently, they are not working a lot with E-health technologies in the clinical healthcare.

When asked about E-health, their first thoughts are directed at applications for patients. Moreover, they are developing an application in-house which is focussed on tele-physio, meaning physiotherapists can assign specific exercises to patients who can view these exercises on the television screen in their hospital room. They are not specifically involved within the development of this application. However, some of their physiotherapy colleagues do work with the developers in order to create this application. They read a lot about robots and new technologies like that. For example, there are robots who can help lift patients out of their beds which could be beneficial to their department.

When asked about barriers for the actual implementation of E-health, they mention it is usually a financial aspect. The tele-physio project they mentioned before is a very expensive project, so they acknowledge money musty be made available for project like these. The project was started years ago and has been ready for further development, but finances play a role here.

Moreover, they mention privacy is always very important in the healthcare sector. This can also be a significant barrier when they want to use external applications. In reality, this almost never succeeds. It should be integrated with the electronic medical records and this should be done by the supplier. However, this is usually not recommended and, therefore, they mostly only use E-health applications that are developed in-house. The privacy and security standard are high for healthcare institutions.

Since the hospital is connected to educational institutions, students are working together with the hospital to perform research and to develop applications. Moreover, they have many interns at the hospital who are focussed on innovation in healthcare. However, the need for more technology such as E-health applications is not present yet. They mention they already have some possibilities: for example, through their electronic medical records, it is already possible to perform E-consults. For both their colleagues and themselves, they don't think there really is a need for anything more at this point in time.

When asked about virtual reality, they mention they have seen videos where such technologies are being used for rehabilitation purposes. Also, they have heard of different applications for the psychiatry sector. They have not used it themselves and they do not use it yet at their department. However, they are not sure if it is being used in other departments of the hospital. They mention the

different departments work a lot on their own. If there is something special, it will be mentioned on the intranet. However, they have not seen anything about virtual reality on the intranet.

They think the use of virtual reality could be very interesting to their department. They perform a lot of balance and obstacle exercises with their patients, which could be nicely simulated through the virtual reality technology. Therefore, they would be very open to implementing virtual reality within their department. However, they do see some barriers. Firstly, it is an application created by external parties and, hence, created outside of the hospital. If no data is being recorded, this would not necessarily be a barrier. They would like to receive information and explanations on how the product works.

After providing an introduction on Reducept, they mention it sounds interesting for the pain center located in the hospital, where their colleagues work. When asked about concerns, they mention they are curious about how the product came to be and what research the product is based on. Therefore, they would first need more information about these aspects. The product needs to be able to be cleaned. If the product were to go from patient to patient, it needs to be cleaned thoroughly or else there could be contamination concerns since many patients suffer from infections. For example, the supplier could deliver special masks that keep the virtual reality headsets from coming into direct contact with the patient.

When asked about how they would like to be approached, they mention they receive literature overviews from societies related to physiotherapy. However, then there need to be articles about the application. They also mention things that have been in the news: if it has been a news article, it could be repeated by these societies in their communication. This is usually done in the form of a mail or newsletter send by the association. Usually, the physiotherapist scans or reads these mails to see if there are any literature articles they find relevant. They also visit congresses at which they visit stands that present new innovations. They do not make use of any social media for professional purposes.

When explaining the company is also working on a mobile version of Reducept, they mention that this could help since the patient would need to download the application and the hospital would not need to purchase any virtual reality headset. They do say that some patients might be quicker to download something themselves than others. For example, the hospital also has many older patients that might have more trouble doing this. They also mention that there is a difference in openness towards technologies between different patients. However, they do not think that this is barrier.

Appendix G: Interviews Psychologists

Psychologist 1:

The psychologist works on a national product regarding early intervention. Here, psychologists help patients with chronic pain to be able to go back to work. Company doctors refer the patients to them. The patients are then screened to see if they are suitable for the program. These are patients for which medical diagnosis has been sought: either a diagnosis is found or the pain cannot be medically explained.

The main goal of the training is to help patients accept the chronic pain. Usually, these are people that do too much beyond their limit. These are usually people that believe extensive physical training or ignoring the pain is the way to minimise the pain. Together with physiotherapists and movement coaches, the psychologists teach the patients how to change their behaviour. They do not focus on reduction of pain but on acceptation of pain, which usually does lead to less pain. However, they do not promise any pain reduction. Usually, when patients change their behaviour in the long term, they experience usually less pain.

They find E-health a good addition. They use some E-health at the practice, but they do not use it optimally. Also, they feels like they still lack behind. The practice is associated with a research facility. However, this technology does not quickly finds its way into the practice. They use a platform with physiotherapists, movement coaches and case managers. Everyone can add their own exercises for the patients to perform at home. For example, the psychologist uses it to add mindfulness exercises for the patient to work with. The physiotherapists use the platform much more. The psychologist has been told to use it more, now they still give exercises and theory on paper to the patients to take home. They do use the platform for sending messages to groups: this way, they do not need mail addresses.

The reason why they do not use the platform often is lack of time. They do not know the platform yet and they would need to invest time in order to understand it. They were not part of the development, so they do not know all the possibilities and they do not feel personally linked to the platform. They do receive some time to spend on E-health each week, but it is not enough to understand the platform fully. There are too many options and functions on the platform: what is relevant for their patients? Colleagues also don't motivate each other to use the platform.

As psychologist, they feel that human interaction aways needs to be part of therapy. Therefore, Ehealth would function as an addition to the therapy and not as a replacement. They do see the potential to fine-tune therapy per person: some can follow the education quicker than others and, now, there is no possibility for people to follow lessons quicker from home.

Another big potential is to create and share visual content to explain the concept of chronic pain, since this is something not many people grasp.

Right now, they only test at the beginning of the process and at the end. It would be nice to gather more information on patients process through data. Some patients do not provide much information during the consults with the psychologists.

They almost never see E-health technologies or hear about them. There was a symposium about E-health technologies once, but they were not able to attend.

A large barrier for implementation is a lack of time. Also, there are many psychologists who are from an older generation, meaning it would take them more time to learn about technologies. Their affinity with technology is usually less than the younger generation. In combination with lack of time, it makes the implementation process slow and difficult. Moreover, a lack of knowledge about which E-health products exist that have a lot of added value is a barrier. They know they have to invest valuable time into understanding the technology or product, meaning there needs to be a lot of added value for it to be worth it. However, the actual benefits and added value are usually not clear right away. Another barrier could be that some psychologists are afraid they will lose hours if E-health can be a replacement.

Management is really interested in implementing E-health technologies. They are also working together with a college to create a mindfulness experience in VR. If you use VR, it is a unique selling point as a psychology practice, especially since they are directly linked to a research center.

One time, they were asked to use an application to write some data down. This application was created two years ago and is still in a pilot phase. When testing, half of the patients would use the online platform and half of the patients would use paper. Also, there were limitations since it would only work on the android platform. Therefore, it became really impractical for the psychologist to actually use it and, at that point, the actual added value was not clear. E-health could make data more visual and less subjective.

Management needs to allow time for implementation of E-health technologies by, for example, planning a practical workshop on how to work with it. Allow some extra time in the beginning to get to know the platform. Also, a follow-up would be nice to see which problems people run into and to motivate people to use the platform from the beginning.

It would be nice to hear from a patient how they experienced the E-health technology, which shows they have gained something from it that other patients might miss. They want to hear from them how it helped them and what worked better than regular therapy. They are not interested in the business story, but they are interested in the personal story.

They have heard of VR E-health technologies, such as for fear of spiders. They have heard about research. They do not hear about this at work, but due to their own personal interest they see it on platforms such as LinkedIn. They find it hard to imagine what the exact added value is: they cannot yet see the added value of VR in their current training.

There are significant advantages of VR if it shows that the applications are beneficial and of added value to the patient without them losing their hours as a psychologist. However, if it works significantly better than a psychologist, you need to be fair and let it replace the training. However, at first, it should be seen as something to be added to the practice. Moreover, it could help make the patient more engaged and enthusiastic about their training.

They were very excited about the explanation of the VR application, specifically about the education aspect of the game. Moreover, they really liked the transfer aspect of the application: if they understand the concept of chronic pain and what they could do to experience less pain, they might be able to apply these techniques outside during their everyday lives.

After playing the demo, they were very impressed with the application and the graphics. They do see a distraction element implemented. They think it could help people understand the concept of chronic pain, due to the fact that it makes the concept more visual.

It should be a perfect match with the pain education they give at the practice right now. Therefore, the content needs to match the theory they presently give. It should be an addition, and, therefore, it needs to match the theory told so they can link the theory back to the gameplay.

They put a lot of focus on emotions, movements, etc. These concepts would need to return in such a technology in order to really match the program specifically for the practice. Therefore, the terminology could be very different between practices and this could cause problems: consistency is crucial for the patient. Therefore, the product would need to be fine-tuned.

As a psychologist, they would need to know on which theory the product has been based and what the content is of the gameplay related to the educational aspects. Also, the product should not focus on avoidance of symptoms, but it should change the behaviour of the patient.

When asked about websites created for medical professionals, they mention they would need to see the added value for patients. Also, they would like to understand how much time is needed to understand how to use the product and who would use the product. Plus, if it were to be implemented in a training, how much time would it require within the therapy training. They would require a lot of practical information (how many times does it need to be used, can the assistant also help, etc.). They would love to see experiences of clients, as mentioned before.

The homepage should contain the added value: what is the product and why should I use it? When you have a product page, background is good to know: was it created form a business perspective or by professionals with experience in what is lacking in the medical field. For them, pricing is not relevant but for management this information is crucial.

They would be more interested in experiences of clients than a blog. They would trust that, if the product exists in the medical field, then it should work well. They think a page with help and FAQ is good, especially for people who are not very tech savvy. It should provide some technical support as well. Through a FAQ, you can easily support these questions.

They would advise to visit congresses where a lot of medical professionals would come together. They think passing by the company and experiencing the game has more impact than a website, but they do understand the logistical issues related to this. They also recommend to advertise in leaflets of congresses. When asked about magazines they would sometimes receive, not many came to mind. There are some magazines related to rehabilitation which would be nice to advertise in.

Also, contacting a regional manager would be nice since they send a newsletter every so often, which is send to all professionals. Networking with people who have large, relevant networks could share your product with other people. However, these people usually do not have much time to spend and there are a lot of E-health technologies out there. LinkedIn is the platform used most on social media for these types of products. They do not think the other platforms would add value for medical professionals.

They think the product has a lot of potential and like that many people with the right experience were involved in the development process. Especially if it could include a dashboard that could obtain data would be a great addition, since some patients are very difficult to read on how their pain progresses.

Psychologist 2:

The psychologist has had their own practice for about 15 years. They work independently as well as multi-disciplinary with a physiotherapist and a haptonomist. They work a lot with patients suffering from chronic pain. Usually, the patients come to them after accidents.

In general, they state that E-health creates the impression of being easy to use and user-friendly, but there is some resistance in the implementation: how do you start the product, how do I start, how can I actually use it. They work with an online training program which allows them to give homework to their patients. There, patients can follow a modular program as an addition to their treatment. The psychologist has worked with it for two years: now, they know how the program works, but before it was very difficult for them to give patients access. Still, when they receive patients, it is difficult to get them started on the program. They need to explain the program to their patients and explicitly state that the program is very easy to use. If it were up to the patients, they would bring their computer to the consult so the psychologist could install the program and help the patient set up.

They would like to combine their treatment more with current gadgets such as a Fitbit. Another tool they have heard of is called Heartmath. They organised a specific time on the weekend when

everyone around the world could login to a platform through a mobile application, which allowed everyone to meditate together. They showed a world map of all the people who participated. This was not only a good initiative to create awareness for the app, but it was also stimulating because you were using the application together as a group (while maintaining privacy).

However, they bombarded the psychologist with newsletters. This did lead to them knowing about the initiative, but they felt the amount of newsletters was too much. They receive a lot of information through newsletters, LinkedIn and Twitter.

The psychologist explains that they do not feel they have a good affinity with technology and they find this a barrier to implementing E-health technologies. Using technology becomes complex quickly. They would like to have a technician who can set up the product as well as maintain the product when there are technical difficulties. They would like to maintain the role of pure psychologist, since discussing technical difficulties with patients could have a negative impact on the practitioner-patient relationship. For example, their online training program has a technician whom they can call when there are difficulties. They do not want to be the end responsible for technical issues.

If the technologies have technical support, they find E-health interesting since it can help them monitor behaviour as well as being a trendy practice. They like to refer their patients to different applications they can use themselves. The technologies need to be accessible and easy to use for their patients. If patients need to learn something or change their behaviour, the tools they use need to be easy. In case they have a relapse, they can access the application again.

A positive aspect of E-health is that patients can use applications when the psychologist is not available. For example, when the psychologist is on vacation, they can still have their patients do homework at home so they can continue their treatment.

Something that could help them implement E-health would be user-friendliness, preferably in dutch. They notice it can be difficult for patients to use English applications. Low costs can also help, especially if patients need to pay for it. Most of the time, they can declare costs at companies or the liable party in case of accidents.

When asked about virtual reality, they explain that they have a headset at home. However, they also explain that they know how to setup the headset with their phone, but then they hand it over to their children who play with it. They do not know how they would implement the VR headset within their practice. They have not heard of a VR E-health application. They would be curious about the possibilities.

If you only talk with people, some things do make an impact. But supporting this with multimedia, or perhaps virtual reality, could probably have a strong positive influence on the treatment. They want to provide content in as many forms as possible (e.g. video, pictures, audio) so the patient has different ways of receiving content and understanding the knowledge they need to acquire.

They have heard of an E-health application that works with a finger sensor: if you are not stressed, you can perform certain actions. This would encourage people to control their bodily reactions. Moreover, it would make people more aware of what is happening within their body.

When asking about possible barriers of implementing virtual reality, they think their lack of technological knowledge would be the main one. They would not know how to start the product, therefore they have a lot of worries about the technology. Furthermore, they explain, they did not even know it existed.

Reducept is explained to the psychologist, who reacts that they know the theory of 'Explain Pain' the product is based on. They think it is a very useful product. Some people don't find it sufficient to only hear about the education. They reckon that, through virtual reality, patients can understand it better and make the knowledge more their own. They explain that the concept of pain can be difficult to

understand and that language is an important factor here: once you have created the suggestion that pain does not exist, the patient does not listen anymore. You have to be very careful on this subject.

The product would generate the same education every time, this can be a positive factor. They explains their story could change sometimes, since they choose different words per patient. Usually, they give homework where the patient needs to look at sheets which explain the theory of 'Explain Pain'. However, 9 out of 10 times the patient does not actually look at the sheets. They do not want to look at the sheets during their consult, since this would be time-consuming as it can also be performed at home.

Therefore, the gameplay should not be too long. After explaining the pain education is 30 minutes and the different gaming elements are 10 minutes, they say it could fit in a consult. They would like to be able to see what their patient can see through the VR glasses. The researcher explains this can be possible through additional technical measures, or you can listen with the patient to the audio. They think the VR could help explain the concept of chronic pain to their patients.

