Telemedicine in diabetes care

The possibilities of remote patient monitoring systems in the Netherlands

Nick Benschop

Erasmus School of Economics

Bachelor Thesis Economics & Informatics

Economics & Informatics programme
Student: Nick Benschop
Student ID: 296428
Supervisor: Prof. M.W. Guah, PhD
Co-Reader: Prof. R van der Wal
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ERASMUS UNIVERSITEIT ROTTERDAM

Abstract

Diabetes poses a significant challenge to the Dutch healthcare sector. With 750.000 to 1.000.000 diabetics and an expected increase in this number by 80 percent by 2025, there are increasing concerns about dealing with the costs and being able to provide proper healthcare to all citizens. New solutions that can improve the quality and efficiency of (diabetes) healthcare could be very helpful in this situation. This thesis looks to the possibilities of remote patient monitoring telemedicine systems for diabetes care in Holland.

Research was conducted in two phases. A literature review was performed to gain an understanding of the diabetes problem and the context in which the system would be used. The second part of the research process consisted of interviews with multiple diabetes stakeholders with the purpose to collect and analyze the opinions from various experts from different backgrounds and organizations in order to acquire a complete and reliable view (of the potential of this type of system).

The system can benefit patients by reducing the impact that diabetes has on their life. It can provide them with the (personalized) information necessary for them to better self manage their condition. The system benefits medical personnel through the automation of data-related processes. In addition, it can provide them with one complete, updated database with patient records. The potential user base could be limited as a result of resistance from stakeholders. Minimizing the (perceived) negative impact of the system on stakeholders is one way to deal with this. Recent developments of large scale concepts in the Dutch healthcare sector could be helpful in acquiring a large user base. Cooperation with and between diabetes stakeholders is another important success factor for the system.

This paper describes the key advantages and functionality aspects of this type of system as well as recommendations and guidelines for large scale usage. This information can be useful for parties interested in developing another such system and/or getting it implemented on a large scale. Additional research can be performed by interviewing more stakeholders in order to get an even clearer view of the system possibilities. Additionally, once such a system has in fact been implemented on a large scale, a comparison can be made between its real life characteristics and those described here. From an economic perspective it would also be interesting to investigate the exact costs and cost effectiveness of this type of system in future research.

Acknowledgements

This document is the result of three months of research on the possibilities of remote patient monitoring telemedicine systems for diabetes in Holland. Overall, it has been a very interesting and rewarding experience for me and I would like to take this opportunity to thank the people who helped to make it possible.

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- Mr. Jonathan Emmerson, Director of Telehealth at Lifescan
- Mr. Dirk Pons, executive manager of DSW
- Ms. Joan Onnink, advising physician at DSW
- Ms. Hannie Bonink, program coordinator at ZonMw
- Mr. Edo Westerhuis, responsible for product development and functionality at Portavita.
- Ms. Nannette Huizenga, project leader of the e-diabetes programme at the Dutch Diabetes Federation

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Chapter 1: Introduction

1.1 Chapter introduction

The purpose of this chapter is to provide some general information about the thesis subject and its context. It starts by providing relevant background information about diabetes and the state of diabetes (care) in Holland specifically. This is followed by a discussion of the current situation as well as expectations for the future. Basic information about telemedicine and its possibilities for chronic diseases are described as well.

Next, focus shifts to describing the importance of research in this area as well as the research aim, objective and scope. Next, it provides an overview of the other topics that are discussed in this research paper and the structure of the thesis as a whole. The chapter ends with a short summary of what was discussed.

1.2 Thesis background

The focus of this research paper is on the possibilities of remote patient monitoring telemedicine systems for diabetes care in Holland. MedicineNet.com describes diabetes as follows, quote:

- *"Diabetes … is a group of metabolic diseases characterized by high blood sugar (glucose) levels, that result from defects in insulin secretion, or action, or both."*
- *"Diabetes is a chronic medical condition, meaning that although it can be controlled, it lasts a lifetime."*
- *"Over time, diabetes can lead to blindness, kidney failure, and nerve damage…Diabetes is also an important factor in accelerating the hardening and narrowing of the arteries (atherosclerosis), leading to strokes, coronary heart disease, and other large blood vessel diseases."* [1]

A recent survey by the Central Bureau for Statistics shows that in 2008 a total of 4 percent of the Dutch population indicated to suffer from diabetes [2]. A report by the Netherlands National Institute for Public Health and the Environment estimated that in 2007 there were 740.000 people in Holland that were diagnosed with the disease [7]. In 2003 there were an estimated additional 250.000 people who have the disease that have not yet been diagnosed. Dutch diabetes organizations, such as the Dutch diabetes fund, estimate that the actual current number of diabetics in Holland is approximately one million [6]. This translates to over 6 percent of the total Dutch population.

The outlook for the future is quite bleak. The number of people with diabetes has increased each year since 1996. The amount of new diagnoses each year is increasing as well [8]. It is now estimated that there will be an increase of patients by 32 percent by the year 2020 due to aging of the population alone [9]. A much higher increase is however expected as a result of the increase in the amount of people with weight problems [8]. Current calculations already estimate that the number of people with these weights problems will increase by 50 percent in the next 20 years [10].

As a result, there is a lot of concern about the current developments with diabetes. The Dutch Central Bureau for Statistics, the Dutch pharmacists' branch organization and the Dutch Diabetes Federation delivered a shared press statement in 2007 in which they stated that diabetes is the largest threat to Dutch public health in the future [9]. The concerns stem not only from a healthcare perspective but from an economic perspective as well. The costs of diabetes increased from 735 million euro in 2003 [3] to 814 in 2005 [4]. This is an increase of 10 percent in just two years. This leads to a lot of concerns about the affordability of healthcare. This research describes the potential role that telemedicine systems could play and the possible benefits it could provide for diabetics and diabetes care in general. Telemedicine is, quote:
"*The delivery of health related services using telecommunication technologies*" [12].

In doctor-to-patient telemedicine this communication takes place remotely between a care provider and his patient(s). The specific telemedicine system that is important for this research focuses on remotely monitoring patients with diabetes. Amongst other things, this type of system enables patients to electronically send relevant data (such as blood glucose readings) directly to a doctor from their own home. While small scale instances exist both in the Netherlands and abroad, such a telemedicine system is currently not being implemented on a large scale in the Netherlands.

1.3 Research aim, objective & scope

Recently there has been a lot of interest in telemedicine as a method to combat several problems in the healthcare sector, including chronic diseases. Reports have shown that doctor-to-patient telemedicine systems for chronic patients can have a positive effect on several aspects of these diseases [12-14]. For example:

- Costs can be reduced by enabling patients to stay at home, emptying hospital beds.
- The impact of the disease on a patient's life is reduced by eliminating physical trips to the doctor for check ups. Vital data is now transmitted electronically from the patients' home.
- Data is collected, stored and analyzed at one central location. With better, more and up-to-date data healthcare personnel can provide more effective treatment.

These advantages do not exist just in theory but they are (to some degree) already being realised in practice. More and more of these telemedicine systems are being developed and applied in real life situations. As stated before, examples of remote patient monitoring systems for diabetes exist as well and will in fact be described later in this paper. However this technology is still very new and it is not yet being implemented on a large scale. Also, while there is a lot of interest in the implementation of telemedicine, there is little information on exactly what role these type of systems realistically could play or the actions that have to be taken to arrive at this role [12-14].

Remote patient monitoring systems have the potential to provide big advantages related to the diabetes problem. This research is relevant because it investigates if these advantages can apply to Holland and if these systems could be implemented (successfully) in the future. The aim of the research is firstly to investigate the potential of this type of system for diabetes care in Holland. Secondly, the research focuses on determining why the system is not yet being used on a large scale and finding out what factors can contribute to the success of the system in the future.

1.4 Thesis structure

The literature review is the topic of chapter 2. It describes and summarizes the information that is currently available on topics such as the problem and impact of diabetes in Holland, the potential effects of telemedicine for healthcare related to chronic diseases and possible obstacles for (large scale) implementation of these types of systems. Chapter 3 describes the methodology that was used to perform this research. It also presents the rationale behind these choices. In this chapter, the main research question and the research sub-questions are presented as well.

Chapters 4 through 8 are case studies. They describe the outcomes and relevant information that resulted from interviews with several relevant experts and stakeholders related to diabetes treatment. These people are linked to organisations such as system developers, a health insurance company and an organisation that promotes healthcare research. Chapter 9 provides the outcome of the data analysis that was performed on all the information that was made available by the interviewees. Finally, chapter 10 is the conclusion which, amongst other things, answers the research question(s).

1.5 Chapter summary

This chapter showed that diabetes is a chronic disease and that there are many people in the Netherlands who suffer from this illness. Since diabetes is not curable, yet stays with a patient for life, costs of diabetes and other chronic diseases make up a significant portion of the total healthcare budget. Unfortunately, a significant increase of the number of diabetics is predicted to occur over the next 10 to 15 years. This naturally leads to a lot of concerns about topics such as affordability and the ability to provide quality healthcare to all these people.

The term telemedicine comes up more and more often as a potential method of dealing with or reducing the impact of these problems of chronic diseases. Studies as well as small scale pilot tests have shown that doctor-to-patient telemedicine systems could provide some substantial benefits in this area.

The scope of this research focuses on one such system in particular. The type of system that‘s investigated in this paper operates by remotely monitoring patients with diabetes. The aim of the research is firstly to investigate the potential of this type of system for diabetes care in Holland. Secondly, the research focuses on determining why the system is not yet being used on a large scale and finding out what factors can contribute to the success of the system in the future.

The findings and conclusions of this research are presented in the following chapters. They describe the following topics in this order:

- Literature review
- Research methodology
- Case studies
- Data analysis
- Research findings & conclusion
- References & Appendices

Chapter 2: Literature review

2.1 Chapter introduction

The purpose of this chapter is to describe and summarize the information that is currently available in this area of research. This study was performed in order to collect necessary background information and to gain an understanding of the problem of diabetes and the context in which the system would be used. Additionally it functioned as a knowledge foundation for entering the interviews and a basis for selecting interview questions.

This section is split up into several parts that each focus on specific aspects of diabetes (care) and/or telemedicine. The first topic discussed focuses on the problem and impact of diabetes in Holland, now and in the near future. Next, the potential effects and benefits of telemedicine for healthcare related to chronic diseases are discussed. After that, attention is given to the possible obstacles for (large scale) implementation of that these types of systems might face in Holland. Like the previous chapter, this one too ends with a short summary.

2.2 The impact of diabetes in the Netherlands

According to the Dutch Central Bureau for Statistics, the Dutch pharmacists' branch organization and the Dutch Diabetes Federation, diabetes will be the largest threat to the Dutch healthcare sector in the future [9]. It is however difficult to determine exactly how many people in Holland have diabetes since there are many people who have the disease that have not yet been diagnosed. Recent numbers however sketch an unpleasant image. A recent survey by the Central Bureau for Statistics shows that in 2008 a total of 4 percent of the Dutch population indicated to suffer from diabetes [2]. A report by the Netherlands National Institute for Public Health and the Environment estimated that in 2007 there were 740.000 people in Holland that were diagnosed with the disease [7]. Unfortunately, the actual number of diabetics is expected to be higher since some diabetics have not yet been diagnosed. In 2003 the number of people that fall into this category was already estimated to be 250.000. Because of this, Dutch diabetes organizations, such as the Dutch diabetes fund, estimate that the actual current number of diabetics in Holland is approximately 1.000.000 [6]. This translates to over 6 percent of the total Dutch population.

With regards to the costs related to diabetes it is also difficult to put down an exact number. Not only is this because there is no certainty about the exact number of diabetics but also because there is a debate on whether or not diabetes-related complications should be taken into account and if so, to what degree. These two factors have a big impact on the cost estimates of diabetes.

To demonstrate this point the Netherlands National Institute for Public Health and the Environment published two reports which included the costs of diabetes for 2003 [3, 5]. Both based their estimates on 600.000 diabetes patients for that year [8]. The first report only took into account a very small part of the costs of diabetes-related complications while the second report included the costs of these complications.

Cost according to report 1 [3]: around 814 million euro total or 1350 euro per patient

Cost according to report 2 [5]: around 1.200 million euro total or 1900 euro per patient

While this in itself is quite troubling, it is not the most worrying aspect diabetes in the Netherlands. The real problem lies with the rapid growth of this disease which has been following a specific trend since 1996. Since then, the number of diabetics in Holland has increased each year [8]. Additionally, the number of new patients per year is increasing as well with 71.000 new diagnoses in 2007 [7]. Between 2003 and 2005 alone the total costs of diabetes have increased by over 10 percent [3, 4]. This trend leads to some very worrying predictions for the future. One report estimates an increase in the total number of diabetics by 32 percent as a result of the aging of the population alone [9].

Another factor that can negatively contribute to the diabetes problem is the increase in the relative percentage of people over the age of 65 (from 14 to 25 percent [11]). This is especially worrying since older people account for a relatively high percentage of the total costs of diabetes, as can be seen in figure 1. Aging of the population is however not the only factor which will cause a large increase in the amount of diabetics. The estimated 50 percent increase in the number of people with weight problems in the next 20 years [10] is expected to negatively contribute as well [8]. Combining these and other factors, the Netherlands National Institute for Public Health and the Environment predicts in their latest report that the total number of diabetics will increase by 80 percent in the period of 2007 to 2025. This would lead to an estimated number of 1.300.000 total diabetics in Holland [7].

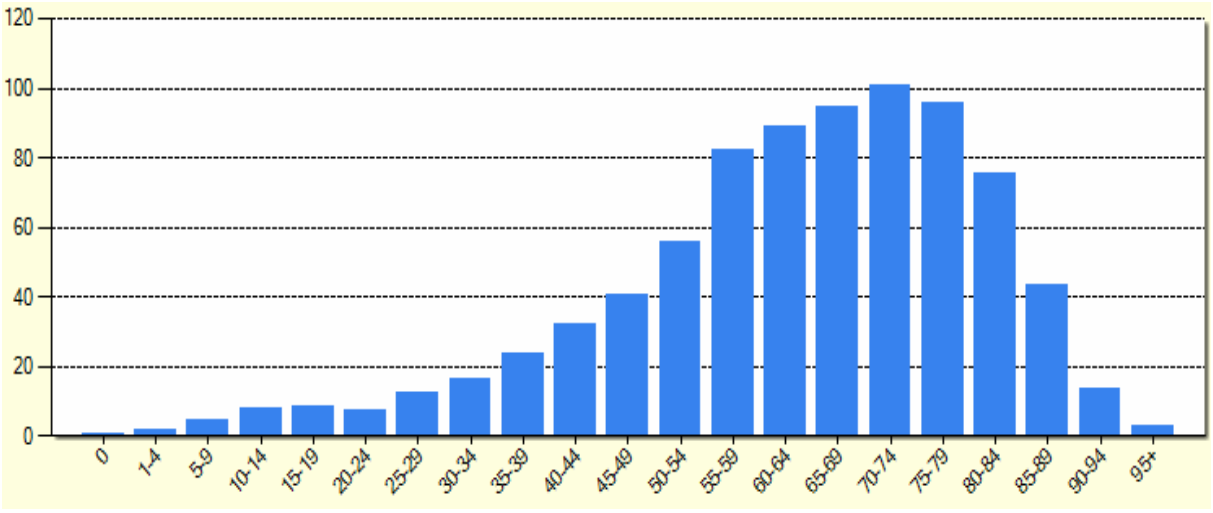

Figure 1: Costs of diabetes in Holland in 2005 per age group (in millions of euro) [43].

2.3 The potential of telemedicine for chronic diseases healthcare

Recently there has been an increasing amount of interest in telemedicine as a possible solution for improving the quality and efficiency of (chronic diseases) healthcare. According to the literature, it is believed to be capable of realizing multiple improvements in this area related to [12, 14, 19]:

- The effectiveness of healthcare (getting the most out of a healthcare service).
- The efficiency of healthcare (realise your goal through the least amount of resources).
- The quality of life for patients
- Improvements with regards to information quality, quantity and availability
- Accessibility of healthcare
- Reducing the workload for healthcare professionals
- Better information quality and easier information sharing

The list below shows some specific benefits that are more applicable to remote care for patients with chronic diseases [12, 14-16, 18].

- Reduce the amount of time spend on face to face meetings with healthcare professionals, hospital visits and regular check ups via digital information exchange.
- Preventing complications or catching them early through better information (analysis)
- Software takes care of data gathering, updating and analysis so that healthcare personnel can spend their time on other activities.
- Regular data analysis and personalised advice help patients to better control their disease.

Of course, telemedicine is not some perfect solution to all problems. Telemedicine systems also have their disadvantages, especially when they are not designed or controlled properly. Some possible issues mentioned in literature [13-15] are:

- Additional training for healthcare personnel is required to use these systems successfully. Also with using these systems, changes to their daily activities will likely occur.
- Privacy. Sensitive data is being gathered and transmitted electronically. This makes it easier for information to fall into the wrong hands.
- Quality of data. For some of these systems it is the patient's responsibility to enter data into the system. How error prone is this method?
- Changes in the doctor to patient relationship. Most specifically this relationship will become less personal since the amount of physical contact is reduced.
- The people who pay for the system are not always receiving the benefits of this system. This does not stimulate the purchase of such systems.
- Even when these people do receive the benefits of the system it may take a long time to achieve favourable returns on their investment.

2.4 Potential obstacles for successful system implementation

Up to this point the literature study has shown two things. Firstly it made it clear that the diabetes problem in Holland is a significant one which is also expected to drastically increase in the coming years. Secondly, it showed that a lot of potential is seen in (doctor-to-patient) telemedicine systems to combat these problems or to at least noticeably reduce their impact. Yet, why are these types of systems not (yet) being implemented on a large scale then?

Some believe an important reason for this to be that these telemedicine technologies are still very new. New promising technologies are often met with a lot of criticism and resistance at first, such as with the personal computer and the internet [20, 21]. Several sources from literature however believe that there are also multiple other barriers that can also stand in the way of telemedicine systems. They can be grouped into four main types of barriers [12, 14, 15, 18-20, 23]:

1. Financial and reimbursement barriers.
2. Cultural barriers.
3. Legislative barriers.
4. Barriers in collaboration between stakeholders.

Of course not all of the barriers that fall under this type will affect the success of the particular telemedicine system that is the focus of this research. In fact, not even every main type of barrier has to pose a problem. However, since they affect telemedicine systems as a whole, it is likely and logical that at least some of them affect our specific system as well. This makes them an interesting subject for further investigation later in this paper.

2.5 Chapter summary

The literature review has shown that diabetes is a significant challenge that the Dutch healthcare sector faces and will face in the coming years. The amount of diabetics in Holland today is estimated to be in the range of 750.000 to 1.000.000, with an estimated average cost per patient between 1350 and 1900 euro per year. On top of this, the number of diabetics is expected to increase by 80 percent before 2025. Telemedicine is described to potentially realize several important benefits in the area of chronic disease management. These relate to amongst others accessibility, efficiency and the effectiveness of healthcare through automation and/or digitalization. Of course, there are also some potential problems of these systems in the areas of privacy, reliability, costs and impact on the care process. Lastly, this chapter described several obstacles mentioned in literature that could hinder the success and implementation of this type of systems. These could be financial, cultural, legislative in nature or be related to collaboration issues between stakeholders.

Chapter 3: Research methodology

3.1 Chapter introduction

This part of the paper describes and explains the rationale behind the methodology that has been used to perform the research. It begins with a general overview of the data collection and research process. The main research question and the corresponding sub-questions are stated after this. Next, focus is placed on several aspects of the research process including the epistemological stance, the fieldwork research procedure and the data analysis technique. These are each described and discussed in more detail than they have been in the general methodology overview. As usual, this chapter ends with a short summary of the topics discussed.

3.2 Methodology overview

Research has been conducted on the possibilities of remote patient monitoring systems for diabetes care in Holland. It is important to realise here that such a system is currently not (yet) being used successfully on a large scale. Because of this, the full benefits, limitations and impact of such a system can not be directly observed or measured. Instead, information has taken the form of opinions and expectations of experts and stakeholders involved with the field of diabetes care. The goal here is to gather, understand and analyse the statements and views from various experts from different backgrounds and organisations in order to acquire a complete and reliable view (of the potential of this type of system).

During the research process, data has been collected from literature with the purpose of collecting background information and gaining an understanding of the problem and its context. The literature study chapter has shown that in theory there is great potential for these kinds of systems. This makes it very relevant to find out if and to what degree these theoretical benefits translate to practice. Additionally, it is important to investigate why such a system is not yet being implemented on a large scale.

For this purpose, a qualitative research approach has been selected. The most relevant information for this research has been obtained through interviews with a small group of relevant stakeholders. The interviews were (mostly) taken in person and consisted of a small number of open questions. Each of these meetings with experts serves as the basis of a case study, described later in this paper. These case studies have the purpose to provide the information necessary for proper data analysis, which is used to answer the main research question and the research sub-questions.

3.3 Main research question & sub-questions

The focus of this research is a type of system that looks very promising in theory. Several real-life instances of this kind of system have also been able to achieve success on a small scale. In fact, two of these are the focus of case study chapters 4 and 5. However, as has been stated before, such a system is not yet being successfully implemented on a large scale. The aim of the research is firstly to investigate the potential benefits and limitations of the system for diabetes care in Holland. Secondly, the research focuses on determining why the system is not yet being used on a large scale and finding out what factors can contribute to the success of the system in the future. The resulting main research question that has been chosen for this paper is:

"What are the possibilities of remote patient monitoring telemedicine systems for diabetes care in Holland?"

In order to gain an understanding of the relevance of the system and the benefits that it can provide, it is required to first acquire an accurate view of the current state of diabetes care in Holland and the size and potential impact of diabetes, both for the present as well as the (near) future. This and the remaining other aspects of the main question are investigated individually and answered using four sub-questions. The sub-questions for this research are:

1. *"What is the current state and impact of diabetes (care) in Holland and what are the expectations for the near future?"*
2. *"What is the potential impact of a remote patient monitoring system for diabetics in Holland?"*
3. *"What is the potential impact of a remote patient monitoring system for diabetes care providers in Holland?"*
4. *"For what reasons is this type of system not yet being implemented on a large scale in the Netherlands and what factors can contribute to realizing this implementation in the future?"*

3.4 Epistemological stance

One common use of interpretive research is to understand phenomena through the meanings that people assign to them. For such a system, where the success is determined by how people perceive it and how willing or likely they are to accept or support the system, this information is very relevant. There is currently no certainty of the potential role that such a system can play and the impact that it could have on diabetes care in Holland as a whole. By collecting, understanding and analyzing the views and opinions of several sources of expert knowledge this research can produce an understanding an understanding of the system context and possibilities. Interpretive research has been selected as the epistemological stance for this paper because it can best support this process.