Since they work independently, they cannot have another employee help them set up the VR headset or instruct a patient to use it while they do other work. Giving the VR headset home with a patient requires more administrative work where the patient has to sign for the release of the technology, etc. Whilst talking, they see more barriers: what if the product breaks? How does it work with the costs?

They would also need to know what the education entails and how the product is supported technically.

They would also like to have a flyer or folder which they could give to the patient to read at home. This way, they can prepare themselves to what will happen when they use the virtual reality application. They have a large variety in patients regarding age. Especially the older generation would need to understand and prepare for what can happen within the consult.

The information they would like to see on the flyer include what virtual reality is and the research behind the product. If they need to declare the costs to the company and liable parties, they need to be able to provide a quotation with a product that is evidence-based. The evidence will show that it is not just a fun game to play, but that it has body. They think they could distinguish themselves as a practice.

When asked about how they would like to be approached about new E-health technologies, they explain they had a negative experience before. They had subscribed for a newsletter about an application, but they received three newsletters in one week. They unsubscribed quickly: it was too much. It is about frequency and the length of the information: short but sweet is best. Moreover, it should be based on something and it should be researched. This is the first thing that should be communicated.

They follow people mostly on Twitter, and sometimes LinkedIn. They follow research groups dedicated to pain and people, but not companies. They do not use Facebook for this purpose. There is also a magazine called "the Psychologist", but it can take a couple of months before they actually open this and read the magazines.

They just saw that there was a new forum on LinkedIn created specifically for pain psychologists, which they immediately started to follow. They do stress that it is also easy to miss these kinds of messages on social media platforms if you don't visit often or have not visited in a while.

When explained that the company is creating a mobile version of Reducept, they think this can be of a lot of added value. They can use the real VR headset at the practice, but they can see it again at home. Another important aspect is that patients can then also share it with their partners. It is important that partners also understand how pain works. If they only associate pain with damage in the body, they could have a counter effect on the progress made during the sessions. Currently, they

always advice patients to look at sheets of 'Explain Pain' together with their partners, so that both are on the same page. They notice that everyone has read something about everything and everyone has an opinion, which can make it difficult for the patient to stick with what they have learned.

Appendix H: Interviews General Practitioners

General Practitioner 1:

The general practitioner (GP) works as an acting GP, meaning they are hired by different practices and they also work at doctor's services outside of normal working hours. In a year, they work at about four different practices. Therefore, they have experience with different GP practices and they see varying workplaces.

They think E-health could be really nice when it is an addition to the services you already offer as a GP. Their partner works with E-health and, therefore, they hear more about E-health than other GP's might. Currently, E-health is not used often at GP practises. One of the only things they have heard about is that the practice assistant makes use of an online website (called 'Therapieland', English: therapy land). The website offers psychological care for people with sleeping problems, mood problems, who are overstressed, etc. People can login from home and follow a program. Also, some GP's have systems so patients can make appointments online.

At congresses specific for GP's, there is more attention for E-health. There are already a lot of E-health technologies, but not many of them are actually being used, which is a waste of possibilities. During their own studies, they did research on E-health for a GP practice, but that research also stranded somewhere. A lot of time and money has been spend, but it never made it to the patient.

There are different practice assistants, who are educated as nurses, one of which is GGZ (Geestelijke Gezondheidszorg, English: mental healthcare). These are the practice assistants who use therapy land. A patient can be signed up for the platform and they can follow a program in addition to their normal contact with the practice assistant. The GP can refer patients to the practice assistant once they have determined the urgency: if it is an urgent case, they receive more intense treatment straight away, otherwise they see the GGZ practice assistant.

They are very interested in e-consult. However, the acting GP usually does not have a secure internet connection, meaning they would not be able to work with e-consult. They know some GP's who use it. However, since they are only at the practice for short times, they were not taught how to use the program or they don't receive the proper access to it. This system could mean assistants receive less phone calls, but it could also mean that GP's receive a lot of mail since they are not being filtered.

Implementing E-health costs time and energy before you can fully use it. However, there really is not any extra time. A lot of times, the E-health is also not reimbursed. For example, if we look at a product such as Reducept they think it would be really nice to offer but the time spend on implementing, the money spend on the device and licenses should be reimbursed. Moreover, GP then also does not know for sure if it will work. In general, GP's are very practical: they need to know what it is supposed to do, it should be easy to use and, favourably, they would like to outsource it. Furthermore, they have to know how it has been researched. If the product could be outsourced, someone at the practice has to be educated on how to work with the product. This, again, requires time which there is already a shortage of.

They state that many GP's are focussed on the tasks at hand and making sure the practice is working. There is a shortage of GP's, so there is not much room to think about new things or changing the way they work.

There are some things that can be improved at the practice in their opinion. Sometimes, there are practices that are connected to a pharmacy. Every year, GP's will get a reminder about a specific

function and medicines to be updated. This can be coupled to blood-work being done. However, if a patient has their blood work done at the hospital, it does not appear in the system of the GP. When the blood-work is done at the GP practice, the specialist does receive the result at the hospital. Sometimes it can happen that people need to do blood-work twice because the GP does not know if they have done it recently. Right now, there is a pilot going on concerning this problem.

Time should be made available to get to know the E-health technology. If a practice wants to incorporate E-health, money should be made available for this, also to pay someone for the extra hours this will cost. GP's are in contact with health insurances. They have money set aside for E-health and innovation in healthcare, but it is not easy to receive this money and there is less money available than a couple of years ago. Especially if it has not been proven yet that the E-health technology really works.

Since their partner is working with VR technology, they sometimes test the VR E-health application. Before that, they had never used or experienced VR. At congresses, they sometimes see stands with VR E-health technologies based on psychology, but they have never tried it. At the university of Groningen, they have heard they are working on VR technology to help with fear. When thinking about VR E-health technologies, they would really like to see evidence what kind of effect it has. Also, it is important that it works better than regular therapy.

If the VR E-health technology can help people and is better than current solutions, they would love to use it at the practice. Advantages of VR could be that you could incorporate new therapy methods for patients that, previously, always needed to be referred to a specialist. Through VR, you might be able to treat the patient at the GP practice. Disadvantages are time and money investments. At this point in time, there are not many E-health technologies for GP practices, so there also is no need to choose between which problems to focus on. However, if there are good E-health technologies for all different types of patients, you might need to hire someone to manage all the technologies in the future, but that is still very far away.

They would already love to use a product like Reducept, since there are many patients that are very difficult to treat (somatoform disorders) such as chronic pain. This is a group that do not have many treatment options. Therefore, they would love for these patients to try the product. As they are personally related to the product, they state they are biased in this matter. They also acknowledges the dilemma of getting this product under attention by other GP's. To be able to implement the technology, they would have to know how much time it would take them to learn how the product works, how the patient should be supported and how many times the patient would need to see the GP for this. However, if this can be outsourced to other employees, that would be nice. However, this would also cost them extra time. Moreover, who pays for the product is extremely important: is it the practice or is it the patient?

A very important aspect is that more thorough research needs to be done with large test groups. Preferably, in a randomised controlled trial. Moreover, the product is in a beta phase, so it first needs to be completely finished. They state that, since their partner is a psychologist, they are more likely to refer people to a psychologist when they experience chronic pain. However, other GP's might not make this referral as quickly as her.

Usually, when they see patients, they have already been through the entire healthcare system. They already go to a pain polyclinic, which is located in the hospital and part of the anaesthesiology department. Patients are referred to there to see how they can manage their pain. However, here they do not receive any pain education, which the GP feels should be offered to all their patients which is a gap Reducept might be able to fill. Referrals to pain polyclinic is at some GP's practices very usual whereas in other places it is a lot more rare to be referred there.

If a polyclinic or physiotherapist would use a product such as Reducept and they would contact the GP to let them know it could help with a specific type of patient or problem, this might be more practical. If someone is working with it and tells the GP that it works, the GP would much quicker refer

patients to this specific practice to work with the product. This would work best through the form of a letter directly addressed to the practice. For example, if the company provides the physiotherapist with the information to send to the GP, they could be supported in this matter. Moreover, this could help get the physiotherapist more patients as well.

Websites are usually used by GP's when they don't know something. They like it when there is a direct link for information about referrals, so they know where they need to look. They like the idea of being able to select a profession to which the website would adapt.

For the homepage, they would like to clearly see what the product is and what it is for. Sometimes, patients will tell the GP that they want to be referred to the product. After, they would like to see where to get the product or how to refer to the product. It would also be nice to see which institutions within their neighbourhood have the product so they can refer their patients there.

GP's want a short and practical website without too much text to read. However, for patients it would be nice to find more information. They give an example of a website they use a lot, called <u>thuisarts.nl</u>. Here, patients can easily find more information: instead of providing flyers to patients, the information is now stored online on this website. They can explain things to the patients and then refer patients to that website to find more detailed information. Therefore, it would be nice if the website of Reducept also has a section for this to explain VR in E-health and how the product works, etc. This is not always relevant for GP's, but it would be nice to refer to patients so they can understand.

The price information should be able to be found on the website (including reimbursement possibilities for both patients and GP's). For Gp's, blogposts and articles are not really of added value since it would take a lot of time to go through all this information. FAQ and support would be really nice for GP's: easy to find and quick answers to common questions.

They have a subscription to several associations that also send magazines. These magazines are specialised for GP's. The GP gives two examples (medisch contact and LHV: Landelijke Huisartsen Vereniging, English: National General Practitioner Association), in which they sometimes see articles about E-health. There are also newsletters send to GP's, which are generally scanned. If it is interesting, they open the link to find out more. Sometimes, flyers are send to GP's practices, but they can quickly disappear in the trash. Sometimes, less than before, pharmaceutical companies come by GP practices to talk about new medicine. However, GP's try to minimise these visits since it costs time. Also, they follow their rules and guidelines and they will not just try anything in their practice.

Personally, the GP does not use social media. The older generation also do not use it for this purpose. Sometimes, associations such as medisch contact are active online on social platforms, but the GP does not work with social media.

When asked if they would like to see a video about the product on the website, they reply that it is very dependent on the length of the movie. When you see it for the first time, you don't know what the movie is about or if it will be helpful: text is easier to scan in that sense. Also, if the patient is there with the GP, it might be impractical to watch the movie. Usually, instructional movies can be very helpful.

In general, the paper mail received by the practice is filtered by the secretary. Here, commercials might be thrown out, but letters from other practices such as physiotherapists will be given to the general practitioners. Also, if mails are send, they advice to send it from the practitioner and not from the company.

General Practitioner 2:

The general practitioner (GP) indicates that they do not work much with E-health currently. They doe see patients working with smartwatches or applications on their smartphones who can show them graphs or data. They mention that those are the patients who are motivated to work on their health. They have had a general training about E-health technologies, but there are a lot of new things. As a

GP, they already have a to of pressure and everything else that adds to the pile of work is too much. Therefore, they usually see E-health as a burden, although they do also see the potential added benefits of E-health technologies.

If a patient shows them graphs created through monitoring devices, they see that the patient is generally motivated. Usually, there are connections that can be seen through these devices (such as gaining weight and higher blood pressure), which can motivate the patient to lose weight. Using E-health with unmotivated patients is very difficult. Having patients see direct results or feedback can be very positive.

Currently, they do not use E-health within their practice. Through training, they have heard about hospitals who monitor patients at home. However, the GP is not usually part of this process. They had a training about making people live healthier where they showed different options, but it came across as just being a lot of work for the GP.

If they were to come across a product that has an added benefit to them or the patient, they would not mind spending free time on learning how to work with the technology. Then, it would be an investment. All changes need time and attention before it can actually happen.

There might be a lot of different E-health technologies, but there is no clear overview of what is on the market and how it can be used. There is a lack of information on the existence of specific E-health technologies. Moreover, many treatments already have concrete protocols.

At this point, there is no reason to implement a specific E-health technology. If they were to come across a good product, they would consider it.

Many different patients with different kinds of medical issues visit the GP. They would like the possibility to refer a patient if it has an added benefit for the patient. Patients do not often ask for a referral: they are also not aware of which products there are. If patients do ask for something, it I can be difficult to understand what the referral is for. They then ask patients to find certain information to be shared: they do not refer unless they knows what they are referring to. This also costs time to figure out.

They prefer to read on paper instead of electronic mail. Therefore, if patients send information by paper mail, they would read it. Also, other practitioners can let them know what they offer and they discuss this with their colleagues at the GP office. They also prefer this to be on paper, since you can share it more easily.

Currently, people cannot schedule an appointment online. The program can actually do it, but it is not being implemented yet. They describe this as cold-water fear: currently, patients describe their problems to the assistant after which a risk analysis can be made. However, if patients were to make appointments online, the practice loses this control of directly helping the patient and assessing the severity of the medical problem. It is not complex how this E-health technology works, but the question lies in how patients will use the system. It is also difficult to assess how much time the GP should spend with the patient.

However, when the GP reads the experiences of other colleagues, they are all very satisfied with an online planner. They read these experiences in magazines about E-health. They also think it is time to allow these type of tools. Patients also prefer this over waiting in a call for an assistant. Currently, however, none of the GP's use it yet.

They have an example where they used another program first to directly communicate to the assistant. After their good experience, the rest of the practice also adopted the technology. One has to be the first.

They have never used a virtual reality headset before. They have also never heard of a VR E-health application. Therefore, they also have no opinion about virtual reality being used in healthcare.

After explaining Reducept, they think it sounds like a good product and helpful, but they do not think they have the know-how to explain how it works to patients with chronic pain. They can imagine that technical or medical support comes to the practice and helps them, but they do not think they will do it on their own.

It could be a prescription: if the product is good and clear for all patients (not all patients are the same). Not everyone understands everything or patients might find things complex. The GP can imagine the older generation might have more problems using the product. If it is a stand-alone product, and it functions well, they would not mind prescribing it to patients.

The product needs to be proven and researched. It needs to be user-friendly and easy to use. They also want to see it for themselves: then they can explain some things about it to their patients, but they would need to experience and see it for themselves first.

When there are chronic pain patients, there is a standard which explains the treatment such as going to a pain center. Sometimes, patients still return with a lot of pain, and that is difficult to see. The amount of medicines being used by patients with chronic pain is a big problem, also for the future. They see an increase of this problem where patients become more dependent on the medicine.

If a patient wants a referral to something, the GP does look for information so they know what they are referring the patient to. They also explain it is nice when a website explains how someone can give a referral to the patient.

On the basis of a website, you cannot always get a sense of the organisation and how trustworthy it is. It should somehow show quality or accreditation. It needs to be clearly structured. Sometimes, a website has specific parts for patients, referrals and practitioners.

They would prefer promotion for E-health through the post or in magazines. They almost never check their mail at the office. They do work with flyers. Previously, pharmaceutical industry would visit the office regularly once per week, but they have ended this since they do not have time for it anymore. Moreover, they did not hear about anything new. If there would be something really new, they would not mind spending some time on it. The GP does not work with social media.

Every two years, GP's will receive training on a regular basis. In their region, there is a bi-annual training where all the GP's of the region gather together for a training of three days with a diverse program, including E-health. Devices could be presented here if planned by the organisation. Usually, they are more focussed on medical education and new developments.

They also mention they do not have much affinity with technology. This triggers a thought that they do use a form of technology within their practice: it is a device that checks if you are breathing when you are sleeping. Previously, it would be done in a hospital, but the device can now be used at home. They have participated within this research. They have implemented it within their practice and can give it to their patients. If the results show the person does occasionally stop breathing at night, they can go to the hospital. This way, not everyone has to go to the hospital for the test. However, if the patient is referred to the hospital, they do still have to repeat the entire test just in case. It is more user-friendly, friendlier for the patient, not stressful for the patient and it is cheaper. Therefore, there were a lot of advantages.

Regarding the research they participated in, they do mention that if such a device has been created, you need practices to try it out. That is why they do want to participate, to help test the device so it can be used more broadly if it has added benefits. In a research environment, it is much easier to try and implement it.

Everyone at the practice has now had the training and the program is installed on the computer. It is outside of the medical system, but it is on the same computer. For this, you have to ensure that the computer does not become more liable for viruses. For their current system, they have double verification. If a dashboard can be accessed in a safe way, it is possible to be used.

At the practice, they know the practice assistant sees patients with chronic pain. Also, there is an assistant dedicated for the elderly generation. This assistant has more time with a patient (one hour), which would allow them to have more time to use such a technology. Time is a large barrier in the implementation. Costs can be a barrier: for the practice, it is dependent on the amount. If the patient needs to pay, the patient needs to decide whether they are willing to spend the money. Through reorganisation, there could be more specialised assistants who might be able to work with such technologies.

Currently, they also send pictures to a dermatologist who gives back advice. This way, the patient does not actually have to visit the dermatologist. This is both cheaper and it saves time. The dermatologist approached the practice. The dermatologist is from a different region, meaning they also receive more patients.

They are positively surprised by the fact that they do use technologies within their practice.

Appendix I: Interviews Healthcare Innovation Managers

Innovation Manager 1:

They have been working for some years to create structure regarding innovation and research for their organisation. They are also program manager innovation and expertise. Their background is in management and they focus on management quality and evaluation. They have recently shifted focus from people management to innovational and expertise management.

They recognise what the researcher said about the difficulties regarding implementation. Healthcare professionals really like to think about innovations. However, if there are innovations, it is difficult to implement them. Practitioners are educated with existing work processes. Therefore, they use innovations besides their usual work processes, meaning it is seen as additional work. To change the whole work process or even a part of it to implement the innovation is difficult.

Moreover, innovations have a long development process, meaning they need to have large returns financially. Therefore, it is usually costly. Unfortunately, the healthcare sector is usually not blessed with a lot of money. This is an additional barrier for implementation. Since, usually, it is not been proven yet and the return on investment for practitioners is not clear, they will be hesitant to use it and they will wait until more evidence is available. However, this is a chicken-and-egg discussion, since someone needs to implement the innovation to provide this evidence.

An organisation will need to say that they want to innovate and are willing to invest something and facilitate it. On the other hand, companies need to look at how they can remove some barriers to help organisations implement their product.

They have an example where collaboration was really good. They are part of Medical Delta, which also includes Erasmus TU, The Hague University and Leiden University. They are part of Living Lab in the healthcare. Here, different innovations can be offered. One of these innovations was a walker called Leia which they wanted to see if it could help in geriatric rehabilitation.

They want patients to go quicker from clinical to ambulant care. They thought the Leia might support this, since it can be a bridge from clinical to home. Theoretically, this seemed like a good match. Practitioners were very enthusiastic. However, two weeks after having Leia at the organisation, it had only had been off the charger once and it was never used. They then matched the Leia with one person who could use the walker well. However, people view the walker as an addition to treatment that also needs to be used, instead of replacing the walker equipment already being used. Then the conclusion is that the Leia is not suitable. However, the practitioner needs to think differently and see if they can be more efficient and innovative.

At the beginning, it should have been communicated that the practitioners would need to invest time to understand the Leia and that the practitioner might win time in the long run by being more efficient. This can be difficult, since the technology does not have any evidence yet, so you need a believer to use the technology and see if the efficiency can be discovered.

The challenge of the innovation manager is to stimulate practitioners as well as facilitate them through management. These are two parallel tracks. For example, the practitioners need to focus on the quality of the product and the managers need to focus on the financial aspects and providing additional time to understand the product. They would provide an x amount of hours, with the request that the Leia would be used instead of a certain aspect of the traditional treatment. The practitioner decides what this replacement should be. A practitioner's first reflex is that they do not have the time.

Therefore, the innovation manager needs to provide this time and convince the practitioners that the product could be of added value. Together, their goal should be to improve quality. Through evaluation, you can discover what this improved quality is.

In general, their personal view is that E-health technologies of added value need to be used due to the ageing and de-greening of the population. Therefore, more people will need care, but you will have less staff to provide this care. Therefore, the work processes need to be re-organised. E-health is one of the tools that could make this happen. Therefore, all innovations need to be seriously considered to see if they fit within the work process.

Furthermore, their mission for the upcoming years it to convince the healthcare professionals that, when they encounter problems, they should not be frustrated but think about possible use of E-health solutions. That means there needs to be a structure in the organisation where the professionals can bring these problems and questions they experience in their work. Healthcare professionals might not know what possible solutions there are, but they do understand the problem thoroughly.

Currently, healthcare professionals are communicating their problems, but it should be done more often. The innovation manager tries to enter the deeper layers of the organisations, so the actual people who work with patients. There are many time-consuming activities there which could be partly supported. They have good connections with knowledge institutions mentioned before, who want to think with them about technical solutions.

They are using more and more E-health technologies, but they would like to see more of them. Right now, it is more from the push-side, but they want to generate more need from the healthcare professionals in order to be able to find more pull-solutions.

They have heard of different platforms such as zorgdichtbij.nl. This platform is based on technology and creates solutions personally for the patient. This allows patients to ask any question or problem they might have, after which the platform provides a tailored solution. The innovation manager indicates that they hope they can cooperate in a pilot concerning this platform.

They have heard of this platform through an extensive network. Moreover, their organisation makes it more and more clear which types of solutions they need, opening up windows for external parties to contact them if the companies's solution fits. The organisation indicates they are very willing to meet these companies.

E-health is a huge market. Therefore, they are searching for regional solutions so they can keep an overview. Sparsely, they are working with medical devices and wearables. They are convinced this will grow. This is dependent on the mindset of the practitioners and nurses, as well as the reliability of the devices and applications themselves.

There are some overviews that show the validated applications and devices, but they are not widespread yet. They have contact with the NEL, which is an institution that researches all of the E-health applications. They try to find the good E-health applications in the abundant offer. They also perform studies with E-health applications. Consumers of the applications are dependent on the researchers that thoroughly determine the validity of E-health applications.

When asked about the barriers of implementation, they mention that the container concept is culture. There is a production culture in healthcare, meaning you need to produce to obtain money from insurance, etc. They all require quality and volume. It is up to the organisation on how to make this happen. Thus, the pressure of production is quite high. This means that there is not yet an innovation and research culture, since the experience is that this takes time away from production.

At the beginning, an investment in time needs to be made to understand and implement E-health. Companies could help in this regard. For example, the company offers to help with the first couple of months to hep with the implementation. They could be the project leader, administrative support, etc. Once it takes off, the company leaves and the organisation can take control.

Moreover, they advise start-ups to not sell a product, but to lease a product. This includes maintenance care, update support, the best products and support when the device breaks. With innovation, if something does not work well, the professional will not use it. If someone can provide technical support, it helps them to use the product. It is very practical, but necessary to create a good first impression.

When asked about VR, they explain they think VR has a lot of potential and future. At the organisation, they use VR for providing caregivers an experience of dementia to understand the patient better and to understand what dementia actually means. This can be a shocking experience. Therefore, now, there are two employees present who will be there after you have finished to have a conversation about the experience you have just had. Many people ask for this application. They also think there are applications possible for other issues, such as for rehabilitation, fall-prevention, loneliness, etc.

In general, the new technology need to be accepted. If it is not accepted, it will also not work. Moreover, there is also much unknown about this technology. This might reduce over time when it becomes more standard to use.

After explaining the product, they state that their clients have chronic pain, but they usually also suffer from cognitive problems. Therefore, they state, this should be tried out. They see more potential in the home situation, especially since the overall goal is to have patients stay at home as long as possible. There, they see a lot of added value.

Their first reflex is to ask for more evidence and to ask which research has been performed. This is usually also a culprit, since many innovations do not have this yet. Therefore, they would need a good demonstration. Also, as organisation, they would like to provide input in improvements for future development.

From the business side, they would need a financial overview. Also, they would require knowledge about the maintenance that is needed or updates that need to be installed. They would need to know the entire package, not just the product or the application. After-sales, or follow-ups, are important: the organisation would want the newest headsets, etc.

The organisation utilises different channels for financial reimbursements or grants. For example, through medical delta or living lab, they can obtain some financial support for implementation. Moreover, they also ask for sponsors or crowd-funding campaigns to purchase some equipment. There are also more serious players, such as the SET- regulation, which are stimulated through the government. This regulation can be used when an E-health application is sparsely used, and you want to help upscale the application.

It is not aways easy to know all the financial possibilities. You sometimes see them in newsletters. However, requesting the grants are usually not very easy. An example of an easy request was when they needed to partner with another organisation who already uses the E-health application. A more difficult example is the SET-regulation, which has a lower limit of 125.000 euros. However, the organisations needs to guarantee half of this money, which is still a very large amount of money.

They do make use of websites when people send them a link. They like it when this link also provides an authorisation to actually try the product online. This might be more difficult for VR. For a platform, however, the website could provide general information and a try-out for the platform to play around with it. Asking for a demonstration is an additional step that needs to be undertaken. Their advice is to make an experience-video to share. They do mention that videos cannot always be played in healthcare institutions due to security regulations. Showing a video could create a positive feeling amongst the healthcare professional. Also, the practitioner will always watch a video from the perspective of the client. When creating a video about how to implement the product, also use some time to show what you see when you wear the headset.

They hope an overview will be made available where different applications are shown with a rating or validated/not-validated. This overview should show how usable, how valid the applications are. At some point, you make a decision for one application. But once you have made a decision, you cannot compare anymore. Therefore, a plan needs to be made and agreements need to be made, but only after a decision has been made on which application to use.

When asked about if they use social media to find E-health, they say they do but limited. They usually do not use Twitter or Facebook. They do make use of LinkedIn. They usually receive forwarded messages from colleagues. This is, then, already paired with some sort of recommendation from peers. LinkedIn is more easy to use for them than other social media platforms. They feel LinkedIn is more professional.

Another more important thing are the newsletters. Different interest groups send out newsletters, for example focused on Parkinson's disease. They scan these newsletters since these interest groups spend more time on finding these applications than they can spend on this. Therefore, they advise companies to connect with these interest groups and be featured in such newsletters.

Regarding the mail, they do scan them, but word of mouth works better. Personal mails work a lot better than push-messages. They like to find things through their network.

Innovation Manager 2:

As healthcare innovation manager at the hospital, their function is to try and implement E-health applications and to validate them through research programs. Here the introduction to technology is crucial. Besides working as a healthcare innovation manager, they also work as a professor at the University specialised in E-health, also referred to as technologically supported healthcare. Here, they think of new concepts to help optimise the healthcare sector as well as to think about what healthcare will look like in the future.

Moreover, they are chairman of a regional platform where different organisations come together to discuss the impact of and changes needed to implement E-health technologies. It is important to work together to make change happen. The educational systems are involved because the healthcare sector needs to adapt to be able to work with technology, the insurance companies and municipality are involved due to the financial matters involved and the different practitioners and healthcare institutions are involved. It is important to innovate on a social level.

E-health is the future, because we cannot do without. Right now, there are 140.000 vacancies in the healthcare sector that are not being filled, since there are no more people who can fill these jobs. Therefore, we need to see what we can do with technology in order to have human availability where it is really necessary in the healthcare sector.

They research with healthcare institutions what can be done with E-health applications. They see most potential in accessible and close-to-home E-health applications for implementation at this time. For example, e-consulting or other communication platforms that allow the patient to stay at home rather than visiting the healthcare institutions. In the future, data driven healthcare can be very important where systems can be self-taught such as predicting diagnosis. This allows for more preventative healthcare.

The solution is that the patient needs to change. After the war, we became a welfare state. However, it is not possible anymore that the government is responsible for our well-being.

Right now, they are working wit a diabetes roadmap. Diabetes type 2 can be 'cured' through a healthier lifestyle, which would save costs and would save people from suffering. There is not much

time for lifestyle coaching. Therefore, through technology such as a personalised buddy, it can help people change their lifestyle to become healthier. This can be radical innovation.

Regarding the barriers for implementation, they mention that what someone does not know, someone does not much care for. There is a lot of pressure on time in healthcare, there is not much time to systematically work with E-health. Technology is not the issue, that is possible. Of course, one must focus on privacy and ethical aspects, but this is not the issue.

However, the professionals and the patients need to adopt the technology. At first, they might be reluctant to use E-health at all. If they are wiling to try, there are too many products available on the market and it makes it difficult for them to know what they want. This is something they need to be guided through. Something as "simple" as video-calling starts with a secretary having to make the appointment, followed by the patient who has to install a certain application. If there are problems, a helpdesk needs to be involved. Therefore, time and space needs to be created for this implementation. Healthcare innovation managers have this time to perform this change in processes and change management when needs to occur.

Also, finances are aways a barrier. You need to be more creative in the whole process to see what the financial options are.

They already use VR a lot in the healthcare sector. They mention relaxmaker, which helps patients through scary things. For example, it is being used for the dentist. They had the ambition to make it MRI compatible, since many people have a fear of MRI scans. They see many opportunities there for virtual reality.

They also sees potential in virtual reality for elderly people who are disoriented in the hospital. Through virtual reality, you can bring a sense of home to the hospital, which allows patients to be in a comfortable and recognisable environment.

They have also seen VR for fear exposure or behavioural change. Through VR, you can build experience of being able to perform a certain task and to create more self-efficacy, which is vital for behavioural change.

Patients accept everything, also the virtual reality. The practitioner or healthcare professional really needs to accept the technology. At this point, virtual reality is still a gambling factor. They can more quickly imagine it being adopted in the e-learning environment, where people can learn in the virtual environment. Right now, VR is still far from the actual healthcare world. There, acceptation is not yet relevant. First, it needs to be determined what it is, what it does and what it can do. Moreover, concepts need to be sharpened before it can be accepted.

After Reducept is introduced, they reply that collaborating with healthcare professionals and practitioners is a good starting point. Many times, collaboration does not occur and that is a problem. This can create a push effect from the business side, which then won't be accepted or implemented well within the healthcare institution. Moreover, healthcare professionals you collaborate with can tell colleagues what the product is and why it is important. Now, it is also important to validate if others also like the product. Through a pilot study, this can be done quite well.