3.5 Fieldwork research procedure

The choice was made to split up the research process into two distinct parts. The first part consisted of conducting the literature study, which is presented in chapter 2. This was done in order to collect necessary background information and to gain an understanding of the problem of diabetes and the context in which the system would be used. The information collected in this process has been used to answer the first research sub question.

In order to answer the remaining sub questions, contact was made with several important stakeholders and experts from different backgrounds in the area of diabetes care. Having the potential of the system discussed and analysed from many different perspectives was important for developing an understanding that is complete and less prone to bias. Because of this, the choice was made to interview people from six different organizations instead of the standard three or four (for bachelor theses). These are briefly described below.

Companies T+Medical and Portavita have both developed a system that provides the remote patient monitoring possibilities on a small scale for diabetics in several foreign countries and the Netherlands respectively. Lifescan is one of the largest producers of blood glucose meters that has recently started to collaborate with T+Medical to investigate the possibilities of implementing this system on a larger scale. The fourth organisation that was selected is the Dutch Diabetes Federation, or NDF, which is a coordinating organisation that brings together care providers, scientists and diabetics (organizations). During its existence, the NDF has worked on developing many different initiatives aimed at ensuring and improving diabetes care in Holland. DSW is a Dutch health insurance provider that operates on a regional scale and has taken an active approach towards the possibilities of ICT to improve the quality of healthcare. The Netherlands Organisation for Health Research and Development, or ZonMW, is a Dutch organisation that promotes quality and innovation in the field of health research and healthcare. It has a specific program that focuses on diabetes.

Contact was made with the organizations and, where possible, meetings were scheduled for personal interviews. These interviews lasted between 45 and 90 minutes and consisted of a limited number of open questions which were sent in advance. This allowed the experts a certain degree of freedom to focus on what they believed to be the most important aspects and factors with regards to the system. For companies T+Medical and Lifescan a personal meeting was not possible since both contacts live abroad. In this case a more structured question list was sent electronically and where needed additional information was requested afterwards.

3.6 Data analysis technique

Previously in this chapter it was stated that the most important part of the research process revolves around the gathering, understanding and analysis of the information provided by the interviewees. The gathering activities have been described on the previous page. The understanding process included the literature study on the subject and using this as a knowledge base before entering the interviews. Additionally it helped that follow up questions could be asked if anything was unclear, due to the fact that most interviews were personal.

The data analysis process encompassed several steps. First, the information from each interview was sorted and grouped into four or five main topics per case that were relevant for the research topic. Data that did not effectively contribute to answering the research sub questions or main question was filtered out. This provided a clear view of (the structure of) the totality of relevant information that was collected in this manner. The information from each case was then systematically examined and also compared to the data from other cases.

An assessment of the relevance of the information was based on several things such as the potential impact it could have with regards to certain aspects of the system (usability, usefulness, implementation process), the degree of importance attached to it by the stakeholders and the number of stakeholders that mentioned the same specific subject. This whole process of collection data sources, obtaining information, performing data analysis and reaching conclusions is shown in figure 2.

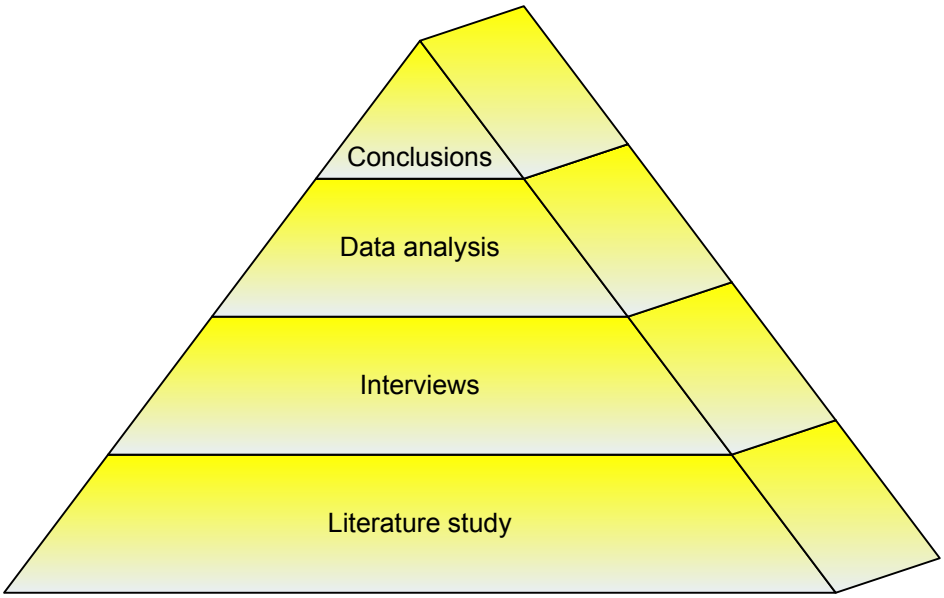

Figure 2: Research data overview

3.7 Overview of alternative strategies

Now, focus momentarily shifts to the other options that were available but not selected. The research was chosen not to be quantitative in nature due to the nature of the subject of this paper. Examples of large scale implementations of this type of system do not yet exist and therefore cannot be directly observed or measured. Because of this, knowledge from experts and relevant stakeholders become a very important source of information. For acquiring and analysing complex and mostly non-quantifiable information from a small number of people, qualitative research is more fitting. Interpretive research was chosen because the data is not objective or measurable in quantities (ruling out positivist research) and additionally the main emphasis is not on social behaviour or human rationale (which makes critical research unsuitable). The alternatives of action research, ethnographic study and grounded theory research were rejected because the subject of this research does not yet (and cannot be made to) occur in reality (on the required scale). Also, case studies really fit well with interviewing a small numbers of experts.

3.8 Chapter summary

This chapter described and explained the rationale behind the methodology that has been used to perform the research. The methodology was determined by and fitted to the nature of the research (subject). The choice was made to acquire the required information from several experts and stakeholders involved with the field of diabetes care with different backgrounds. For this purpose, qualitative research was the best fit. More specifically the choice was made to collect this information from interviews with contacts at various organisations. The research process was split up into two parts. The first part consisted of the literature review. This was done to collect necessary background information and to gain an understanding of the problem of diabetes and the context in which the system would be used. Additionally it functioned as a knowledge foundation for entering the interviews and a basis for selecting interview questions.

In the second phase, contact was made with the organizations and, where possible, meetings were scheduled for personal interviews. These consisted of a number of open and broad questions that allowed the interviewees to focus on what they believed to be the most important aspects and factors with regards to the system. In the data analysis process information from each interview was grouped into a number of categories and data irrelevant to the research (main- and sub-questions) was discarded. Data for each case was then examined and compared to information from other cases. An assessment of the relevance of the information was made based on aspects such as the potential impact, the degree of importance attached to it by the stakeholders and the number of stakeholders that mentioned the same specific subject.

Chapter 4: Portavita case study

4.1 Chapter introduction

Portavita is a rapidly growing, IT company in Holland with 24 employees. The company focuses on the healthcare sector and has created a multidisciplinary Electronic Health Record system (Dutch: multidisciplinair Keten Informatie Systeem) that has been operational since 2002. This system provides an overview of relevant data, both for the patient as well as care providers, for a growing number of chronic diseases including diabetes. The system enables remote patient monitoring by allowing diabetics to enter their relevant test data and values on a website. The remainder of this chapter describes the outcomes of an interview with Mr. Edo Westerhuis and his personal view on the possibilities of this type of system. Within Portavita, Mr. Westerhuis is responsible for product development (and functionality specifically). Note that this section discusses certain (functionality) aspects of the organisation's diabetes system. For a general overview of this system please refer to: http://www.portavita.nl/bedrijf/index_en.html

4.2 Transparency & availability

The meeting started with a short demonstration which showed the workings and functionality of the system. Here, it quickly became clear that the main benefits that the system aims to provide are transparency and availability. The system has the ability to store a great variety of relevant information such as an appointments log, lab results, current medications and available treatments as well as guidelines on when and how often these should or could take place. While it can be very useful to have all this data available it is important to note that it is not available to just anyone, due to the private nature of the content. A patient's own general practitioner decides who is authorized to access (specific parts) of this information.

Since diabetics can come into contact with many different care providers who each have their own patient records there was often data fragmentation, redundancy and lack of a complete overview. Using this type of system can solve those problems by collecting, storing and making available a complete file of patient information at one central location. As a result of these improvements on (the quality of) information, better fitting solutions can be selected for the patients and less errors as a result of lacking information (for example with regards to medicine usage) will be made. An additional factor that contributes to this is the possibility for diabetics quickly and more regularly update their records with new information and test results. By automating these information-related processes the workload of personnel in the healthcare sector can be reduced, which is another important benefit that the system could provide.

4.3 Patient empowerment

Diabetes is a disease that affects patients throughout their entire life so reducing the impact can make a big difference. By enabling patients to transmit their test results digitally, doctors can get a general idea of the patient condition and progress. This could result in a decrease in the required number of face-to-face control sessions for patients who are progressing well. Additional patient benefits are enabled via the internal messaging possibilities of the system. This allows them to more easily contact their care providers to ask for advice or to answer specific question, without having to leave their home. The system can also perform data analysis and generate reports or assessments of the patients' performance and provides advice based on the results. It shows them how they are progressing and what effect certain measures/behaviour can have. Information is provided in the form of lab results which are now more accessible and become available more quickly. This empowers patients to better prepare themselves for the next meeting with their care provider. These aspects of the system can be helpful in allowing patients to better manage their disease. It is possible that, with this information, patients will also become more enthusiastic to do so.

Figure 3: Digital logbook for diabetes treatments in the Portavita system.

Another advantage that the system provides is an overview of diabetes-related tests/controls along with their recommended frequency. This is shown in figure 3. The system also keeps a log of previous treatments and consultation/control outcomes. Keeping track of treatments, prescriptions and doctor's advice can be helpful in case patients forgot them and it saves patients the trouble of having to give the same information over and over to medical personnel. It is also important to note that the logging of all this information provides for accountability of care providers, which could push care providers to get even more involved with their patients. This could help to reduce medical errors. Due to its many benefits for patients the system has been awarded with the consumer award for diabetes chain care by The NPCF [24].

4.4 System limitations

During the meeting it became clear that the Portavita system had certain limitations as well. It was acknowledge that automated data analysis is limited and also quite difficult beyond standard rules and situations. This means that the system can only give some degree of advice to diabetics and that possible improvement suggestions can be tailored to specific patient needs to a certain extent. Secondly, the system has the potential to reduce the amount of physical visits required but only by a certain amount. Diabetes care cannot (yet) be fully automated and some physical contact will still have to take place.

Thirdly, it is important to realise that a significant group of diabetics is poor at self management. This is usually a result of lacking motivation or involvement. While the system is said to be able to increase both of these, this is likely only the case for patients who are willing to give the system a chance and are already motivated to some extent. Then there are also some other limitations to consider. Because organisations in the healthcare sector often have to work with set budgets, money can definitely be an issue. As a result the system functionality might be purposely limited to lower its price. Unfortunately this might mean that the demands of system buyers get priority over demands of other stakeholders, which might ultimately be more useful.

Another limitation in this area stems from the fact that getting from pilot project to large scale implementation is a very big and difficult step to take. In fact a lot of promising pilot projects seem not be able to get past this point. This is because it requires a party that would benefit greatly from the system in order to get sufficient funding/support. In Mr. Westerhuis' experience, insurance companies are so far reluctant in taking up this role.