When the practitioner decides they want to implement virtual reality, a question will need to be addressed of who will pay for it. What we regard as practical questions, that is the core business in the healthcare sector. Furthermore, generic applications are not really possible: there are always specific parts of the application that needs to be adapted to the institution.

Their main doubts about Reducept would be that there is no time, no knowledge about the product, not knowing what to do with it, it does not fit with the current systems and the question who will pay for it. They believe that VR is not there yet and these issues will only become relevant in five years

when the healthcare sector is more ready to adopt such technology. Right now, it is still in the phase of developing a concept and creating more awareness for it.

When asked how to create more awareness for the product, they say you need to go to congresses and meetings and ask if you can showcase your product there, more missionary work. This should not be under-estimated. In a previous project, there was someone who worked full-time to visit centres and practices to see if they want to use it. Healthcare institutions then can quickly take one year to decide if they want to use it at all.

Appendix J: Interviews Healthcare Enthusiast

Healthcare Enthusiast 1/ Coach for Innovation in Elderly Healthcare:

The interviewee focusses with their work on change in the elderly healthcare domain. This includes the implementation of technology, as well as working more closely together and working from a specific vision. Here, they have different roles such as speaker, coach and project leader. They notice that there are a lot of issues when looking at implementing new technologies within the healthcare domain.

They have worked with E-health themselves: they worked on a project where chronic patients would receive a device to be attached to their television to allow for monitoring in their homes. For this specific project, the interviewee worked closely together with general practitioners. They also advised to take a look at the website of <u>vilans.nl</u>, which includes several articles about implementation of technology within the healthcare domain.

A while back, there were financial possibilities to be able to integrate technology, specifically in the elderly care. However, this resulted in the fact that everyone would focus on the technology and that something should be done without it, whereas the healthcare professional was not specifically asking to use more technology. Therefore, technology has been pushed, resulting in failed projects due to the absence of ownership by the healthcare professional.

There are three major players when it comes to the need of implementing technology in the healthcare domain. First, the organisation could strive to be innovative, therefore they feel the need to implement technology. The second can be the patient or the caretaker. The third can be the healthcare professional. However, only a few healthcare professionals are actually saying they want to implement more technology: bluntly put, they are usually more focussed on today than tomorrow. The ones that do, sometimes even switch to IT companies.

Right now, healthcare focussed companies are recruiting healthcare coaches to try and fill the gap between company and healthcare professional. What is crucial for an E-health product, is that it should help the patient while also being accommodating in the world of healthcare. Systems need to work together with systems already integrated in the life of the professional. If you want to implement an E-health technology, ask the healthcare institutions which infrastructure they currently use within their practice and ensure your product can be integrated within that system. This will allow for data to appear directly in the system of the healthcare professional. The absence of this is the reason many Ehealth technologies are not being implemented or used. In summary, be an addition to their current system.

VR is being used more often in the elderly healthcare sector. For example, for people suffering from dementia, there is a VR application that is focussed on triggering memories by showing how certain places were some decades ago. Another example is a VR application where the healthcare professional can experience and understand what the world of someone suffering from dementia looks like. Slowly, glass (Google Glass) is slowly being accepted, experimented with and implemented within the healthcare domain. Therefore, the healthcare is gaining experience in working with such devices. You also see an increase of VR in the educational sector.

They don't have questions or doubts about the technology, since it is a tool to reach a result. If the result is being achieved, if it connects to the world of the professional and it works effectively, the tool does not matter. However, embracing new technologies is a very slow process. There is no resistance in accepting new tools, it just takes a long time to implement and accept. The culture around

healthcare is very focussed on the interaction between two people, which leaves little room for technology. Also, the reputation of E-health within healthcare is not very high, meaning you really have to show that your technology actually works and helps. Right now, there are too many examples where it went wrong. They said that new healthcare professionals might be enthusiastic, but people who have been working in the healthcare sector for a longer time are usually not excited about it.

Healthcare is very pragmatic and has needed to change a lot of times to accommodate technology, where it should have been the other way around. An important factor here is that management decides technology should be implemented in a hierarchal manner. Right now, there are a lot of grants being made available for E-health: this is a trigger for companies to start making E-health technologies. However, there are only a few companies that will ask what the need actually is. Companies are creating gadgets, but the healthcare sector is not looking for gadgets. Therefore, there is a mismatch. The push to create E-health technologies is money instead of a need.

The question is raised if a website is necessary. A website is always good to have, but if you look at the world of a healthcare professional you will see that not many will Google to find information about which E-health technologies are available. There is also too much to find on E-health online, meaning they probably won't find your specific product. Therefore, they suggest it is also interesting to look at other possibilities.

For example, you could put information on specific facebook pages for nurses and caretakers. It is not easy to become a member but, perhaps, you can ask a question. If you send e-mails containing a PDF, people will read this quicker than visiting a website. Therefore, you could also design a leaflet or factsheet with a focus on the problem and the patient, the intervention and this is the validated effect with a call to action at the end. You can also put this in magazines and profession-related magazines or send it to innovation managers. It is interesting to look at where the innovative nurses are and address them directly. The interviewee specifies that you can take two approaches: you can create a lot of awareness everywhere, or find a focus on a couple of innovative healthcare institutions and increase the scope later on. Also, go to congresses and make personal connections there. However, an obstacle here is that you need to find the right people.

A lot of organisations are recruiting innovation managers. If you make a personal link to one person, figure out where the innovative party is and directly link them. Giving the individual person material is usually lost and does not reach the right person in the organisation. The interviewee says that there are two types of organisations when focussing on implementing innovative healthcare: those who are intrigued by the grants and those who are intrigued by the need. The latter are the organisations you need to approach and connect with.

LinkedIn is another platform that has networks of nurses that are being used. You also have innovation circles or networks within the healthcare. However, then you target more individual people instead of organisations as a whole. The better you understand the world of the healthcare professional, the further you will get.

In summary, go to congresses, try to reach the media, be published in professional literature or magazines, use social media and have one A4 factsheet with visuals and colours. Ensure to focus on what it will add of value to the patient or the healthcare professional. Name your partners or the professionals, since they help support your product.

On a website, you usually see a lot of company information: what is the company, what do they do, what is the product, etc. Usually, they are filled with nice stories but no practical information. When asked about what should be added on such a webpage, they mention that the homepage should contain four steps: this is it, this is what it can do, this is how it helps the patient and this is how it helps the healthcare professional. Do not focus on the technology, but focus on the content and the implementation.

Make sure you emphasise the "for healthcare, by healthcare" principle. With that in mind, look at the hospital-like institutions, the nursing home-like institutions and the home situations. On the website, you have to quickly focus on what your (read specific type of healthcare institution) patient's benefits will be. The institutions need to feel a match between what they are doing and how the product can be integrated: it needs to feel close to their world. Perhaps, select a workplace to which the website will adapt. Websites are usually very generic and written from the perspective of the company instead of from the perspective of healthcare. Moreover, keep it simple: not too much text, lots of visuals and use of colours.

When asked about how to approach general practitioners, they replied that this is aways very difficult. Pharmacies have found a way through money. Of course, there are a couple of individual general practitioners, but in general it is very difficult. What might be more interesting is to find a way around the general practitioner, because referrals are not always needed anymore. Referrals are only related to money and they act as a director in the medical field. Alternative medicine is becoming more popular and is approachable by patients directly. Also, the specialists have become easier to approach by patients. In general, general practitioners are already overwhelmed and are, most likely, less open to implement such technologies.

Use two ways to implement the product into the market: make it available through healthcare institutions and make it available on the consumer market. The role of the healthcare professional in decision making is decreasing. Before, devices that could be used for healthcare, such as GPS trackers, were only available through medical suppliers, but now everyone can buy GPS trackers online. They ask, do you want to go from medical device to consumer device, or is it okay if both devices can be there at the same time? A company can probably grow faster through the consumer market.

When asked about laws around E-health, GDPR needs to have a large focus. The ISO certification or NEN certification are also needed. These certificates focus on points such as where the data is stored when the product fails.

Healthcare Enthusiast 2/ Chronic Pain Specialist6:

They started as physiotherapist after which they performed a masters in psychology and epidemiology, followed by a PhD in Medicine. They guide PhD students at the University of Brussels. They have researched about pain and exhaustion, specifically what happens within the nervous system. They also researched lifestyle, education programmes and applying neurophysiology in education programmes. Everything is focussed on pain and psychology. They also look at behaviour. In summary, they educate, research and see many patients, specifically pain patients.

Since 6 years, they have a center for chronic pain patients. They work transitionary, meaning doctors need to understand the body and the nervous system, whilst also understanding the psychological aspects. Moreover, they do not focus on prescribing medicine, but more on avoiding prescribing medicine.

If E-health is implemented, it must provide the same vision to the patients as the doctors provide. If it provides a different vision from what you are saying as a practitioner, it does not work.

Within the center, the patient sees different specialists. In any case, the patients see a doctor and a psychologist, usually they also see a physiotherapist. The secretary is also someone the patient sees and fits within the same system.

When asked about their general vision, they state that it can be a valuable part of a treatment. However, there is the question of how to make this patient tailored. Generic applications lose their

⁶ Due to their broad set of occupational skills, they have been categorised under Healthcare Enthusiast rather than a specific profession.

added value since the patient is always changing. For example, they are developing (with other parties) an interaction tool which monitors sleep and movement, which contains an interaction tool for practitioners. When developing such tools, they are always collaborating with other parties, such as knowledge institutions.

They use online tools such as informational movies. They also refer a lot to retrain pain, a website which explains a lot about pain to patients. This information supports their process. Physiotherapists make more use of activity trackers. They have also heard of therapieland, but they do not feel that it matches their treatment and their vision.

They have thought about implementing VR within their practice, but the evidence is still lacking for, for example, Reducept. This makes them hesitant. The E-health needs to fit within the entire model. The vision of Reducept does fit. However, you would need to instruct your staff on how to use it. For this, they would need to receive more information.

Barriers could be lack of evidence and lack of knowledge on how to implement the new technology. Also, the time it costs to learn and use it and the unknown of the technology are barriers as well. They state there is the standard list of barriers that are always there.

However, we need to get to more implementation. First, people live far away and applications such as Skype could help a lot. Also, as substantiation of your treatment it is very important to have. It could make treatment less therapist-dependent, if it is done in a blended form. The interaction with the actual practitioner still needs to be a part of the entire treatment. Therefore, it is supportive to the treatment.

Moreover, you can monitor something and the knowledge can be there, but behavior can still not change, which means that the effectiveness is not there. If the VR is a therapy on its own, then how does it lead to this actual change in behavior? Therefore, information on implementation needs to be included from the company in order to blend it within current treatment strategies.

Another question is for who does it actually work? It is a utopia to think it will work for everyone. Some patients might be more open towards it, others might be more sensitive to the technology. Therefore, who do you provide the E-health application to?

They have seen a very early version of Reducept, which was their only experience with VR. Regarding VR, they wonder if it will work have a therapeutic effect (like medicine) or if it is mostly a distraction mechanism. They are not sure how it would work for pain. Therefore, if it does work, how does it work? And does it also work after playing the VR, or is it only effective when you are playing? Moreover, what will you tell patients after they have trained with Reducept? It is important to understand what the effect is of Reducept, but equally as important is it to know how that effect has come to be.

They state it is important to understand pain and accept the mechanism. A patient needs to accept that you cannot do anything about the pain mechanism, but you can learn how to manage the pain and understand what is happening within the body. It is also important to understand that there is nothing physically wrong.

Currently, they provide this education with a whiteboard. First, the patient will see the doctor, after which the psychologist explains different factors and things the patient can start to do themselves. They receive a booklet with information and a referral to the retrain pain website.

If it would be clear how the VR E-health application would fit in the bigger picture and if there would be more evidence for it, it would be easier to implement it within their practice. Moreover, they wonder about the management strategies that are taught within Reducept. If they would participate in a research, they would gain some feeling with the product. However, it could be difficult to obtain grants for such research studies.

Their colleagues in Belgium work with VR. Therefore, they do hear about different applications and they see how it is implemented through colleagues. Their network is very big, which helps them see shared innovations on social media platforms for example. Sometimes they also receive newsletters. They do not really have a preference about how they are approached about new innovations.

They thought the price of the headset was higher. However, this does not yet include the monthly costs for the license. They do have enough physical space in the practice to have patients obtain a free room to work with Reducept.

When explained a mobile version is being developed, they replied that the price would not be different since it works through a license. It is a consideration that needs to be made. Perhaps you can give it to more patients, although they are limited by the license.

If the work could be outsourced, if the patients could take it home or practice on their own would be beneficial. They would rather give it home with the patient than use it at the practice. You cannot give the VR headset to anyone. If they were to use their own smartphone, it would be easier.

Moreover, they state that they are curious about the long-term effects. Perhaps there are also negative long-term effects that are still unknown. That is what research is for. For example, what does it do to the brain? Also who it is actually suitable for is something that needs to be discovered.

Appendix K: Interview Surgeon

The interviewee is a surgeon and a professor of surgery. They are also very focused on innovation. They have done a lot of research on chronic stomach pain and, through this, they have a connection to RelieVR BV. There are different programs they are a part of concerning innovation in healthcare. These are focused on virtual reality and augmented reality. They are also working on a European funded study concerning creating a personal healing environment.

Virtual reality has been playing a role for education in surgery for a longer time, so, for them, the switch to virtual reality in healthcare was not big. They have been thinking about virtual reality for 5 or 6 years already. Soon, they will start a clinical research study about using virtual reality after operations to help to manage the pain.

When asked about the barriers of the implementation of virtual reality, they mention that one of the most important ones for a hospital is the fact it has relative low clinical proof or research validation, but also that the technology is very new for hospitals. You notice that many new technologies need a runup of enthusiasts who will see possibilities for it after it will be researched. Then, the first big publications and journals will follow and then it takes off.

At their hospital, there are more doctors who have heard about the technology. They sometimes ask internship studies to look at it in more details. Then, together, the doctors can look at a connection. Working together leads to more things happening surrounding the new technology. This does not lead to more purchasing or more usage, but more that a start has been made.

In general, publications are important for hospitals. However, in other hospitals, doctors or nurses sometimes use a new technology faster, even if there is no research yet: 'let's try and see how it goes' mentality. The same goes for Reducept: Louis (the founder) thought of an application and obtained user experience with a prototype to gain traction. Now, larger user groups are being tested to see the actual added value and effectiveness of the application.

Currently, there are four systematic reviews on VR and pain, which is a lot of evidence. But then, it is still not being used much. They think this could be due to healthcare being quite conservative. Usually, practitioners hold onto the known protocols. Moreover, many VR applications are aimed at procedural pain, for which it is already used quite often. However, for chronic pain, it is still quite unknown.