4.5 Sources of resistance

Outside of the system limitations or perhaps because of them there are several sources of resistance to innovative IT systems such as these. During the interview it was mentioned that the culture of healthcare personnel is a good example to this. Amongst care providers there is a general resistance to performing additional tasks and using yet another system, especially when they do not see the benefit. This is especially troublesome since it is difficult to prove the exact value of the system compared to the current situation (more on this in chapter 5). Additionally, medical personnel are generally averse to the idea of being monitored or logged and they don't want to be caught doing something wrong.

Care providers are however not the only group that includes people that are resistant to the system. As stated earlier, there is a group of patients who are not enthusiastic about self managing their disease and thus it is likely that they are not motivated to use such a system. Diabetics might also resist the system for other reason such as a resistance to IT in general. Some people will always prefer physical visits over automated or digital ones and will not make use of (most of) the possibilities of this system. These reservations exist especially for systems like these that deal with private information. Privacy and security are two major concerns here that are shared by patients and care providers alike. These general concerns are also interwoven into Dutch legislation. With regards to innovation, healthcare and security, this is very rigid which makes it more difficult to successfully introduce such a system.

4.6 Making the system a success

Support of important stakeholders such as care providers and patients is a critical factor for success of this type of system. Convincing people of the benefits of the system is however not an easy task since they can often doubt the subjectivity of the company selling the system. In order to convince them of the improvements that the system can bring pilot tests should be actively conducted and results should be made public. Leadership and involved champions of the system amongst healthcare personnel are also important factors. People in the healthcare sector are more likely to trust the opinion of other care providers and thus are more likely to accept and/or support the system.

Once stakeholders are interested in the system it is important to tailor the it to their needs in order to minimize the negative impact that it will have, for example by forcing them to make big changes to their work process or presenting them with more work overall. In this respect, the aim should be to really fit the system in well with their current activities and systems used. Preferably there would be one central national system that is build according to standards (such as the HL7 V3 care standard [25]). By using such a national standard the system can be more easily supported, connected to or integrated with existing systems in healthcare (such as the Huisartsen Informatie Systeem [26]). This will make the system easier to understand and more attractive. This is especially true if this system is going to be implemented for multiple chronic diseases. Not only will this help people to be more familiar with the system functionality but it also makes the system more robust and trustworthy for people when they see that it has already booked success with other chronic diseases in the past.

There is however more to it than that to making the system a success on a large scale. All those involved need to do their part and work together to get the system implemented. In this case, an active approach of taking action instead of only talking is vital.

Portavita itself has experienced that the project moved along a lot quicker once they started making example templates for their system and requested specific feedback afterwards. Patients and (by extension) insurance companies should also take a more active stance by generating demand. Healthcare personnel should look past just achieving their own personal goals. Instead they should work together and share the costs and benefits of the system. Recent developments show that the Dutch healthcare sector is already beginning to move in this direction. These are the 'zorggroepen' (coordinating organisations for all primary healthcare, or those involved with a specific disease, in a specific region) and the 'keten dbcs' (diagnosis-treatment combinations which take into account the complete set of actions and treatments related to a specific disease/diagnosis). They could bring large scale acceptation and implementation a big step closer.

4.7 Chapter summary

This chapter has described some important advantages to the use of remote patient monitoring systems for diabetes. Such a system that collects, stores and makes a complete patient file available at one central location can help to reduce common problems in the healthcare sector of data fragmentation, redundancy and lack of a complete overview. As a result it can reduce medical errors, enable care providers to select better fitting solutions while at the same time reducing their work.

Diabetics benefit because the system provides them with more and useful information about their condition as well as personalized advice for improvements and an overview of their progress. This can enable them to better self manage their disease and might even help to motivate them to do so. Additionally the system could reduce the amount of personal meetings that a patient would require while on the other hand enabling them to contact their care providers more easily, digitally.

The system is however still limited in its ability to provide automated data analysis and advice. A significant part of the diabetes care processes cannot be automated and will still have to be performed by humans. Additionally there might be resistance to such a system by different stakeholders. The causes of this vary from concerns about privacy, change or addition to the existing workload, costs, usability or IT in general.

Support of important stakeholders such as care providers and patients is a critical factor for success of this type of system. In order to realise this, action has to be taken to convince people of the benefits and potential of the system. At the same time an effort must be made to minimize the negative impact of the system. It is a difficult process to attain large scale acceptance and implementation of such a system and each stakeholder must contribute to make this happen.

Chapter 5: T+Medical & Lifescan case study

5.1 Chapter introduction

T+Medical is a multinational company that provides disease management systems for chronic diseases, including diabetes. Patient data is transmitted by mobile phone and added to the system database. T+Medical itself is responsible for storing and providing the data and makes uses of trained nurses to manage patient data. Lifescan is one of the largest producers of blood glucose meters that has recently started to collaborate with T+Medical to investigate the possibilities of implementing this system on a larger scale. The remainder of this chapter describes the personal views of contacts from both companies on the system and the results of the question list that was sent to them. Mr. Tim Clover is the former CEO of T+Medical is currently a partner at Fidelity Investments. Dr. Jonathan Emmerson works at Lifescan as the Director of Telehealth and is responsible for day-to-day cooperation between both companies. Note that this section discusses certain aspects of the T+ diabetes system. For a general overview of this system please visit:
http://www.tplusmedical.co.uk/information/01Patients--04tplus_diabetes.html

5.2 Improving diabetes care efficiency

The literature study of this research showed that the amount of diabetics is expected to increase dramatically over the next 15 years. Additionally, since people will generally live longer and since diabetes is (currently) incurable, the demand for diabetes care is expected to rise significantly as well. When taking into account that there will be relatively fewer people who are of working age and that chronic diseases already account for a large part of the total medical expenses, it becomes easy to see that this will be a big problem. A system that could help to provide care to more people at relatively fewer costs while still enabling a high quality of healthcare could potentially play an important role in this situation. Both interviewees agreed that there is a lot to be gained in improving the efficiency of (diabetes) healthcare.

The system can improve the efficiency of healthcare personnel by automating certain tasks and taking these out of their hands. Care providers will save time on the gathering, storing, presenting (and to a certain extent, analysing) patient data. By gathering this data and making a single complete record of each patient available at an easily accessible location, data redundancy can be minimized. As a result, additional time is saved which care providers can spend on other things. It was mentioned that a specialised nurse using the system could monitor the results and progress of up to 1.000 patients and provide them with advice to manage their condition. In contrast, nurses who provide healthcare without using such a system could only manage around 50 patients on average.

This means that the system could provide a dramatic increase in the amount of patients that nurses could manage. Additionally this would mean that relatively fewer nurses would be needed to service the total population of diabetics. Additional efficiency gains are realised by changing the interaction between care providers and patients. Diabetics using the system gain more responsibility. They can perform their own tests and can easily send the outcomes to the system using a mobile phone. Because the system gives healthcare personnel a clear and up to date overview of the patient's situation and progress, the amount of required personal check-up meetings could be reduced for a certain group of diabetics who are progressing well. This is shown in figure 4.

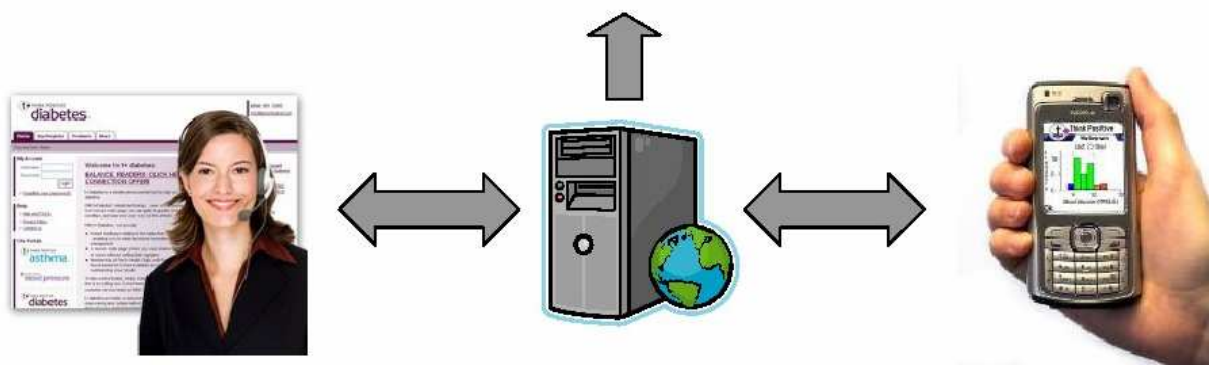

Figure 4: Visual overview of the T+ diabetes system core functionality.

5.3 Improving diabetes care quality

The above focused on the efficiency-related benefits that the system could provide. There are however also various effectiveness or quality-related advantages to using the system that were mentioned. Note that using electronic communication instead of physical meetings, for example, can also be seen as a quality improvement for patients who no longer have to travel as much to get advice from their doctor.

Another such benefit comes in the form of the potential to prevent diabetes-related complications or catching them in an (relatively) early stage. Both interviewees brought up this subject and Dr. Emmerson mentions that such a system including remote patient monitoring and data collection/analysis has the, quote:

"*Potential to reduce the risk of long-term micro and macro vascular complications resulting either from chronically elevated blood glucose or from high post-meal blood glucose excursions. It is also possible to reduce short term complications of hypoglycaemia and ketoacidosis which can result in emergency treatment/admissions.*"

With regards to patients, this system however perhaps plays an even more important role in allowing for better self management of their diabetes. The system provides them with an overview of their own progress and personalised advice and feedback based on their results. This has multiple advantages in that it helps diabetics understand their current situation, it tells them how they could improve their situation and patients can also see the impact and improvements as a result of the changes made. Diabetics using the system were positive about the fact that they could easily transmit their results by mobile phone and the fact that their situation is now monitored much more regularly than before.

The literature study has shown that diabetes-related complications are estimated to make up a significant part of total diabetes costs (in Holland). Therefore, measures that could help reduce these complications are very interesting. One critical benefit of this system is that, through the patient self management that it enables, diabetics can better control their HbA_{1c} or glycated haemoglobin levels. Keeping these levels constant and low has proven to have a significant impact on preventing diabetes complications, as discussed in more detail later in this chapter. One final advantage related to preventing or catching complications early is that better analysis can be performed on more and updated patient data. As a result, action can be taken as soon as negative trends start to develop.

5.4 Proving the value of the system

One problem that innovative systems such as these often phase is that it is difficult to prove their exact value. This is a relevant problem, which is also mentioned often in the other cases, because stakeholders will not support a system if they do not see the benefits of it. Pilot tests and studies of these types of systems can provide clarity. However, Dr. Emmerson notes that the usefulness of the results of such a study is limited because, quote:
"There are a diverse range of technologies used, patient groups differ, the evidence is based on different care systems, and studies are of variable depth and quality."

That said, both mentioned that there have been many studies out there which support the clinical benefits of remote patient monitoring of diabetes, and the economical benefits resulting from them. Mr. Clover as well as Dr. Emmerson provided several papers which provided statistics regarding the benefits and cost reductions of remote patient monitoring and management either using an electronic system [27-33] or by telephone contact [34-39]. While it is difficult to use these results to predict exact (cost) benefits of the system, combining and comparing the results can help to get a good estimation of its potential. The one thing that all these studies have in common is that they show that this potential is expected to be high indeed.