Additionally, there might be a lot of conservatism from the practitioners, who might say that virtual reality will not actually work. You have to show them that it actually does work. In this sense, publications help show the application works. This is not the only way, and sometimes not even the most important way to provide evidence of the effectiveness. There are many examples of things being implemented in hospitals that are now standard of care where the effect has never been proven thoroughly, but who were lucky to enter the market at the right time, or easy to implement, or were available or the time was right.

Now, the time is there to provide something else then medicine for chronic pain, due to the upcoming opioid addiction. Patients could also hear about this and think that they do not want medication anymore, which would allow for more technologies to be implemented.

The VR apparatus is not easy accessible, it is relatively expensive to buy. Currently, the developers of VR applications sell licenses for a year, but you have to buy the VR glasses as well. They create closed-systems, meaning you cannot add any other applications to the headsets. They do this to try and gain a market position, but through a closed system, which does not work very well.

For the healthcare sector, usually, you need to buy the VR glasses from the company since the content necessary cannot be purchased commercially through an app store. Also, if it were, how do

you know as a consumer or patient if apps through the app store are actually fit for healthcare and if they are effective.

The VR headsets now do not have any cords anymore and everything is incorporated into one headset. This is a development of recent years. There are also headsets for smartphones, but you do notice the difference of quality.

For the healthcare, cleaning is a large issue. It needs to be bacteria free. The developers of the headsets and content are usually aimed at wellness market instead of healthcare market, since the hygiene issues and concerns at hospitals are much more demanding. Headsets for smartphones are not a completely closed system, meaning it is open, which leads hygiene specialists in hospitals to say that they are a potential dangerous system concerning health regulations. Even for closed systems, there are concerns and challenges. If patients had their own headsets, then it would be less of an issue.

The insurance company is not yet used to reimburse such treatments. Therefore, they ask for evidence. This means you keep turning in a circle. Therefore, you are dependent on practitioners who are willing to participate in risk-projects to see what the new technology can add in regards to the standard available treatments.

Insurance companies want things that allow patients to stay at home instead of going to a hospital. Therefore, things you can apply at home are more attractive to insurance companies. They want a more effective treatment for less costs. They might be less eager to do such tests in hospitals since it requires a higher budget. The hospital has to purchase many headsets with licenses from different companies (due to closed-systems). Therefore, the business case is less appealing. Currently, they are trying to make this happen since they see the added value.

In order to create a study, the ethical committee needs to give permission. They look at the way the study will be performed to ensure evidence will be obtained. Moreover, they look at the relative risks of the patient versus the expected return. VR does not bring a large risk to patients. Therefore, the approval of the ethical committee should not be a big problem for this study.

When asked about the implementation of VR in their hospital, they mention that they have different virtual reality applications they want to implement such as one for pain, one for movement, one as an information tool for patients. The latter is meant to reduce stress and fear for certain procedures. Therefore, there is a big rage for which VR can be applied. In VR, you could even create a whole world where you can meet each other. For example, you can have contact with patients through such a world.

Concerning pain, the current treatment options have a lot of side effects. The elderly patients, which is a large part of hospital population, cannot handle morphine well since they also use other medicine, meaning they experience a lot of side effects. Morphine does not work well for them, plus they experience nausea and dizziness which limits their movement. However, movement is important in the healing process.

Moreover, there is a lot of stress and fear in patients. Through VR, stress could be reduced to prepare them more for procedures. For example, they could already experience the procedure through VR, which could act as exposure treatment and reduce the fear. Through this, they receive sufficient information and they understand what they can expect of a procedure.

On the other hand, they mention they are a hospital that cares a lot about personal care and innovation. They are also the ones who understand the need to test for who this technology works and for who it does not, or even has negative effects. This is another important aspect: through the studies, they want to understand who such technology is effective for. Medication is given to everyone, but it is not known who it actually works for. Some patients react badly to this medication, but everyone receives it.

They want to be able to predict for who new treatment is actually effective. With this specific technology, that is possible since you can record a lot of data while using VR. That is not possible with a pill. This data allows for many more possibilities, since predications can be made. The data is automatically generated.

Patients with cancer receive chemo, but only after some sessions you can establish if it works or not. However, the patient already has the side effects. Therefore, prediction is really important. Even heavy medicines do not comply with a one-size-fits-all principle.

The nurses are very important in hospitals. Therefore, hospital staff needs to be open to use VR, otherwise it will not work. They notice that the staff at their hospital is very open to use such technologies. However, this does not mean that they will actually use the technology much. For VR, nurses are more open to use it since it does not harm the patient if it does not work. They are also curious about it. For patients as well: for elderly, the patients are eager and curious to try it.

For the design, you need to focus on intuitive design: it should be able to use without a manual. For example, for Reducept, you do need to go through many steps before you get where you need to be, which means it is less intuitive. Patients might lose focus if they have to go through many instructions.

They notice that elderly people react better to VR than other patients. This could be due to the fact that they are more surprised about what is possible. Therefore, they might be much more distracted by this medium. They are so emerged in the VR, maybe more than young people who are less surprised by the possibilities of technologies. However, also young people reacted well to interactive VR where patients need to perform tasks: patients felt less pain than without the VR application they did the study with. However, the elderly noticed a larger reduction as stated before.

When asked about how they find new applications, they say they follow some people on social media who post things, people react to your articles, developers contact you, you connect with suppliers at congresses, applications are found through literature.

Currently, they are very open to being approached by companies who present their ideas to them. That is great for an academic hospital. Other hospitals need thoroughly validated and through research supported applications before they will implement it. Their hospital wants to partner with companies and start-ups to improve these technologies, meaning they have a head-start.

It is important that different practitioners (e.g. general practitioners, etc.) become more familiar with VR technologies.

What is notable is that the American market is developing many applications, and it is difficult for the Netherlands to receive attention from the American clubs. The American clubs are oriented on the American market. It is difficult for the countries of the EU to show their potential for a large sales area. Companies do not understand the healthcare of America.

In America, FDA asks for evidence for registered treatments to be approved. If it is FDA approved, then it is much easier for America to implement the technology. The CE approval of Europe is less impactful than the FDA (since it did not require evidence until a short time ago). Therefore, the FDA is super important before the application can reach the American market.

The most important thing is to create a momentum. Sometimes, things that are not proven are used in standard care. Of course, it needs to have a CE approval, but other things lead to the actual usage of the product.

If you have the support of famous people, adoption and implementation goes a lot smoother. The power of the patient becomes a lot larger. If the patient knows, they can have an influence on the adoption of technology through sharing posts and raising awareness. An example is Pink Ribbon,

which has had a large influence on the treatment of breast cancer. However, chronic pain is not a disease-oriented club, or has less power than other diseases.

VR for pain is such an attractive concept, therefore they believe it will be implemented also in the first line (e.g. general practitioners). Besides marketing, you also have to think of a distribution system. Everything needs to run smoothly. Intuitive instructions are necessary. For example, when you buy an iPhone, it works. Practitioners should be able to purchase with one click on a button. By having a good infrastructure and a good organisation, you create the expectation that the product will also work.

At the hospital, they provide a training to the practitioners. However, they do not want to keep doing this: they want intuitive applications. You do not want to create more work for practitioners, but less. Therefore, a training or manual should not be necessary, but the application should guide practitioners through it.

For their research study, they guide the practitioners on how to implement the actual product. Also, they let them know how to solve technical issues, which they do through a helpdesk or back-up team. Practitioners will lose interest if there are many technical malfunctions.

Reducept could provide a VR training for practitioners to show how it works. Keep it in the same medium, so not on paper. They only say this because VR is also a good medium for knowledge transfer and education, more so than paper or in 2D media.

Appendix L: Interview Ministry Representatives

Representative of Ministry of Health, Welfare and Sport (WWS) 1:

The interviewee has a been working in the healthcare sector for about 15 years, also with a focus on E-health and innovation. They do this, not because it is technologically possible, but because it can be of added value for people. Through the VWS ministry, they are part of a small team concerning innovation and care provision. This team works throughout all different domains and sectors. The goal is to see how innovate healthcare concepts can be upscaled or made part of the regular treatments available. They see technology, not as a goal, but as a method or tool to address the questions and problems in healthcare. In their unit, everything concerns digital technology, but only 10% is actually focussed on the technological aspects. There are different requirements the technology must meet before it can be implemented, so it is more focussed on expert matters.

They state that, in general, E-health is a fun tool but what does it really add? Instead of E-health, they focus more on process innovation, meaning they don't reason from the product but from the processes they want to improve. They want to improve healthcare, wellbeing and the organisation and, to do this, you use applications. In general, they want to organise healthcare in a smarter way.

E-health can absolutely support this vision. However, if you compare it to a hammer, you can use it well to build things or you can break things. Therefore, it is very much dependent on how you use the tools you work with. They say 20% is related to the quality of the product, whereas 80% is related to how it is actually being used and where it is being used. Therefore, the added value, quality and safety does not lie with the product itself, but in the way it is being used.

There is a large mismatch in a lot of initiatives, since companies usually have a large focus (or focus entirely) on the product instead of its implementation. They ask that, if the product is the solution, then what is the problem? From the very start of development, talk to the people who will actually use it. Don't wait for a pilot study to do this. Look at the user's lives and work. Then, see which problems they experience and then create the solution. The technology-push is well-meant, but it does not work. You will come into contact with people who cannot change or do not want to change. Therefore, understand the urgency of problems. If there is no necessity, people will not change. After all this, you can think about which products would fit.

Added value is not an objective thing. Added value is determined by people. They explain that, what can help them as a patient or human being, might not be helpful to you even though you use the same solution, in the same context to address the same problem. There are many applications, and determining which ones actually add value is still a search. In the end, people decides which ones add value for them.

When asked about the future of health and healthcare, they mention they prioritise going from disease and healthcare to behaviour and health. The biggest challenge they are facing is the organisation of healthcare. The way it is organised it now is bankrupt. It costs too much money, the population is ageing and there just ar not enough people anymore to fill the vacancies, which makes it urgent. However, through the digital advancements, the population has much more control to live healthier. Lifestyle is becoming more important: if you live healthy, you can prevent having diabetes. In the future, preventative healthcare will become essential. Moreover, family takes care of patients more often as well. Therefore, you can see that the roles are changing.

Looking at healthcare now, you would organise it a lot differently than hospitals. However, it it has been organised in a certain way so now we have to search on how to change it so it fits with current

times. It can be organised differently in different regions. For example, in the province of Drenthe, there are almost no general practitioners anymore: the vacancies are not being filled. They state "never waste a good crisis", and elaborates that it could be an impulse to use more E-health solutions in that region.

Through VWS, the interviewee is also part of another group that focusses on getting healthcare at the right location. Here, they encourage pioneering in the healthcare instead of focussing on what is currently being done. They explain that you also want to keep healthcare closer to home. Doctors can obtain a coaching role.

Since the current system is bankrupt, it needs to change. This creates possibilities and chances to utilise E-health. Other countries are much further in E-health since they did not have an existing infrastructure. This urged them to find the best solution possible.

Their job largely consists of discussing the current interests of different parties: e.g. who is responsible for what and things that might lead to financial losses in hospitals. Change in healthcare has barriers. One of those is potential financial losses for healthcare institutions. Others they mentioned were that people don't change unless they have to (human nature), finances, interests, position/location, being scared of the unknown, using technology, digital skills and sharing private data securely. They mention there are many.

Many professionals choose to work in healthcare to not work with technology, but with people. However, now they are pushed to work with technology.

Healthcare needs to become smarter and it needs to transform. Otherwise, if you stick to the treatment you know, many E-health possibilities will be ruled out. If there would be unlimited money and unlimited people, upscaling of E-health would not be an issue.

On one hand, the E-health technology needs to fit within current treatment, on the other hand current treatment needs to change. A rapport shows that 46% of hospital activities don't actually need to occur inside of a hospital. E-health can play a role in creating a change here. But then you do change current treatment and processes.

The population does want change, but the offer is stuck in rules and regulations from different parties. We are a little spoiled with the way healthcare has always been organised in the Netherlands. In other countries, where healthcare at a distance has been necessary, everything you could use would be used: if not, someone could die.

Liability is also an important topic: who is responsible if something goes wrong?

Another factor is that many people do not know what can be done. Additionally, people cannot always understand what might be possible until they try it.

Regarding digital skills and medical skills, there are many people who have trouble reading, writing and who do not take care of themselves well regarding their health. Everyone usually has some lack of discipline. These are also the people who use a lot of healthcare. As a developer, you easily overestimate what people can do with technology. Moreover, E-health is not a one-size-fits-all. On the other hand, elderly people do use more technology such as iPads.

It is important to understand which technology works for who. Not just dependent on age or technical affinity, but also how you view yourself as a person is an important factor.

Moreover, if you visit a hospital or living lab, you act differently than if you were at home. Therefore, you have to observe in the actual world of the person, even though this is almost impossible. Being aware of being observed changes people, even unwillingly. A living lab situation already helps, but it is still different than the actual situation. Meaning something could work in a living lab, but not have the

same effect at home. Therefore, trying out applications in the actual lives of people can work well. Basic things like a lost WiFi connection happens a lot more often than someone might think.

Regarding facilitators, you have to think about the entire process. For example, the patient receives something at home in a box. The box is the very first impression of the product. This is something the company can utilise: make the first impression good and make someone enthusiastic about receiving a package. A poorly designed or poorly functional box can actually put a brake on the implementation as well.

If products are used by both patients and practitioners, the practitioners can have a positive influence on the implementation if they ask follow-up questions and they discuss the results obtained with the patient.

For the professional, high quality, good division of risks, financial support are highly influential on the structural usage of E-health applications.

Regarding the finances support for E-health, there is an overview for the Dutch possibilities provided by the NZA (Nederlandse Zorgautoriteit). This cannot be briefly described. Usually, tools are not per se reimbursed, but more the healthcare and context is essential to determine what can be financed. There is also the question if people pay themselves, or if the healthcare is reimbursed. As professional, you also agree on financial possibilities with the municipality and healthcare insurances. That is focussed more on the type of healthcare you provide and how you provide it.

They explain that je might receive a budget per treatment, but how you spend that money is up to you. If you want to do a consult online, that is also fine. However, you have to make decisions about how to spend this money. Usually, professionals will look at finances and think the money is already spend, so doing something new will cost additional money. However, using that new method could save on current processes or treatments that might become redundant when using the new method. You have to be creative and smart in organising the treatment. It could mean that, after a period of time, you work more efficient and smarter. However, this does require an investment and some change on the side of the professional. In other sectors, the concept of investment and return is very common, but this does not yet fit in the healthcare mindset.

For example, professionals have also bought tables and chairs for their practice. Apparently, budget was created for this purchase. This is also through managing finances. The same thing applies for purchasing tools and products to use during treatment. You can say that it is possible, but that does not necessarily make it attractive. For example, people are used to having patients come visit them, have them wait in a waiting room until you have time for them. However, people can also be monitored at home. Here, money and habit are important factors. For practitioners, this is a process that works.

The intrinsic motivation of healthcare professionals is good, but the desire to change is not there. Change cannot only be good for the patient, it should be positive for the practitioner as well.

When asked about their participation in promoting technology in healthcare, they reply that they are. They have a website for both citizens and professionals where they can find an overview of possibilities. They also organise a week focussed on E-health with partners. However, they stress they do not promote technologies, but the added value it could offer. For example, they focus much more on people who talk about what a certain treatment has meant for them. It is also not focussed on telling others it could work for them: it is purely talking about positive experiences the patients have had themselves and how it improved their quality of life.

If patients or professionals share their experience about the product, it can be placed online. It is not meant for companies to promote their product. Companies could use this if patients and professionals have positive experiences, to showcase their product through this way. For example, one project now ensures that people with heart conditions can stay at home. This means less days in the hospital, less ambulances needed, less emergency care, lower costs, less need for healthcare employees, etc. All these advantages have nothing to do with the technology, the focus lies elsewhere. Therefore, it is important to understand what it actually means to the patient.

Very generally: the ministry does not care for the technology. If a competitor comes and provides better care, they are more than welcome to join in or even replace the earlier technology. It is about the people.

For companies, understand the people who need to use the product. The healthcare sector is a complex world. Therefore, focus on how people think and work in a specific context. Right now, businesses focus on their product, but it should focus more on what it solves. But here, you have to find a balance, which they admit is very difficult to do.

In general, they see potential in situations, resulting that they see potential in all technologies including virtual reality. More important, if people see the potential of the tool for daily life.

When asked about how they find new E-health applications, they sometimes find it through different colleagues. For example, to increase therapy compliance, which types of E-health applications are available for that. They also follow the news. They talk to a lot of people and people visit them at the ministry. In specific domains, they have less knowledge of what is out there: they focus more on chronic conditions and know more about what the possibilities are for that specific domain. There are specific people who focus on communication who also look broader at E-health.

They focus more on the upscaling and integration of tools and techniques within the regular healthcare system. A lot of things could work, but there are many factors that form barriers for the actual implementation. They will never ask how the actual technology works, but are more focussed on how it could be implemented. Currently, implementation asks for too much change in healthcare. Healthcare needs to be more open for new organisation.

Not unimportant is that, what might work for one country, does not automatically work for another. Even in Europe, there are many different processes and mindsets. You cannot claim that it works in one country, which means it will work somewhere else. However, it would be nice it would work like that, or even to expand on what you have learned in one country.

Representative of Ministry of Health, Welfare and Sport (VWS) 2:

They are program director for innovation at the Ministry of Health, Welfare and Sport (VWS). With a very small club of eight people, they try to create an innovation climate in healthcare. They do this through different methods, such as education, communication, nudging, creating awareness, portraying good examples and understanding how the policy can be limiting this implementation. If policy does create barriers, they try to change the policy. They know how complex the healthcare system is and how many different parties are involved. Every party wants to grow, whereas the healthcare sector should actually decrease. Therefore, there is not an easy solution.

They try to stimulate that the population have more control in matters, more self-direction and more self-reliance. This will allow the population to stay at home longer. They want to prevent unnecessary hospital visits through a healthy lifestyle. Therefore, they focus on organising healthcare in a smarter manner. Moreover, how can healthcare be digitally supported, which directly builds a bridge to E-health support.

In general, they see great innovations in small regions, but this does not extend to the rest of the country. Therefore, a goal is to spread great innovations and smart organisation of healthcare across the country. Partly, this is due to unawareness of advances, although this period is almost ended. Four year ago, when they started, they spend most of the time educating about possibilities. Now, that is less necessary.

Currently, healthcare institutions say they are already too buys, so they do not have time for implementation. Moreover, they receive different suppliers who come by, but they are not sure which application works best for them and which they should choose. They are worried of connecting themselves to suppliers and being stuck with them. Therefore, there are also many concerns and barriers on management level and regarding strategies of the healthcare institutions.

Healthcare professionals do not want to think about ICT infrastructure, that is not what they signed up for. Currently, larger healthcare institutions acquire more CIO's and innovation managers. This is a step in the right direction.

When asked about their vision, they state that the department knows that the healthcare costs keep on increasing since people are getting older, but also acquiring more chronic diseases. We want to live longer at home. These are all cost-increasing manners. Throughout the years, the costs have been increasing. Recently, a realisation has been made: we always claim the healthcare costs are going to be unpayable, but we will never reach that point since we don't have enough people to provide that healthcare. Between 70% and 80% of the costs are salaries of healthcare professionals.

Therefore, we need to decrease the need for health through healthier lifestyles. Second, we need to organise healthcare in a smarter way. The healthcare sector is outdated: they still use fax machines and you need to bring a DVD to actually transfer data from one hospital to another. There are a lot of unnecessary things, or things that take place twice, that can be eliminated. Everything can be done much smarter and more efficient.

At this point, we already have a shortage of healthcare professionals, and this shortage will only increase over time. It is important that people want to work in the healthcare sector and are willing to stay there for some years as well. The industry needs to become more attractive.

E-health is super important, because it helps the population be more self-reliant, self-directed, etc. Moreover, it addresses the shortage of staff in the healthcare industry. Since it can support both urgent matters, it needs to increase.

When asked about their vision of what healthcare will look like in the future, they say that there will be much less unnecessary shifting between different healthcare institutions. Technology will make healthcare less time and place dependent. Their department's motto is from waiting room to living room. Through technology, patients can be monitored at home and alarmed if parameters are off. Moreover, patients could be less anxious due to a reduction of necessary logistics, such as acquiring transport to the healthcare institutions, since telecommunication with the practitioner might also be possible. Therefore, the right healthcare needs to be at the right location.

When asked about barriers, they respond there are many things. The sequence is not important, since all of them are related to each other and all of them effect each other. An important barrier is that there is a lot of comfort and money in the healthcare system. You can continue what you did today tomorrow without anything going wrong. Older doctors might not feel the need to change since they can keep doing what they are doing until they retire without facing difficulties. Financial pain is a good driver to spark change. However, there is still a lot of money within the system, meaning the need to change is low.

Moreover, they explain the organisation is old-fashioned. However, the solutions cross all domains. For example, right now the patient has to go from institution to institution, where it should become the case that healthcare is designed around you as a patient in a network where everyone works together. The reason for this is that you want the patient to be at home, which would require a financial investment from the hospital, but at the same time they lose money because the patient is not in the hospital anymore. Maybe home-care will increase. Then, the municipalities must pay. There are many inequalities in investments and returns. Therefore, you need a finance company, an insurance

company or a municipality that smooth out these folds. They explain that 40% of hospital care could have been done outside of the hospital.

However, this means the insurance company needs to sit together with all these parties who all have different needs and requests. Together, they need to come to multi-year contracts that provide a solution to these problems. This is very time-consuming and it does not always succeed. This is easier when a hospital is in financial trouble, because then the need is there.

When asked specifically about insurance company, they explain that they have an important role. Municipalities want healthy populations, the insurance company can also take control over this. Insurance companies have explicitly received this role within the Dutch healthcare system.

Other countries, for example in England, the government organises the healthcare system. Because these are civil servants, it is easier to work in a top-down approach. This does not mean that it is better or worse there, only different. This is also how the Netherlands worked before, but it meant long waiting periods before things were actually achieved. Therefore, the healthcare system was decentralised in order for regions to determine what is most important for them and to make implementation of new regulations quicker.

To make their future vision reality, they think an economic board should play an important role here. The provinces can also play a role where they are granted to do so. For example, in Drenthe, the big insurance companies, health providers and government officials come together to try and make changes for the province. If you want to get something you done, you need at least four or five parties to agree and to implement something. Not everyone has the same needs or interests, which could make these discussions difficult. Moreover, much time needs to be freed for this. Therefore, free capacity to guide this process is very important, a neutral person would be the best option.

The VWS recently offers a SET-regulation, where practitioners can ask for grants regarding process support to integrate E-health with the goal of having people live at home longer. They explain that this is not meant for care leaving the hospital, and that this is where the complex formalities of such grants come to light. They agree that it can be quite difficult for practitioners to understand how financial support is being offered and which applies to them.

The VWS does have a website (zorgvoorinnoveren.nl) which is not yet well-known, but it offers guidelines to practitioners on how they can receive financial support and for what. Also, practitioners can contact the VWS with specific questions or they can arrange a meeting. They do stress that sometimes they are too busy, but they try to help everyone quickly.

They explain there is an overview of the different financial regulations, which has only been recently created. It is a booklet containing different regulations, showing how complex the system is. Care For Now (Zorg Voor Nu) is an initiative to stimulate the implementation of digital care. They try to generate more awareness for this by promoting it at big events, congresses and healthcare institutions. Both practitioners and general public are interested in learning more about these regulations. They try to encourage the question for more digital healthcare. They are very active in the promotion of more E-health in healthcare.

For example, thuisarts.nl (translated = home doctor) has the effect that patients now go to the doctor for their consult and say that they might have a certain condition because they have read about it online. Their own general practitioner also told them that, if there is a suspicion about what their patients might have, they will look it up on the internet to see what information the patient could have found on the condition prior to the consult. Another general practitioner now only offers consults through phone. However, if it is necessary, the patient can come by, but only after they have diagnosed themselves. The GP encourages patients to look online and try to determine what they have. Patients find correct information most of the time. It could even play a part in them not having to see the doctor anymore, since they found on the internet what they experience is actually quite
common. People are going to search for information anyways, so you might as well take advantage of that.

Generally, the treatment is reimbursed. However, assistive technologies or medical devices and apparatus can also be reimbursed. There are many requirements for this. It needs to diagnose or be therapeutic. If it is an assistive product, it could be reimbursed and this sounds very attractive for companies to do. However, you need to go through many regulations and it is a very time-consuming process. In the end, the actual return of investment might be attractive, but the way there is not.

The system is a little out-dated in this regard. Two months ago, the VWS has send a letter to parliament to announce that they will review these regulations. However, they state, this also is a time-consuming process so it can be a while before anything is actually changed.

Now, if you go through the process of testing new technology, it will be outdated once you are done. The healthcare institution determines what innovations are effective, are reimbursed, are safe and provide quality. The VWS is already talking with this institution to see how these processes can be accelerated. There is a regulation called "Veelbelovende Zorg" (translated = promising healthcare) which is aimed at accelerating innovations to be added in healthcare reimbursements, which is a grant (which also takes time to acquire).

After showing a demonstration of Reducept, they state that if it is effective, it can be important in the healthcare system. The question remains, how will it be financed so you can get it from the shelves to the patient? They discourage the assistive product route. Either, you need to find a pain centre in a hospital who wants to work together. Or, you need to go to other places, perhaps through the workplace route where companies are aiming to decrease absence which could be chronic pain related.

When asked about their previous experience with VR, they explain that they have tried many different VR applications, also one aimed at stress reduction. The brain can easily be fooled through visuals. Even so, they are very impressed at how it actually works on their own brain.

They would like to see more VR in the healthcare sector. They are advocates for gamification in healthcare. They trust VR is capable of this. However, it is important to obtain the evidence. Moreover, you need to find the young and enthusiastic doctors who want to work with it.

Companies sometimes visit the VWS to give demonstrations of their product. They really like this. They usually try to find the right people who are related to the product to come and provide some feedback as well.

Moreover, they also have a Facebook page where companies can showcase their innovations. There is a lot of interaction on this page. They also have a website and they Twitter some. Instagram is not really working yet, LinkedIn is also in existence but not very active.

Usually, they are approached by companies or they hear of new innovations by word of mouth. When companies come by, they usually check the website to see what the product is. They also Google to see if there is already some more awareness of the product.

Appendix M: Complete List of Barriers and Facilitators Identified

Overview of All Barriers Identified	
Negative Pre-Misconceptions	Incompatibility
Unaware of VR Advances	Overabundant Offer
Eligibility of Patients	Costs
Patient's Unwillingness to Try	Organisational Issues
Lack of Clinical Evidence-Base	Critical Staff
Lack of Transfer	Unawareness of Patients
Realism	Outdated Healthcare System
Standardised Platforms	Fear of Replacement
Reliability of Hardware	Absence of Ownership
Self-Efficacy	Not Solving Problem
Time	Hygiene
Practitioner - Patient Relationship	Liability
Overview of All Facilitators Identified	
Overview of All Facilitators Identified Evolving of Technology	Stronger Evidence Base
Overview of All Facilitators Identified Evolving of Technology Training	Stronger Evidence Base Affordable Hardware/Licenses
Overview of All Facilitators Identified Evolving of Technology Training Technical Support	Stronger Evidence Base Affordable Hardware/Licenses Community
Overview of All Facilitators Identified Evolving of Technology Training Technical Support Organisational Support	Stronger Evidence Base Affordable Hardware/Licenses Community Raise Awareness
Overview of All Facilitators Identified Evolving of Technology Training Technical Support Organisational Support Knowledge Transfers (KT)	Stronger Evidence Base Affordable Hardware/Licenses Community Raise Awareness Compatibility of Content
Overview of All Facilitators Identified Evolving of Technology Training Technical Support Organisational Support Knowledge Transfers (KT) Better Treatment	Stronger Evidence Base Affordable Hardware/Licenses Community Raise Awareness Compatibility of Content Background Company
Overview of All Facilitators Identified Evolving of Technology Training Technical Support Organisational Support Knowledge Transfers (KT) Better Treatment Independence of Patients	Stronger Evidence Base Affordable Hardware/Licenses Community Raise Awareness Compatibility of Content Background Company Gather Data
Overview of All Facilitators Identified Evolving of Technology Training Technical Support Organisational Support Knowledge Transfers (KT) Better Treatment Independence of Patients Motivation of Patient	Stronger Evidence Base Affordable Hardware/Licenses Community Raise Awareness Compatibility of Content Background Company Gather Data Decrease of Medicine
Overview of All Facilitators Identified Evolving of Technology Training Technical Support Organisational Support Knowledge Transfers (KT) Better Treatment Independence of Patients Motivation of Patient Participation in Research	Stronger Evidence Base Affordable Hardware/Licenses Community Raise Awareness Compatibility of Content Background Company Gather Data Decrease of Medicine Reorganisation of Healthcare Services
Overview of All Facilitators Identified Evolving of Technology Training Technical Support Organisational Support Knowledge Transfers (KT) Better Treatment Independence of Patients Motivation of Patient Participation in Research Recommendations	Stronger Evidence Base Affordable Hardware/Licenses Community Raise Awareness Compatibility of Content Background Company Gather Data Decrease of Medicine Reorganisation of Healthcare Services Smooth Distribution
Overview of All Facilitators Identified Evolving of Technology Training Technical Support Organisational Support Knowledge Transfers (KT) Better Treatment Independence of Patients Motivation of Patient Participation in Research Recommendations Novelty	Stronger Evidence Base Affordable Hardware/Licenses Community Raise Awareness Compatibility of Content Background Company Gather Data Decrease of Medicine Reorganisation of Healthcare Services Smooth Distribution Demonstrations

Appendix N: Interview Company Regarding Website

The founders of the company also need to be involved to give their opinion on what are essential parts of the product that need to be included on the website.