Mr. Clover showed that this potential was also there for the T+ diabetes system by providing the results of T+Medical's own clinical trials with the system. Studies have shown that reducing patients' HbA_{1c} levels by 1 percentage point lowers the complication costs associated with diabetes by a whopping 30 to 40 percent. Trials with the T+ diabetes system have shown that it can help in lowering and stabilizing the value. A first trial with the T+ diabetes system for type 1 diabetics with high HbA_{1c} values (mean of 9 percent) showed a reduction of 0.62 percentage points amongst those using the system. Another trial with type 2 diabetics showed a HbA_{1c} reduction of 0.70 percentage points. Perhaps more importantly, all subjects in the trial with high HbA_{1c} values (above 7.4 percent) were brought under control when using the system. More detailed outcomes of these two tests are shown in figures 5 and 6, below.

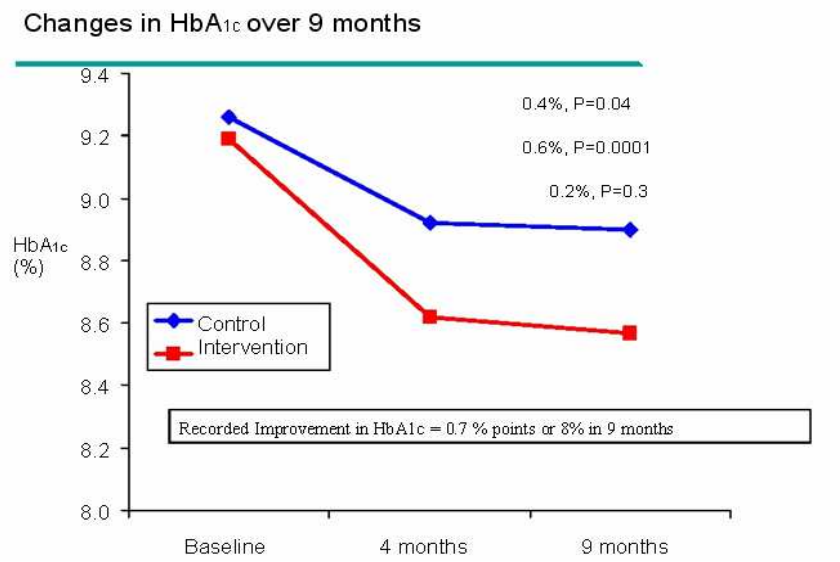

Figure 5:
Results of a study amongst patients with type 1 diabetes.

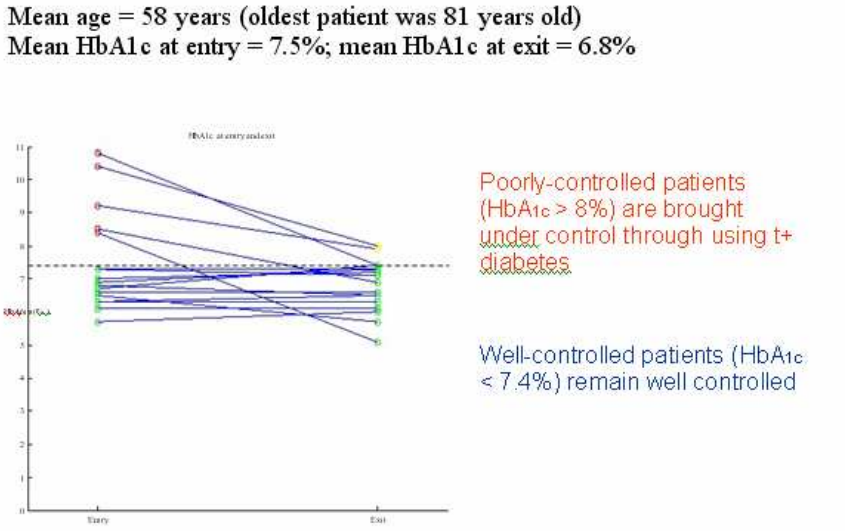

Figure 6:
Results of a study amongst patients with type 2 diabetes.

5.5 System acceptance

As was mentioned in the previous chapter, getting people to accept and support such a system is critical for its success. This is however easier said than done and there are known to be several concerns that people might have that can hinder this process. There are for example some concerns about the effect that remote monitoring will have on the doctor-patient relationship. Patients as well as care providers fear that physical and personal contact will largely disappear. This also causes them to worry if the system can provide the same services and quality as the people that it replaced. Then there is of course the problem with privacy. A lot of people are uncomfortable with the idea of having a system that handles sensitive information. T+Medical acknowledges the importance of proper data security and privacy and therefore the company has made sure that it's systems are properly certified according to leading standards (such as ISO) in order to ease these concerns.

Another form of resistance is related to the culture of the healthcare sector (employees). They have a reputation for resisting innovative systems such as this. There can be several reasons for this such as a distrust of IT systems in general. Secondly, it is possible that care providers will be unhappy with the fact that they have to change they way in which they do things or they might perceive that the system will be an additional burden to their already busy schedule. This can be especially true if they do not understand or see the benefits that such a system could bring them. Thirdly, the sector is relatively risk averse in general which is likely due to the fact that the sector is public and that there is only a limited budget to work with. This makes support of new investments less likely.

Overcoming these barriers is no simple task but there are several things that can help make this easier. For people to support the system they must be convinced that it benefits them. This means that the system will have to be sold to the different stakeholders. Studies and successful pilot test can help to prove the value of the system. Additionally, leadership and involved champions amongst care providers are very valuable. They can set an example and other care providers are more likely to trust them and their claims than they are to trust the people whose job it is to sell the system.

In addition to demonstrating the benefits, one must also work to take away misconceptions or concerns about the system. This means raising awareness and assuring people that the system is safe, secure, reliable and easy to use. By taking this actions support for the system can increase. This is especially important since other parties can help to provide the required finances or customers platform for your system. In the case of T+Medical these parties were Vodafone and Johnson & Johnson's Lifescan which are expected to provide great benefits in increasing the scale on which the system will be used.

5.6 Chapter summary

In this chapter, the possibilities of the system to improve the efficiency and quality of diabetes healthcare were discussed. In the efficiency department the system contributes by automating tasks of data collection, storage, presentations and (some) analysis. This reduces the workload of care providers. Additionally, trained nurses using the system can potentially manage many times more patients than those who don't use such a system. Quality-related benefits result from providing care providers with updated information that is easily available and possibly reducing the amount of physical control meetings that are required for patients.

Perhaps the most important benefit of the system is however its possibility to help patients to better self manage their diabetes. The system can provide them with personal progress information and advice which helps them to better understand their disease and the impact that their behaviour can have. Tests of the T+ diabetes system have shown that patients using the system would experience a noticeable drop in their HbA_{1c} values. Keeping this value low can have a significant effect in preventing diabetes-related complications.

Tests like these are very important to the success of such a system since it is difficult to demonstrate the exact benefits that it could provide. Literature studies and pilot tests with comparable systems are only of limited use due to variations in patient groups, measurement criteria, etc. This type of information is however very relevant in acquiring the support of potential system users and stakeholders.

Convincing people these parties of the potential benefits of the system as well as addressing their concerns is an important factor here. This is especially important because these stakeholders can help to provide the required finances or customers platform for the system. This can prove to be very important in achieving large scale implementation and usage of (remote patient monitoring) systems in healthcare.

Chapter 6: DSW case study

6.1 Chapter introduction

DSW is a Dutch health insurance organisation with over 420.000 clients that is closely involved with the quality of the care process and the concerns of its clients. A good example of this is DSW's recent involvement with the Vlietland hospital (see figure 7). DSW is recently also investigating the possibilities of care-at-distance systems (telemedicine) [40]. Because of its active and quality-focused approach with an emphasis on the use of ICT, DSW has consistently been one of Holland's top health insurance companies (according to independent consumer research [41]). A meeting was scheduled with Mr. Dirk Pons, executive manager of the organisation, who was accompanied later on by Ms. Joan Onnink, advising physician at DSW. The remainder of this chapter describes the outcomes of that interview and their personal views on the system possibilities.

Figure 7: DSW is the first Dutch insurance provider to (partially) own a hospital [44].

6.2 Possibilities for supporting healthcare

The interview at DSW definitely provided a different perspective than the interviews from the previous two chapters. DSW turned out not to be unique in this, which becomes clear in the report on the meeting with the Dutch Diabetes Federation (chapter 7). There were however also some noticeable similarities. An advantage of the system was mentioned in its ability to automate certain tasks medical personnel would usually perform themselves. Allowing healthcare providers more time to focus on other matters is important in a time where the strain on healthcare personnel is high. The system can provide additional support by sorting patient information and presenting it in a structured manner.

This would also mean that there would be one complete patient file that is easily locatable for care providers. Such a system database that collects regular and up-to-date data on patient progress and status could be beneficial in fine-tuning insulin dosages for patients whose values tend to vary relatively often. However, it was mentioned that these people only make up a very small part of the total diabetics population. The interviewees believed that for diabetics that do not experience these fluctuations, the more frequent data would not provide any substantial benefit for care providers.

6.3 System scepticism

The previous page describes just one example of the scepticism about the capabilities and potential of the system. Several other reasons were mentioned which caused the interviewees to be sceptical about the size of the diabetes user group for who the system could provide significant benefits. One example of such a reason is that a significant number of diabetics is known to not be motivated or involved with self managing their disease.

A system that gives patients even more responsibilities seems illogical in this case. It would be better to instead take a pro-active approach where care providers are more involved and can better control or check patient behaviour and progress. Another reason is that diabetes is a disease which manifests itself in many forms and there is a lot of diversity amongst diabetics. This leads to serious doubts about the systems ability to support all of them.

The interviewees also challenged the added value that the system would provide to those stakeholders who would use the system. It was mentioned that there already been significant improvements with regards to the quality of healthcare in Holland. These are the result of several important new developments such as the ‘zorggroepen’, ‘keten dbc’ (as described in chapter 4) and the use of more rigid protocols and national care standards (such as the NDF care standard, as described in chapter 8). In this situation there are doubts about the added value and improvements that such a system can bring on top of these standards and practices.

Several smaller sources of scepticism came up as well for example relating to the fact that most general practitioners currently use patient database and communications systems, the most popular system being the “Huisartsen Informatie Systeem” or HIS [26]. There were some concerns about how a remote patient monitoring system would fit in with such a system and what degree of added value it would bring to it. Mr. Pons mentioned also the systems limitation with regards to automating healthcare processes and reducing the amount of physical control meeting with patients.

6.4 Sources of resistance

The previously mentioned factors are cause for additional concern when taking into account the fact that the actual added value that the this type of system brings is difficult to see, let alone prove. If stakeholders do not see the benefit of a system they won't be interested by it. This is especially true adopting the system means that they need to spend additional time or effort using it. Because of this, personnel in the healthcare sector is a group which is likely to resist the system since they might quickly expect that this system would present them with additional work or force them to change the way in which they work. In addition, care providers are known to be quite rigid and resistant to change, especially when it involves ICT systems. In this case there might be some genuine concern that too much emphasis will be placed on automation and the IT aspect of care provision. Personal contact and the relationship between doctor and patient are important aspects of healthcare that cannot be easily replaced by technological tools.

Not only medical personnel are expected to have concerns about the system, but so are patients. As stated earlier a significant part of the diabetics will likely resist it purely because they are not motivated to self manage. Others are averse to this system or technology in general and will prefer personal contact about their condition. Privacy is one particular issue that is always a cause for concern. People are quick to avoid systems that have the possibility to store and communicate sensitive data. Because of this, the use of high security standards and proper access restriction is highly recommended. Then there are of course the financial issues. The healthcare is a part of the public sector and the use of, often strict, budgets is standard practice. This limits the amount of money that healthcare personnel can and are willing to spend. Investing in a system such as this might not be their highest priority. The creation of a government budget aimed specifically investing in promising healthcare projects might be a solution. However, considering the current financial situation, this is unlikely.

6.5 System positioning: how can it fit in?

Mainly because of their concerns and criticisms related to the system, the interviewees are of the opinion that the implementation of this kind of system should not be a priority right now. Currently there is a lot of fragmentation within the healthcare systems. Many parties/regions have developed their own information (exchange) systems. The problem is that most of these are quite specific and tailored to local preferences. Because of this lack of conformity and standards, these individual systems often encounter many difficulties in interacting with other systems. Getting the remote patient monitoring system successfully implemented on a large scale at this moment would require it to be able to fit and successfully interact with all these different local systems, which is very difficult.

However, various healthcare stakeholders are currently in the process of introducing or up scaling of several new concepts which are expected to have a great impact on the sector. These concepts include the electronic patient dossier and the implementations of standards such as the HL7 V3 standard [25] and the NDF care standard (discussed in chapter 7).

The implementation of the concepts described on the previous page will hopefully help to eliminate much of the existing fragmentation and provide for a foundation in healthcare and a standardized nation-wide information system which is accessible by and supported by the relevant stakeholders. The remote patient monitoring system will have a much higher chance of a successful, large scale implementation in Holland once these are in place.

By adapting to and integrating with the widely used electronic patient dossier, for example, the system can suddenly easily become available to a large group of users much more easily and effectively. While these nation-wide standards and large scale concepts and systems can provide important benefits, Mr. Pons mentions that it is important to be careful not to take this generalization too far.

6.6 The role of health insurance organizations

Most of the people interviewed during the research process mentioned the importance of collaboration between relevant stakeholders. Each interviewee had his or her own opinion however about the specific roles that these various parties could play in supporting the success of the system and its large scale implementation. This subsection focuses on the potential role of health insurance companies which was discussed during the interview at DSW.

Compared to most other insurance providers, DSW has taken an active approach to supporting innovation and promising healthcare-related projects. It is also relatively closely involved with people in the medical field, general practitioners and since recently hospital employees in particular. It was mentioned that cooperation and communication is very important in this process. Part of the reason for this is that people in the field are closer to the problem and can more accurately determine which solutions or initiatives might be helpful. Their assistance can be used to help DSW pinpoint the most interesting initiatives for possible support. In order for this to happen it is important for the concept to clearly demonstrate its potential and the possible benefits it could bring.

Once interested, a health insurance provider like DSW could support such concepts in the areas of consulting, guiding policy or finance. It is however important to note that this becomes less common and more difficult for bigger insurance companies which are often less flexible and bulkier. Additionally, a system would have to bring relatively larger potential benefits for it to be interesting for them. However, getting the system successfully implemented on a small or regional scale is already very difficult to realise. Large insurance companies which will look to up scale to nation-wide implementation will understandably have an even harder time.

6.7 Chapter summary

The interview at DSW took a very different tone from the interviews of the previous two cases in that the interviewees generally were less enthusiastic and more critical about the system. Though, the interviewees did see potential in the system's capabilities to automate certain information-related tasks, taking work out of the hands of medical personnel and presenting them with a complete and easily accessible patient dossier. The up-to-date data that the system could provide could help in fine-tuning insulin dosages for the small group of patients with fluctuating values.

The major focal points of interviewee scepticism related to the potential impact of the system. With the recent improvements in Dutch healthcare quality, there are doubts about the added value that this type of system could bring to current practices. Some additional concerns arose about how exactly the system would fit in with existing systems and diabetes healthcare as a whole. Another source of scepticism involved the potential user base for this type of system. It might not be a very useful tool for patients who are unwilling to self manage their disease. People could also reject the system for several other reasons such as fear of additional work or changing the way in which care processes are performed or concerns with regards to privacy or the impact that the system might have on changing the doctor-patient relationship. All these factors could severely limit the user base and as an extension the impact and success of the system.

Currently and over the coming years, several new concepts, national standards and large scale systems are being introduced and implemented into the Dutch healthcare sector. The implementation of the concepts described on the previous page will hopefully help to eliminate much of the existing fragmentation and provide for a foundation in healthcare and a standardized nation-wide information system which is accessible by and supported by the relevant stakeholders. These could also provide an important opportunity to the remote patient monitoring system. By adapting to and integrating with the widely used electronic patient dossier, for example, the system can suddenly easily become available to a large group of users much more easily and effectively.

Chapter 7: Dutch Diabetes Federation case study

7.1 Chapter introduction

The Dutch Diabetes Federation (from now on referred to as the NDF) is a coordinating organisation that brings together care providers, scientists and diabetics (organizations). The organization operates independently and aims to be the contact point for both government as well as healthcare insurance companies. Additionally, the organization provides and guides a platform in which all relevant diabetes stakeholders are represented. During its existence, the NDF has worked on developing many different initiatives, often at the request of the Dutch government and in collaboration with other diabetes stakeholders. One of its main accomplishments is the creation of a care standard for diabetes. This standard describes the necessary elements in diabetes care for the prevention, timely diagnosis and correct treatment of the disease.

With funding from the Dutch Ministry of Health, Welfare and Sports has set up a national action plan for diabetes (from now on referred to as NAD [42]). The NAD is a result of a cooperation between many different diabetes stakeholders including the Ministry, health insurance companies, general practitioners, diabetes patient organizations and of course the NDF. The main goal of the NAD is to accomplish widespread implementation and adherence to the NDF care standard. In February 2009, they presented the Dutch Minister of Health, Welfare and Sports, Ab Klink, with their recommendations for the period 2009-2013 (shown in figure 8).

Figure 8: The Dutch Minister of Health, Welfare and Sports receives the NAD recommendations.

Due to the NDF's high degree of cooperation with the relevant stakeholders a meeting was scheduled with Ms. Nannette Huizenga who is the project leader of the e-diabetes programme at the NDF. The remainder of this chapter describes the outcomes of that interview and her personal views on the system possibilities.

7.2 Possibilities for supporting healthcare

Advantages of the system were acknowledged in its potential to of support to current healthcare practices and care provider workload. Some of the tasks that would normally performed by doctors can be taken out of their hands by using the system. For example, the system takes care of storing and updating the patient records and it even performs basic status checks based on the patient information it receives. When patients regularly self test, the results are being transmitted digitally, directly to the system where care providers can check them. This could reduce the amount of face-to-face control meetings that care providers need to perform. Having up-to-date and regular information on the patient's status can also help in determining the correct insulin dosage. This is useful, in particular, for patients whose values tend to vary relatively often. Another potential advantage is that the patient information is now being stored at a single, easily accessible location. This could eliminate a large degree of data redundancy and it makes it more likely that the complete medical record of the patient is available to the relevant care providers. This can reduce errors as a result of lacking information. Also, patients themselves no longer have to personally take care of and hold on to their personal information, which would otherwise be submitted into a personal diabetes diary. This also means that this data is less likely to get lost.

7.3 System scepticism

Much like with the meeting at DSW (chapter 6), there surfaced some definite scepticism with regards to the capabilities and usefulness of the system during this interview. For instance, Ms. Huizenga has some definite doubts about the claim of the system providers which states that the system provides added value in detecting possible diabetes-related complications. By following the NDF care standard and performing quarterly check ups on patients' relevant values, care providers are already adequately checking for any potential complications. The additional contribution that the system would bring in this situation is unclear. In fact, the opposite might be true. An important aspect of checking for complications involves taking many different blood glucose readings under different conditions (time of day, before or after eating, etc.) in a short time period. These readings are considered to be more useful for this purpose than taking tests over a longer period of time.

Other limitations to the system were mentioned as well such as doubts about the amount of processes that the system could take over or assist in. While the system can potentially eliminate certain physical patient check ups, some amount of personal meetings between patient and care provider will still be required. On top of this, there were also concerns about the amount of patients that could benefit from such a system. Patients who are not motivated to self manage their disease the system will probably not really benefit from the system, or use the system at all.

These concerns regarding the usefulness of the system are increased as a result of another practical limitation from which it might suffer. With the amount of self tests that diabetics perform in their lifetime, it is bound to happen that on some occasions a patient will not have a measurement device ready. This can be either a result of the fact that he or she has misplaced it, forgot to take it along on a trip or visit, because the device broke down or for whatever other reason. Normally, the patient would have the option to use the measurement of another diabetic in their environment (friends/relatives/neighbours). While automatically transmitting test values might be very convenient, it poses a problem in this situation. The personalized measurements that are part of the system might make it inadvisable to use another person's measurement device. It is important to take this into consideration when looking at the system's functionality.

7.4 Sources of resistance

The limitations mentioned previously are not the only problems related to the usage of the system. On this subject, the interview developed in much the same way as with the previous cases. Again, resistance as a result of the culture in the healthcare sector was mentioned. From her personal experience as an internist Ms. Huizenga has noticed that many care providers often have an aversion to automation and the use of ICT. They care usually do not understand or acknowledge the benefits that such a system could bring. Because of this, they aren't motivated to put in the extra effort to use the system. Other times people have a resistance to change or the use of IT in general.

In the current day and age, people are very concerned about their privacy. Because of this people are quick to resist a system like this that uses sensitive data. However, in reality systems like the electronic dossiers follow strict standards and are very will protected. People need to be made aware of this and the fact that their information won't just be accessible to anyone with system access. Unfortunately, taking away doubts about such a system is not as easy as it sounds.

Another group will not support the system simply because they are not motivated to self manage or because they prefer to have personal interaction with care providers. This, and the other forms of resistance mentioned in this sub section have been mentioned (multiple times) in other interviews. One type of resistance mentioned was however unique to this interview and it is cost-related.

In Holland, test strips (to take blood glucose readings) are not covered by insurance for all diabetics. This means that there is a certain percentage of the diabetics that has to pay for their own test strips. Because this system advocates more frequent self testing, costs for these patients will increase. This can definitely affect their motivation to use this type of system.

7.5 System positioning: how can it fit in?

Like the interviewees from DSW, Ms. Huizenga felt that it would be better to focus on getting things like the electronic patient dossier and the NDF care standard implemented and used. These are important nation-wide foundations which, once they are in place, can more easily realise large scale success of a remote patient monitoring system. By fitting the system into already existing national concepts, it can become more interesting for the various stakeholders to use. This also means making sure that the system adheres to certain standards (such as the HL7 V3 care standard [25]).

Another important factor that can contribute to the success of the system is getting support from stakeholders. In order to get this support, particularly from diabetics and care providers, it is vital to make them understand the contributions and benefits that the system can bring as well as taking away their fears and misconceptions of the system. Education was mentioned as one important method of obtaining this. Patients and healthcare providers alike need to be educated on the functionality of the system and the measures taken to ensure security and privacy of information. Once people realize that the system could benefit them, they are more willing to work on making the system a success. Only when all stakeholders involved are willing to support the system can they work together to actually make it a reality.

7.6 Chapter summary

The interview at the NDF was very similar to the one held at DSW and as a result the content of these two chapters is as well. Advantages of the system were acknowledged in its potential to of support to current healthcare practices and care provider workload. Another potential advantage is that the patient information is now being stored at a single, easily accessible location which can potentially reduce data redundancy and medical errors due to lack of information.