The mission statement of the product is to provide thorough psychological educational care for people suffering from chronic pain that is accessible and affordable. Moreover, it is scalable, understandable, it is easy to use and fun to play.

When talking about the product, one founder puts the focus on the psychological background, the design research done throughout the development of the product and the pain education included in the product. The other founder focusses on the patient and that it is very difficult for them to understand the concept of pain and that, through this innovative method, they help them understand this. Moreover, it is based on good theory which needs to be transferred to the patient.

The most important impression people should have of the product is that you can influence pain by using Reducept. People should believe that, through gaming, they can influence their pain. Moreover, that it is crucial for patients to understand how pain works: if they cannot understand pain, you are already far behind in the treatment. Also, the training provides a technique that influences the emotional aspect of pain. Not everyone even knows that pain has an emotional component that is crucial in the experience of pain.

The goal of the website is a combination of providing information and convincing people. Convincing will happen when they trust the product, if they trust the background research. Moreover, the quality you express through the website can be crucial in their decision making. However, the information and content is the most important aspect: it should provide them with all the content they need to understand the research behind the product.

This is a new product and people do not know how it works and what is possible: therefore, this information needs to be present.

A professional look and feel of a website is extremely important. Partners that you collaborate with can also add an extra sense of quality: it shows they are serious and they have a strong position. Something else they focus on when looking at other companies is the people who work there and their educational background.

Things that are crucial from their perspective to be added to the website are that people very clearly see how they can get in touch with the company, that the product is well-explained, that there is a FAQ section that also explains the added value to the medical professional if they were to use this product, that it is explained that research has been conducted, the partners that the company works with, the price of the product and what the medical professional receives for the stated price. Also, how you use the product in a basic layer (thoroughly it does not need to be present right at the start). How the company has developed in order to create trust in the product and the people who have created it. The website should be active: it should not be completely the same after one month. This should not require a lot of effort from the company side.

Ideally, the product should be explained more visually than through a lot of text. Making use of visuals and metaphors would be better than text.

An example of a good website is choose muse, which uses one picture that clearly explains the product and what it does. This is something that would be great to have on the website. The website

had a little too much text still. However, there is a good balance between what the product does and on which evidence this is based. The website feels basic, but there are possibilities to dive further into research. Therefore, there were levels of details. The website felt logical to navigate through.

The footer of the website is also really good: the menu is slightly different from the navigation, providing an additional way to navigate.

If you want to put experiences online, they would like to use a balance of patients and medical professionals. Perhaps, this could be done through a movie in which you see a patient and a medical professional interacting. However, this could become very cheesy, and that is something to watch out for because it could be counter-productive as well.

Appendix O: Accessibility Requirements: Design

- 1. Video: text alternative available (A)
- 2. Audio: if audio automatically plays, users have to be able to stop or pause (A)
- 3. Images of text: images of text do not convey important information (AA)
- 4. Low or no background audio (AAA)
- 5. Timing adjustable: if there is a time limit, it can be adjusted (A)
- 6. Pause, stop, hide: for blinking or moving media (A)
- 7. No timing is an essential part (AAA)
- 8. Interruptions: can be postponed unless it is an emergency (AAA)
- 9. Re-authenticating: if session expires, user can continue after re-authenticating without loss of data (AAA)
- 10. Timeouts: users are warned if they will be logged out due to inactivity (AAA)
- 11. Three flashes: nothing flashes more than three times per second or is below flashing threshold (A)
- 12. Three flashes: does not contain anything that flashes more than three times in any one second period (AAA)
- 13. Animations from interactions: motions can be disabled (AAA)
- 14. Multiple ways: more than one way to locate a webpage within a set of webpages (AA)
- 15. Location: locations of user on webpage is visible (AAA)
- 16. Consistent navigation: consistent order of menus (AA)
- 17. Consistent identification: same functionality has same name (AA)
- 18. Help: context sensitive help available (AAA)

Appendix P: Interviews Evaluation Website, First Iteration

Physiotherapist:

When asked about the infographic on the homepage, the physiotherapist thought the steps were good. They mention that the second step is not very clear what it meant: is it that you could use it with your own exercises, or that it can be used prior to exercises? They also suggested that, if applicable, you can use the product as an actual exercise. For example, the patient might be triggered to do more difficult exercises they might otherwise not perform or with great difficulty.

For physiotherapists, it can be important to mention that using this application could trigger movements in patient relevant to their treatment. They like the visuals incorporated in the infographic rather than large texts.

They mentioned that it that it would be good to already mention research on the homepage including sources. The researcher explains that the infographic could be expanded with more information and text. This would be a good place to add research. You could also add research straight after introducing the product. Perhaps this could be mentioned this next to the promo video.

Regarding the team page and the research page, they did not have any suggestions or improvements.

When the FAQ page is showed, they thought the different features on the page made sense.

They do not need any additional information about the product. In the end, you want to experience the product, so they would suggest to add a "request a demonstration" option. They would want to see this on the homepage.

For them, the order of the webpages should be homepage, team, science, pricing, FAQ.

Psychologist:

The idea of an infographic is good and should be implemented. They think it is the most important. Moreover, they thought the title is good, which stressed that Reducept is an addition to the treatment and not a replacement. The difference between step two and step three is not yet clear. What they missed in the infographic is that pain education and the training modules are part of a treatment process, since the patient cannot just receive pain education, they need additional treatment. It needs to be clear that it is part of the treatment.

The infographic needs to contain short texts. If the practitioner wants to know more, they could choose to see more details. They also stressed that the infographic needs to be logical in order, which might become more clear through text. You can also add icons that explain the treatment has started without additional explanation, to show it is part of a whole treatment and not something on its own. They would also like to see an overview of the whole treatment and how Reducept fits within that treatment.

They expect the added value for both patient and practitioner to be added in the text in the infographic. This added value could be described as making complex content visual available for the patient. In the end, you want the treatment to become more successful. Explain in the infographic how the treatment improves for the patient. Also, they would like to see the content or information the

virtual reality application gives the patient. How do you know it actually fits with the current treatment. Explain that the patient will go on a journey through the nervous system.

The experience of patients and practitioners helps make the website obtain a personal touch.

They would not expect to see a contact button at the top of the page: they would search for the contact button at the bottom of the page. They would expect more 'information request' or 'demonstration request' at the top of the page. You can also name it differently, but direct it to the contact page.

They do not necessary need a team photo, but it also does not hurt. They think it would be nice to have the general contact option on the team photo. They would like to see who they need according to their background and to be able to contact them correctly. They would name the page contact instead of team, because they would not go to team page for the goal of contacting the team.

It is important to see who have developed the product (e.g. for a school project or from a medical perspective makes a big difference). They think it would be better to have two pages: one with the team and one for the background of the product where the roles of the team members/ founders are discussed.

For the FAQ, they like the search bar in the beginning. They also like that FAQ's are expendable. Moreover, they do not actually think the "in the practice" module fits on the FAQ page. Therefore, they would rather see search balk, FAQ, manuals, contact form. They would move it to a media page, or maybe to the research page.

They really like the science page, especially because it is a new product. They would need to see the evidence the product is based on and likes to see it at the top of the page.

They like the repeated call-to-action of purchase and referral on the pricing page. The referrals button has to refer to a list of practices where Reducept is being used. They think it could be part of the contact page, but then it should be renamed to community. However, they are doubtful: they want to have a contact page on the website, because it has a clear function. Therefore, they would suggest to make a new page with experiences of patients and practitioners and where the product is currently being used (maybe called "In the practice"). They think this is a complex issue and needs to be brainstormed about further. They would rename the pricing page, since the word also describes awards in Dutch.

For them, the order of the webpages should be homepage, research, team, pricing, FAQ.

General Practitioner:

The infographic will contain one or two sentences of text that clearly explain the step, supported by some more text that explains the step further. Here, the balance needs to be found between minimal text and enough information provided. They do like the fact that the infographic provides a clear overview of how you can use it and that the video is supported with text that explains the content of the video and the length. They also like the contact function on the homepage. They also like the idea of having more information options next to the infographic to make it more lively and interactive.

Some webpages have a contact form where the FAQ are provided under the form. When explained that a new page would be created for FAQ, they think it would be sufficient. You can also choose to mention on the contact page that you can search through the FAQ to see if the question is mentioned there.

They raised the question if the infographic would mention specific professions, after which the researcher explained that it would be more generic in order not to have professionals feel excluded when they are not specifically mentioned when others are.

As general practitioner, they do not work with intakes. Including this in the infographic would make it seem it is not suitable for general practitioners.

They think the referral option should be more present at the top of the page or it should be a separate page mentioned in the header. You either need to have Reducept yourself as practitioner, or you need to refer to a practice that has it.

It should be clear on the homepage that you can also purchase Reducept. The website should not create the impression that you can only refer to other practices where they have Reducept.

On the homepage, they like the experiences of both patient and practitioner.

When referring, it is important to also show what kind of practice it is. For example, some people do not want to go to a psychologist, whereas others prefer psychologists. If patients are reluctant to go to a specific practitioner, it could be counterproductive in their treatment. Therefore, through colour coding or initials behind the practices, a distinction can be made.

As a tip, they would have all the mail be centralised before it would reach the individual through the team page. Otherwise, you might receive too much mail if too many people want to contact a specific person. Perhaps you can address the mail to an individual, but send it to a generic mail address. This can also be changed once the problem occurs, perhaps it is not an issue.

For the FAQ page, they think the experiences in the practices does not fit in the context. They likes the module, but it does not make sense on a support page. If they would like to read it, they would not search for it on the FAQ page.

When looking at the science page, they would name it background for the top part of the page. The media articles do fit the context of the page, but the name of the page should be reconsidered (also 'background' does not fit then). When asking about the dutch title (also named Science at this point), they would not make a quick connection and they think it does not fit for a Dutch audience. Maybe you can call it background or scientific research (both suggestions made in Dutch). Maybe only research could work.

The pricing page is presented next. They thought the page is pretty clear. They raised the question if patients can order the product themselves. The researcher explained they could if they really wanted to, but the website would not promote it yet since the consumer version would be released later with different prices. What is important to add in this section is what the patient would need to pay if they would be referred to a practice that uses Reducept. Does the patient need to pay anything extra, or is it included in the normal treatment plan? This should be explained explicitly both here and in the FAQ.

Product information can be added in a few sentences on the homepage, perhaps in the infographic. More information would not be necessary.

For them, the order of the webpages should be homepage, science, FAQ, pricing, team. If there would be a referral page, they would like to see this in the front of the header.

E-health Enthusiast/Coach for Change:

For the homepage, they expect to see a VR headset directly at the top of the page. If a video would be added, their suggestion would be to make the video as short as possible (perhaps 30 seconds only).

Saying an E-health application is fun to play can be detrimental. Therefore, they made the suggestion to add "therapy compliance" as a term somewhere on the webpage, because that is the result you

want to achieve. This means patients are more invested in their treatment and more motivated due to the innovative (and fun) technology.

When looking at the graphic, they also made some specific suggestions for phrasing the steps: since the infographic is aimed at practitioners, make them the the most important in the infographic as well. For example, instead of saying that Reducept can be combined with the treatment, phrase it that the treatment can be combined with Reducept.⁷ Phrasing needs to be considered throughout the website: make the practitioner feel most important.

They suggested to add "therapy compliance" as the third point in the infographic. Moreover, their advice is to add a sixth point about reimbursement within treatment, since there are many private healthcare institutions that need to know about this information.

Moreover, they suggested to add quotes of practitioners mentioning therapy compliance: this is an important aspect and can only be validated by practitioners who have noticed a change in attitude from the patients regarding their treatment.

For the community page, they would rename the 'board of quality assurance' (bestuur van kwaliteitsbewaking). The name sounds vague and it is not directly clear what the people do for the company. Therefore, they would suggest to rename them something like 'influencers', which would directly create a sense of their added value to the company and/or product. It is then also important to add which influence they had on the product and that the influencers mention something about the product within their bio description to show that the collaboration works both ways.

Regarding the blog on the community page, they do not think it would add value. They say that you have to think about where you can reach your target users and understand how they communicate. If they let you know they do not have time to read a blog, where can you find them? Shareable content is good, since it brings visitors to your webpage. After discussing the results from the interviews, that newsletters and LinkedIn are more frequented channels, they suggest focussing on those channels and linking those posts to your website through links.

For the science page, they think it would be good to add the further development with partners, since it shows progression of the product and it is shareable content for social media channels.

Costs and reimbursements are big topics for practitioners. The interviewee suggests providing practical information on what the actual reimbursement would be and to, perhaps, give some examples.

RelieVR BV8:

Representing RelieVR BV in providing feedback would be one of the investors who has a lot of expertise with processes within the healthcare sector.

First, they like the idea of an infographic, but they suggest to add a USP per step. This way, you can easily communicate the added value of Reducept for both patient and practitioner. As an example, they say the first step could contain that the pain education complies with the IASP guidelines for pain⁹, and step four could mention that the treatment improves when combined with Reducept.

⁹ Dutch: Zorgstandaard Chronische Pijn

⁷ In Dutch, this creates a difference in emphases: "Combineer Reducept met jouw behandeling" to "Combineer jouw behandeling met Reducept", putting more emphases on the treatment by mentioning it first.

⁸ When interviewing RelieVR BV, more text had been created and more specific feedback on phrasing could be provided than in previous interviews with practitioners. Here, some of the second iteration prototype had already been completed. Therefore, not all the requirements were integrated in the second iteration prototype.

For the title of the infographic, they suggest to specify what is meant with addition: for example, say "we are the E-health support for your treatment"

Moreover, they say that practical examples should be provided where possible. Now, the website would mention that physiotherapists can use it, but mention what is a specific added value: for example, physiotherapists see an increased range of motion and psychologists can have in-depth conversations more quickly.

In general, they suggest to read through all the text out loud a couple of times, since some of the suggested texts do not fit well within the wireframes. Also, it is always better to have someone go through the texts who is unfamiliar with the subject: they can more easily identify confusing sentence structures than someone who has been working too long on a specific text.

For the footer, they suggest to rephrase the sentence. Since the footer repeats on every page, ensure to include all the import features Reducept offers. This will also increase your visibility in search engines, since the footer weighs heavy in searching for keywords of websites.

For the science page, they suggest to provide a Dutch title for the Dutch target group: even though the word might be more fitting to the content, the word is not common in Dutch and should nog be included in Dutch webpages. Moreover, a large portion of the science page would be dedicated to Lorimer Moseley. This should only be done if he agrees to collaborate with the product. Otherwise, it would be one-sided promotion, which would not work well for the integrity of the product.

The idea was to provide an overview of practices when anyone would want to refer their patients. However, the investor mentioned that you should never provide a list of all your partners or clients, since it could be an easy way for competitors to contact them and put you out of business. They suggest to show only a couple of practices as representatives. Moreover, here the reimbursement options should also be mentioned briefly or linked to more information.

For the pricing page, they find the two call-to-action buttons confusing and would prefer one action instead of having to choose between purchasing and requesting a demonstration. Additionally, they would mention the reimbursement options sooner on the webpage, since it should be clear that there are reimbursement options available. This is vital for the healthcare sector.