There were however some doubts, for example, about the system's added value in detecting possible diabetes-related complications. Additional concerns focused on the expectation that the system could only automate care processes to a limited degree. It was also mentioned that patients that are not motivated to self manage their disease will probably not really benefit from the system. Like with DSW, there was also some scepticism about the size of the potential user base of such a remote patient monitoring system. This might be (strongly) limited due to stakeholders' resistance for several reasons. Later in the interview, emphasis was also placed on the importance of first developing and implementing several other new healthcare concepts. These in turn could make large scale implementation of the system more likely.

Chapter 8: ZonMw case study

8.1 Chapter introduction

The Netherlands Organisation for Health Research and Development (from now on referred to as ZonMw), is a national organisation that promotes quality and innovation in the field of health research and healthcare. ZonMw aims to facilitate innovation, inspiration and cooperation among various healthcare stakeholders. The organisation is involved with many different care-related programmes, which each hold multiple projects (as can be seen in figure 9). Two of these programmes focus on diabetes. A meeting was scheduled with Ms. Hannie Bonink, program coordinator at ZonMw and responsible for the quality of several of the organisation's programmes, including 'Diabetes Ketenzorg'. The remainder of this chapter describes the outcomes of the interview with Ms. Bonink and her personal views on the system possibilities.

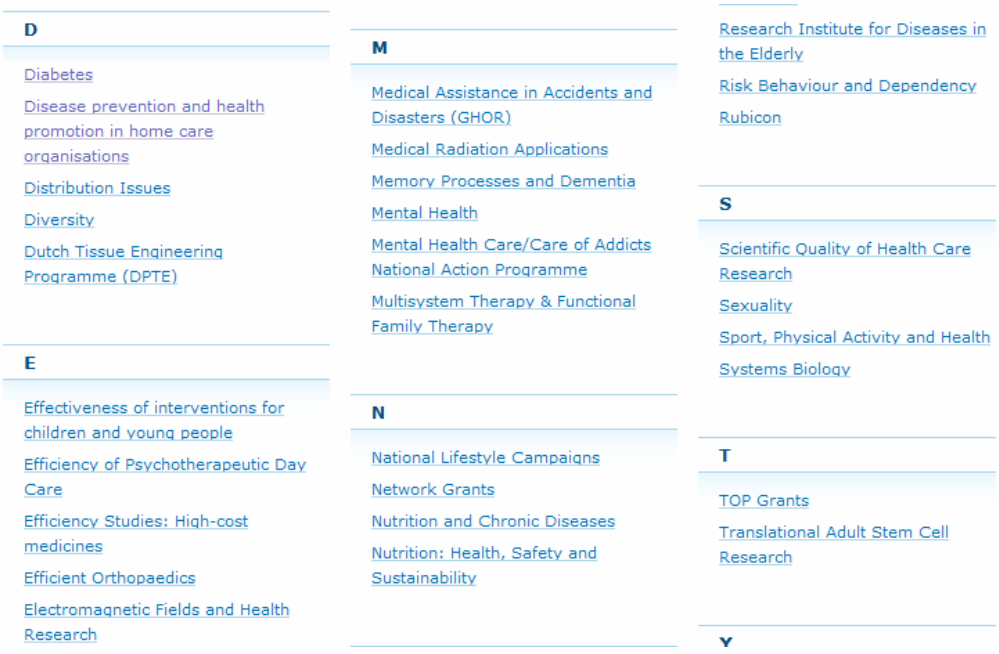

Figure 9: Just some of the areas of healthcare in which ZonMw is involved.

8.2 Data gathering & analysis potential

During the meeting, several benefits that the system could potentially provide were discussed. These mostly focused on the services that the system could provide with regard to the gathering, storing, analysing and presenting of information and the impact that this could have on patients and care providers alike. The (partial) automation of this process helps in reducing the workload of medical personnel. By reducing the amount of tasks they need to perform, these people now have more time to spend on other activities. Improving the efficiency in this manner is especially relevant when looking to the near future and the increase in diabetics that it will bring.

With the significant increase of people with diabetes (and other chronic diseases) that is expected and the prognosis of a general decline in health care personnel, efficiency has never been more important in order to be able to still provide care to those who need it. By letting a system perform these activities instead of human, more data can also be treated in a shorter amount of time and generally also at a lower cost. There is also the added benefit of providing one central, complete and easily accessible information database. The increase in the number of measurements, as well as the fact that information becomes available much more quickly than before helps to improve the quality of healthcare by reducing information errors and also by providing a clearer picture of the patient status and progress, which can help in selecting better fitting treatments. By electronically sending their test values to care providers on a regular basis, patients might not require as much face-to-face check up meetings. On top of this, the system provides information and advice about diabetes and their personal status and progress. This could help diabetics to better understand their disease. Also by seeing what the effect of, for example, better dieting has on their values can get them more motivated to actively self manage their disease.

8.3 System limitations

Of course, there are also some critical notes with regards to of the system. Most of these points are already mentioned in (several of the) other cases. One problem is that it's difficult to prove exactly what benefits the system brings. During the research it became obvious that this is especially true with regards to cost benefits because with regards to diabetes there is no clear vision on the costs which can be accounted to the disease. Another subject that came up was the scale on which the system could potentially be used. Patient motivation was an important factor in this since patients that are not willing to actively self manage will likely not benefit (much) from using such a system. Additionally there may be other reasons why patients or medical personnel won't use the system. Determining how many people exactly potentially would use the system is very difficult. As a result, the overall usefulness of the system can be questioned.

8.4 Sources of resistance

Aside from the above, there might be other reasons why successful, large-scale implementation of the system could be hindered. Ms. Bonink noted that resistance to change could be a problem. Healthcare personnel specifically have a reputation of not being supporting of changes. It is a problem if the system leads to additional work, or if it noticeably changes the way in which they work. Working with a new system would require training and technical support for a certain period of time. Not only will this process take time but it will also require money that might not be available.

This is however not the only problem. A system that collects, stores and transmits sensitive data is bound to cause concerns about privacy. Another reason why people might not use it is because they do not trust IT in general or they might simply prefer personal contact over using such a system. Additionally there are the patients who are not motivated to self manage All of these people are a potential source of resistance which can make large scale acceptation and usage difficult.

8.5 System drivers & possibilities

During the interview, several potential drivers and opportunities were mentioned that can potentially aid the successful implementation of a remote patient monitoring system. The recent developments of 'Zorggroepen' and the use of 'Keten dbc' (see chapter 4) could be helpful, for example. Through the combining and cooperation of services and care providers the costs as well as the benefits of the system can be shared and spread out. This eliminates potential problems where the organisation or group that has to pay for it does not personally benefits from it or that it cannot provide sufficient funding by itself.

An awareness campaign could also be an important driver for system implementation. This could take the form of a campaign to inform all relevant stakeholders of the (expected) problems and impact of diabetes. By making people aware of the size of the problem and the need for a solution can help in gathering support. Another possibility would be to actively inform people about the functionality, usefulness and possibilities of this specific system. People may not even know about the system while others might not have insufficient or incorrect information on it. In this situation pilot testing would be recommended since it can help to show and convey the workings of the system and the benefits it could provide.

Getting the system to fit in with or become a part of large scale concepts such as the NDF care standard could make it possible to reach a large user base much more easily. Chapters 6 and 7 already provide an analysis of the possibilities of this situation. Unlike the interviewees in these chapters, Ms. Bonink did not stress the need to wait for these developments to become successfully adopted and applied before introducing the system. An organisation like ZonMW itself could possibly also be of help for the development and implementation of such a remote patient monitoring system in Holland. It is however important to note that The Dutch Ministry of Health, Welfare and Sport and the Netherlands Organisation for Scientific Research are the main providers of funding and it is usually they who decide on the programmes for the organisation to get involved with.

Normally, ZonMW could still support the system by possibly fitting it into an already existing programme such as their programme on disease management. Additionally they could bring the system to the attention of important stakeholders and request for additional ministry funding. While this does have its benefits and the potential to bring system developers into contact with other parties that could provide. It is also possible that the Ministry itself becomes interested and involved with the system, in which case they could officially request the support of ZonMW. The organisation could then (partially) finance the system from government funds. Additionally they can actively inform and approach the relevant stakeholders in the field. By getting their support and through cooperation the chances of success greatly increase.

8.6 Stakeholder collaboration

It has been established that involvement and cooperation of the parties involved with diabetes care is an important success factor for the system. Unfortunately, getting these stakeholders to accept and support the system as Ms. Bonink can testify. In recent years, ZonMW has played an increasingly important role in informing, gathering and motivating project stakeholders. Through experience and lessons learned the success rate for these activities has been climbing in recent years.

Of course, people cannot support a system that they do not know about. Generating awareness and actively contacting potentially interesting parties therefore is very important. Of course just knowing about the system is not enough. An important part of motivation is making clear the costs and benefits of the system. No one will want to support a system that does not provide benefits or that is too costly for its value. This means that the system has to be more effective or efficient than current practices and it has to be easy to use and fit into the business process or daily routine. As a result, it is important to think about how the system can fit in or adapt to existing processes so that it should add as little extra work or burden as possible.

Once stakeholders are interested, the collaborative process can begin. Organisations like ZonMW and system developers should work hard to create further awareness and promote the system amongst its potential users and buyers. Patients and through them health insurance companies are responsible for generating demand for the system. If there are more potential users of the system, it becomes more interesting and relevant to develop. Government and possibly health insurance companies should work on ensuring that there is sufficient budget for the system. Developing a system and getting past the pilot test phase are difficult and costly. For the system to have a chance of being implemented on a large scale, funding is needed.

8.7 Chapter summary

In this chapter, advantages of the system were mentioned related to its possibilities of gathering, storing, analysing and presenting patient information. The (partial) automation of these processes helps in reducing the workload of medical personnel. Better information also helps to improve the quality of healthcare by reducing information errors and in selecting more fitting solutions and treatments for diabetics. By providing patients with more information and advice about diabetes and their personal status and progress, the system can help in getting them to better understand their disease and to be better able and more motivated to self manage their condition.

There were however some doubts about the scale on which this type of system could potentially be used. The system might not be the best solution for certain patients and might be resisted by them and other stakeholders for several reasons including lacking motivation, resistance to change, fear of additional work or high costs, privacy issues and an aversion to IT in general.

During the interview, several potential drivers and opportunities were mentioned that can potentially aid the successful implementation of the system. Amongst them are the recent concepts, systems and standards that are being introduced to the Dutch healthcare sector. With the help of these new developments and by adjusting to or fitting in with them, the system could potentially reach a very large stakeholder group and user base.

An awareness campaign could also be an important driver for system implementation to help stakeholders understand the importance of solutions to the growing diabetes problems and to inform then of the system benefits. Getting the support of stakeholders is a very important factor for system success, which can be achieved if each party fulfils a specific role.

Chapter 9: Data analysis

9.1 Chapter introduction

In the previous chapters, various stakeholders from different backgrounds were interviewed about the potential benefits, limitations, impact and implementation possibilities of remote patient monitoring systems for diabetics in the Netherlands. In this process a lot of information was collected. Because not all of this information is equally important or relevant for this research, proper data analysis is important. The case studies were purposely ordered so that the information from each interview was sorted and grouped into four or five main topics. This created an overview of the total provided information. Outcomes from the various cases were compared to each other and examined. In this process the relevant information was filtered out using multiple selection criteria, which are shown in figure 10. This information was used as the basis for this chapter, while the remaining irrelevant data are not discussed here.