When talking about the different pricing packages, the investors says we should mention what type of healthcare institution this would be right for, or how many patients can be treated. This can help practitioners understand which package they should be ordering for their practices.

Within titles, the content should be very clear. This goes for the entire webpage, but as an example they mentioned that reimbursement options should be renamed to reimbursement for the practitioner, so the practitioner knows who the text is meant for directly from the title.

Appendix Q: User Requirements, Second Iteration

Must:

- 1. The website must contain contact options
- 2. The website must contain links to sources
- 3. The website must contain company information
- 4. The website must contain information about the organisation (team)
- 5. The website must contain privacy information
- 6. The website must contain information about the implementation of Reducept
- 7. The website must contain information about the dashboard
- 8. The website must contain experiences of patients with Reducept
- 9. The website must contain experiences of practitioners with Reducept
- 10. The website must contain research Reducept is based on
- 11. The website must include research results obtained with Reducept
- 12. The website must include pricing information
- 13. The website must include reimbursement possibilities
- 14. The homepage must mention that Reducept is an addition to treatment, not a replacement of the practitioner
- 15. The website must contain information about the ease of use of the technology
- 16. The website must contain information about Reducept providing both pain education and management strategies
- 17. The user must be able to request a demonstration through the website
- 18. The website must include an FAQ page
- 19. The homepage must mention that Reducept is evidence-based
- 20. The homepage must mention that Reducept is a virtual reality E-health application
- 21. The footer must contain important keywords related to Reducept
- 22. The pricing page must contain information on patient's costs after referral

Should:

- 23. The website should contain information that is actively updated
- 24. The website should include multimedia content
- 25. The website should contain downloadable content for information
- 26. The homepage should contain information about what Reducept is
- 27. The homepage should contain information about how Reducept works
- 28. The homepage should contain information about how Reducept helps patients
- 29. The homepage should contain information about how Reducept helps practitioners
- 30. The website should include the educational background of the team
- 31. The homepage should not contain pricing information
- 32. Large texts should be expandable to show more details
- 33. The website should contain visuals
- 34. The website should contain information about the mental aspect of pain
- 35. The website should contain information about Reducept for mobile
- 36. The infographic should contain descriptive titles containing an USP
- 37. The website should contain practical examples
- 38. Titles should reflect the purpose of the related text
- 39. Titles should be in the language of the page
- 40. Media articles should not be mentioned on the science page
- 41. Lorimer Moseley should not be prominent on the science page if he is not on the board of advisors
- 42. In practice examples should not be mentioned on the FAQ page

Could:

- 43. The website could include timestamps
- 44. The website could include downloadable shareable content
- 45. The website could contain a movie about how Reducept works
- 46. The website could contain the pros and cons for patients and practitioners
- 47. The website could contain information about the content of the educational training
- 48. The website could contain a section for patients to receive information
- 49. The website could include events where RelieVR BV will be present
- 50. FAQ could include a question about patient's costs after referral
- 51. Referral section could be added to the contact page
- 52. Referral section could be a separate page
- 53. Pricing packages could contain information on type healthcare institution or amount of patients it is suitable for

Won't:

- 54. The website won't adapt to the visitor for specific work domains
- 55. The website won't include a blog
- 56. Different pages for background and team won't be created
- 57. Referrals won't be added to the header
- 58. Calculations of prices with reimbursements won't be added to the website

Appendix R: Original Dutch Wireframes, Second Iteration



Bestuur van Kwaliteitsbewaking/ Influencers

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| Foto van BvK lid |
|------------------|------------------|------------------|------------------|
| Foto van BvK lid |

. .

In de praktijk

Wilt u Reliviate verwijzen voor uw patiënt? Vindt hieronder een praktijk in de buurt waar uw patiënt naar verwezen kan worden. Voor de patiënt zijn er geen extra kosten verbonden.



Wij zijn de komende tijd te vinden op de volgende evenementen:

Aankomende evenementen				
Datum	Beurs			
Datum	Beurs			
Datum	Demodag			
Datum	Beurs			
Footer				



Waar is het op gebaseerd?

Illustratie Moseley

Hier zullen we een korte uitleg geven over de theorie van Moseley en wat voor een invloed het heeft gehad op het product. Er kan hier ook een link in de tekst toegevoegd worden zodat er direct verwezen kan worden naar de theorie van Moseley.

Aanvullend Onderzoek



Header **Prijs** Wij bieden Reliviate aan in drie verschillende pakketten. Wanneer u interesse heeft, kunt u contact met ons opzoeken via ons contactformulier. Pakket B Pakket C Pakket A Feature 2 Feature 2 Feature 3 Feature 3 Feature 3 Feature 4 Feature 4 Feature 4 Feature 6 Feature 6 €1629,-€4500.-€12500,-Demonstratie Aanschaffen

Vergoedingsopties

Hier willen we uitleggen dat er richtlijnen zien die je kunt inzien om te kijken hoe je praktijk vergoeding kan krijgen voor het inzetten van e-health. Hier willen we dus gebruik maken van een linkje naar de richtlijnen. Wel eerst aanschaffen.

Patient: We willen daarnaast duidelijk aangeven dat het voor een patient binnen zijn normale behandeling past en dat er nooit extra kosten bij kommen kijken.

Neem contact op!

Zou je graag meer informatie willen ontvangen, het product willen aanschaffen of een demonstratie willen aanvragen? Vul het contact formulier hieronder in en wij nemen zo snel mogelijk contact met u op.

Contact Formulier

Footer

Header

FAQ: Frequently Asked Questions

Hoe kunnen we je helpen?

Zoeken)
Categorie A		Categorie B		Categorie C	
Vraag A	\sim	Vraag F	\sim	Vraag K	\sim
Vraag B	\sim	Vraag G	\sim	Vraag L	\sim
Vraag C (wordt dan wijder wanneer vraag lang is)	\sim	Vraag H	\sim	Vraag M	\sim
Vraag D	\sim	Vraag I	\sim	Vraag N	\sim
Vraag E	^	Vraag J	\sim	Vraag O	\sim

Antwoord op vraag E

Handleidingen



Niet kunnen vinden? Neem contact met ons op!

Contact Formulier
Footer

Appendix S: User Requirements, Third Iteration

Must:

- 1. The website must contain contact options
- 2. The website must contain links to sources
- 3. The website must contain company information
- 4. The website must contain information about the organisation (team)
- 5. The website must contain privacy information
- 6. The website must contain information about the implementation of Reducept
- 7. The website must contain information about the dashboard
- 8. The website must contain experiences of patients with Reducept
- 9. The website must contain experiences of practitioners with Reducept
- 10. The website must contain research Reducept is based on
- 11. The website must include research results obtained with Reducept
- 12. The website must include pricing information
- 13. The website must include reimbursement possibilities
- 14. The homepage must mention that Reducept is an addition to treatment, not a replacement of the practitioner
- 15. The website must contain information about the ease of use of the technology
- 16. The website must contain information about Reducept providing both pain education and management strategies
- 17. The user must be able to request a demonstration through the website
- 18. The website must include an FAQ page
- 19. The homepage must mention that Reducept is evidence-based
- 20. The homepage must mention that Reducept is a virtual reality E-health application
- 21. The footer must contain important keywords related to Reducept
- 22. The pricing page must contain information on patient's costs after referral

Should:

- 23. The website should contain information that is actively updated
- 24. The website should include multimedia content
- 25. The website should contain downloadable content for information
- 26. The homepage should contain information about what Reducept is
- 27. The homepage should contain information about how Reducept works
- 28. The homepage should contain information about how Reducept helps patients
- 29. The homepage should contain information about how Reducept helps practitioners
- 30. The website should include the educational background of the team
- 31. The homepage should not contain pricing information
- 32. Large texts should be expandable to show more details
- 33. The website should contain visuals
- 34. The website should contain information about the mental aspect of pain
- 35. The website should contain information about Reducept for mobile
- 36. The infographic should contain descriptive titles containing an USP
- 37. The website should contain practical examples
- 38. Titles should reflect the purpose of the related text
- 39. Titles should be in the language of the page
- 40. Media articles should not be mentioned on the science page
- 41. In practice examples should not be mentioned on the FAQ page
- 42. The website should contain a separate contact page
- 43. The website should contain a newsletter sign-up option
- 44. The footer should contain a privacy policy
- 45. The footer should contain the terms and conditions

Could:

- 46. The website could include timestamps
- 47. The website could include downloadable shareable content
- 48. The website could contain a movie about how Reducept works
- 49. The website could contain the pros and cons for patients and practitioners
- 50. The website could contain information about the content of the educational training
- 51. The website could contain a section for patients to receive information
- 52. The website could include events where RelieVR BV will be present
- 53. FAQ could include a question about patient's costs after referral
- 54. Referral section could be a separate page
- 55. Pricing packages could contain information on type healthcare institution or amount of patients it is suitable for
- 56. The website could contain a timeline of future development of Reducept
- 57. The website could mention the development of a mobile version of Reducept

Won't:

- 58. The website won't adapt to the visitor for specific work domains
- 59. The website won't include a blog
- 60. Different pages for background and team won't be created
- 61. Referrals won't be added to the header
- 62. Calculations of prices with reimbursements won't be added to the website
- 63. Lorimer Moseley won't be prominent on the science page [if he is not on the board of advisors]
- 64. Referral section won't be added to the contact page
- 65. Manuals won't be added to the website

Appendix T: Accessibility Requirements: Developers

<u>General</u>

- **Info and relationships programmed (A)** e.g. a button has the role of a button and not as a link, important for screenreader and blind users
- **Meaningful sequence programmatically determined (A)** Main title is programmed as H1 and subtitle as H2, etcetera, so hierarchy is programmatically determined
- Information not only provided by sensory characteristics (e.g. color, shape, etc.) (A)
 if something is a link, it cannot only be conveyed through different color but also through underline for example. Nothing is identified by one element. Also not using just icons to convey information.
- Orientation: both landscape and portrait compatible (AA) orientation is possible and no information is lost
- **Contrast: minimum 4.5:1 (AA)** ensure that text and background have a ratio different of 4.5:1. There are special tools for this. I can check this in a later stage of the website.
- Resize text: able to resize text up to 200 percent (AA) when only increasing text, user can do this up to 200% without losing information.
- Reflow: vertical or horizontal scrolling (AA) do not use both horizontal and vertical scrolling
- Non-text contrast: 3:1 (AA) icons need to have a ratio of 3:1 of contrast.
- Text spacing: programmatically determined (AA) enough space between text lines
- Content on hover or focus: controlled by user (AA) if content triggered by hovering, e.g. community, then content removed by hovering ending
- · Animations from interactions: motions can be disabled (AAA) avoid animations
- Page titled: every page has a title that describes purpose (A) title described the page (delivered in content)
- Multiple ways: more than one way to locate a webpage within a set of webpages (AA) including menu in the footer
- Location: locations of user on webpage is visible (AAA) underline in header which page the user is at.
- Language of parts: programmatically determined (A) language is indicated in programmatic language
- Consistent navigation: consistent order of menus (AA) repeated menus are in the same order, delivered in content
- Consistent identification: same functionality has same name (AA) repeated functionality has the same name, delivered in content

- Parsing: end tags programmatically determined (A) every tag starts with < and ends with />
- Name, role, value: programmatically determined (A) in the FAQ, the dropdown buttons need to be folded or unfolded, programmed in state

<u>Media</u>

- Non-text content: all non-text content has an alternative text (A) foto has a description (delivered with content)
- Video: captions are available (A) captions as a setting on a video (delivered with content)
- Video: text alternative available (A) text alternative to video available (delivered with content)
- Images of text: images of text do not convey important information (AA) images do not contain text that is important, otherwise it should be programmed as text and not part of the image.

<u>Links</u>

- Color is not the only visual means of conveying information (A) when creating a link, this cannot only be done through color change but needs something extra such as underline to show it is a link
- Link purpose: link describes purpose (A) when using links, there is a text programmed that describes where the link will go, delivered with content

Contact Form

- Identify input purpose programmatically determined (AA) in a contact form, the user can see what they need to input in the field
- Label in name: name is text visually (A) in contact form, the name is equal to the programmed label of the form
- Error identification: automatically detected (A) if user does not fill in correct mail address format or leaves field empty, this is communicated to the user
- Labels or instructions: provided (A) contact form includes labels
- Error suggestion: suggestions for corrections made (AA) if user does not fill in a correct mail address format, a suggestion is given (e.g. janedoe@mail.com)
- Status messages: programmatically determined (AA) when contact form has been send, the user sees a status message at the end

Keyboard navigation

- Keyboard: operable through keyboard interface (A) able to move through website using keyboard keys
- No keyboard trap: switching focus through keyboard possible (A) when using keyboard, you are never stuck in the website
- Bypass blocks: mechanism available to bypass blocks or repeated content (A) skip to content link at the beginning of the pages
- Focus on order: focus must be in logical order of meaningful sequences (A) when using keyboard to go through the website, the focus order is logical
- Focus visible: focus through keyboard is visible (AA) when receiving focus through keyboard, it is visible to the user on the screen
- On focus: receiving focus does not initiate change (A) if user uses keyboard, if they receive focus they do not automatically change something

Appendix U: Website Evaluation Questionnaire

Website Evaluatie

Beste behandelaar,

Als een van de vier mensen die mee heeft geholpen bij het ontwerpen van de website, zou ik je graag willen vragen om een enquete in te vullen over het eindresultaat. Alle feedback wordt meegenomen in volgende iteraties van de website. Ook zal de feedback helpen om het laatste onderdeel van mijn scriptie af te maken.

Zoals je wellicht hebt gemerkt, is de naam van RellieVR inmiddels veranderd naar Reducept. Het gaat wel nog steeds om dezelfde VR applicatie voor mensen met chronische pijn.

Per pagina zou ik kort je mening willen horen met eventueel aspecten die je mist of juist erg leuk vindt. ledere pagina heeft drie linear scale vragen en twee open vragen die optioneel zijn.

Wanneer je tijdens de enquete op de link klikt wordt deze automatisch geopend in een nieuw tabblad. Hierdoor kun je makkelijk schakelen tussen enquete en website. Ik heb gekeken of ik de website kon integreren binnen de vragenlijst, maar dat is me helaas niet gelukt. De website is het best te bekijken in fullscreen modus.

Mocht je vragen hebben of opmerkingen, kun je me altijd bereiken via <u>maaike@reducept.com</u>. Alvast ontzettend bedankt voor je medewerking!

Met vriendelijke groet, Maaike

* Required

Homepage

De homepage kun je vinden op: https://www.reducept.com/nl/

 De pagina is overzichtelijk * Mark only one oval.





De pagina spreekt me aan * Mark only one oval.

	1	2	3	4	5	
Helemaal mee oneens	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	Helemaal mee eens

4. Onderdelen die je mist of die verbeterd kunnen worden in de toekomst

5. Overige opmerkingen

Here, only the example of the homepage is shown.

The questions are repeated for the other webpages.