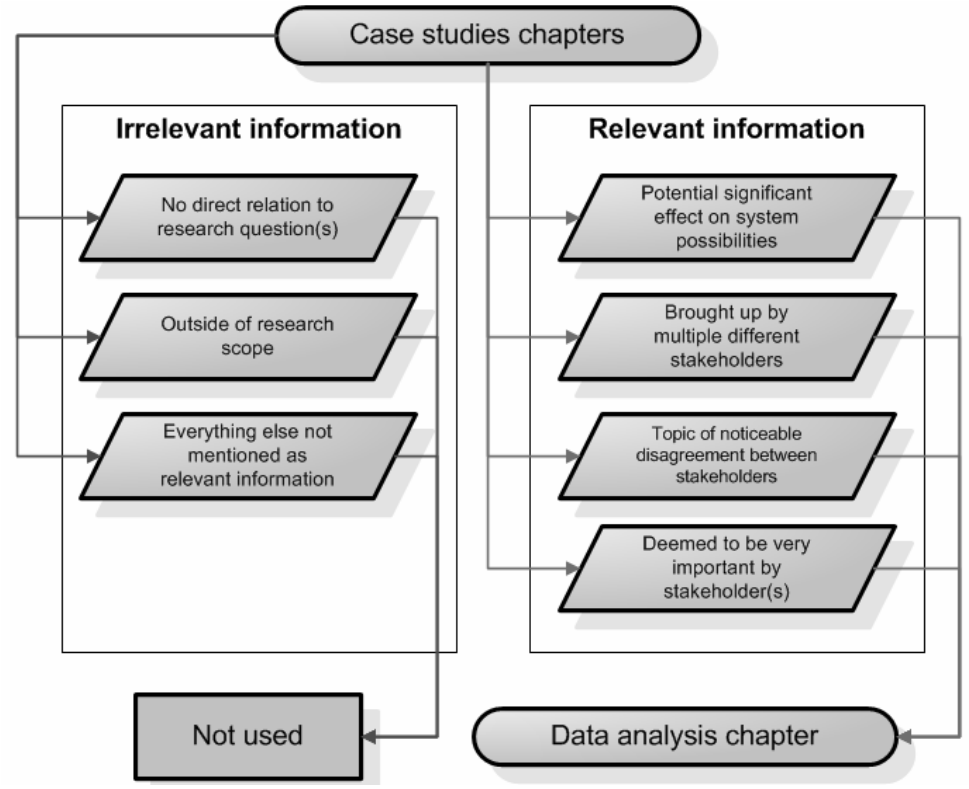

Figure 10: Data analysis selection criteria.

This chapter is split up into several sections. It begins with a description of the system's characteristics including the potential benefits and disadvantages that the system could provide to diabetics, care providers and other stakeholders. Next, time is spent on determining what role the system could possibly play in Holland and how it would fit in with the diabetes care process as a whole. Finally, focus shifts to the process of actually realizing this potential and reaching successful and large scale implementation of the system.

9.2 Characteristics of the system

During the research process many different (potential) advantages and disadvantages of this type of system were mentioned. Whether or not these will in fact occur and to what degree will (partially) depend on how such a system would be implemented and the specific additional functionality that it will provide, outside of the core processes of collecting, storing, monitoring and making available of patient data. Still, even just this basic functionality could provide diabetes care providers with some noticeable advantages. By performing a large chunk of the information-related activities automatically, or by letting patients themselves do so, can reduce the overall workload of medical personnel. It is also important to take into consideration that such a system can perform these data-related activities quicker than humans can and that a trained nurse using the system could manage many times the amount of diabetics that a nurse without such a system would. This not only results in an increase in efficiency but it is cost effective as well.

One other relevant advantage of the system is that it provides one central location from where patient information is easily accessible (given proper authorization). Data collected by the system will automatically be added to the diabetic's dossier ensuring that records of patients are both up to date and complete. This will not only reduce data redundancy but it will also give healthcare providers the full picture on a patient. This can reduce medical errors can help to better personalise solutions or treatments for patients. Additionally, care providers gain more insight in patient progress and developments but the opinions of interviewees differ about the relevance and realistic benefits that this would provide in practice.

The fact that important information is stored and is easily available, benefits patients as well. For one, this means that they themselves would no longer have to keep track of and store this information in so-called diabetes diaries. Coincidentally, this means that it is less of a problem if patients forget (to mention) certain information. Another potential advantage is that the system makes it easy for diabetics to electronically transmit relevant data using either mobile phones or the internet. By providing their care providers with regular status updates, diabetics might not need as many physical check-up meetings.

One specific aspect of the system that is particularly appreciated by patients is that it empowers them. The system can provides them with the opportunity to better understand their disease and personal progress or situation. Additionally, it can make it easier for them to contact their care providers. Additionally, the Portavita system provides an extensive logbook. This gives patients insight into lab results, available treatments and results of previous meetings. It also enables them to hold healthcare personnel accountable for their actions and recommendations.

With the system patients can track their own progress and can see how a certain change in their behaviour, diet or insulin dosage affects them. Because of this many diabetics using the systems get more involved with their disease and are more motivated to self manage. The interviewees disagree on the systems potential to help healthcare providers better prevent diabetes-related complications. However several studies, including tests by T+Medical, show that the system can play a positive role in helping diabetics to manage their disease themselves. Self management and controlling and lowering of a person's HbA_{1c} value can have a significant impact on preventing complications.

One important advantage of the system, which was mentioned earlier in this section, is the ability to reduce the workload for medical personnel. Naturally, there are limitations to the degree to which this can be done. There are many different forms of diabetes and patients react differently to treatments. Because of this it is difficult to generate automated personal advice which becomes restricted to more general tips and pointers. While the system can provide them with much information and possible indicants, an important part of the actual analysis and interpretation activities will still need to be performed by care providers themselves. Another disadvantage is that the system can only gather a limited amount of data and test values from patients. While this could help to possibly reduce the amount of physical visits, it will not be able to replace all of them.

One significant obstacle for such a system is that it's difficult to make a precise estimation of the benefits and added value that it could provide. It is difficult to demonstrate the relevance or importance of a system if you cannot provide evidence or data to support your claims. In this respect, studies and pilot tests with comparable systems are important but unfortunately only of limited use due to variations in patient groups, measurement criteria, etc. More problems arise when trying to collect data related to potential cost savings since it became clear during the research process that there is surprisingly little knowledge amongst stakeholders on how the various costs related to diabetes are allocated (with exception of the DSW interviewees who provided a limited indication).

One heavily discussed topic was the contribution of the system in reducing or preventing complications. Interviewees of DSW and the NDF specifically had their doubts. They were critical of the real added value the remote patient monitoring system would bring to care providers who were working with the latest care standards and technology. Other practical issues that could limit the usage of the system were discussed as well. The system places more responsibility in the hands of diabetics and can enable them to better self manage. It was stated by multiple times that for patients who are not interested or motivated to manage their condition this approach might not be wise. In addition, it was noted that access to more (regular) and updated information might only have a significant impact on a small group of diabetics with values that tend to fluctuate relatively much.

Economical aspects could also be a potential source of trouble. For patients who do not get (the full price of) their test strips reimbursed by their health insurance, the increased frequency in blood glucose tests that the system could be a real issue and a reason to not use the system. From another perspective, the healthcare sector is often subjected to budgets and has relatively little money to invest. In order to get the system implemented at acceptable costs, certain functionality aspects may be ignored. This is especially likely for aspects that do not directly affect the system acquirer.

9.3 System impact

A lot of uncertainty remains about the scale on which the system could possibly be used and how it would fit in with other systems and diabetes care as a whole in Holland. Obviously, it is a long and complicated process to get to large scale implementation. The support of personnel in the healthcare sector is likely to be very important for the success of the system, yet they are the group that is expected to have the highest degree of resistance to it. This seems to be the result of the general culture that is inherent to the sector. In general, care providers have a reputation to be averse to changes and innovation. This is especially the case if the innovation involves an IT system. Often, there is a lot of doubt about the added value of the system. This can either be the result of lack of information an understanding of the specific system or a resistance to IT in general. Medical personnel can be quick to judge a system in such a situation and experiencing it as pointless and yet another addition to their workload. Other roots of resistance might be the fact that they have to be trained and change the way in which they work in order to use the system and that they don't like the fact that their actions and recommendations are logged by the system and can be monitored.

Patients too, can be a potential source of resistance to the system for several reasons. One subject that is the topic of much concern and debate recently is privacy. Also, as it was the case for certain employees in the healthcare sector, some group of patients might just be resistant to IT in general. This is usually because they are usually concerned that these systems could not adequately replace the actions of a care provider. Because of this they will possibly refuse to use the system even if this means more time or work (travelling, for example). Finally, diabetics might resist using the system simply because they are not motivated to (self) manage their disease.

Another problem is there is a general risk averse attitude in healthcare. This is likely due to the fact that the sector is public and that there is only a limited budget to work with. This makes support of new investments less likely. Combined with the resistance to change, which seems to be common amongst care providers, it becomes less likely that medical personnel will easily agree to a system which requires (the funding of) personnel training to use the system effectively.

All these potential sources of resistance could really reduce the user base of this type of system. One of the key success factors thus lies in managing and minimizing this resistance. One important part of this is reducing the negative impact that the system has on its stakeholders as well as making them aware of the benefits that it could provide. Methods of doing this, as well as other success factors, is described later in this section. One specific factor is however discussed right here since it relates to the positioning of the system within diabetes care as a whole.

Recent developments in the Dutch healthcare sector such as the 'Zorggroepen', 'Keten dbc', electronic patient dossier and the NDF care standard for diabetes could potentially be very useful in reaching a large user base for the remote patient monitoring system. Tailoring the system to easily interact with or conform to these standards and systems could be a very critical factor to its success. It is however definitely not a given that this will ensure that the system will indeed be possible. Time will tell if these new developments will indeed be successful and if there is a place amongst them for a system like this.

9.4 Key performance indicators

In the previous subsection, it was mentioned that dealing with and reducing reservations and resistance that stakeholders might have towards this type of system is important. One part of this was reducing the negative impact that the system would have on care provider workload and the manner in which they work. Other concerns to address relate to system security and privacy. It is important to make stakeholders aware that these things are well in order by, for example, conforming to security standards such as ISO.

Unfortunately, measures to reduce stakeholder resistance are still useless if people do not know about them. Creating awareness and actively marketing the system therefore is another critical success factor. People need to be informed to take away any misconceptions that they might have about the system and to help them understand its' functionality. Most importantly, however, parties involved need to see how this type of system can benefit them personally. If people do not believe that a system will be useful to them, then it is unlikely that they will support it.

In order to convince them of the potential and benefits of the system, pilot tests and their recorded outcomes can play an important role. Leaders and champions amongst medical personnel who openly support and promote the system can also greatly help in convincing other care providers to accept and support the system.

It was a somewhat contradictory and confusing to find out during the research process that many innovative projects with potential fail to make it past the small scale, pilot testing phase due to lack of funding and support from parties like health insurance providers or the government. Yet both companies that were investigated during this research do not (heavily) rely on such funds for their respective systems. This however does not mean that a remote patient monitoring system such as this cannot greatly benefit from cooperation with and support of stakeholders. Such involvement can be a definite boost and support, or in some cases even enable, large scale implementation.

9.5 Socio-technical factors

It has been stated that communication with and support from other relevant parties could aid in the process of getting innovative new systems implemented on a larger scale. This applies to cooperation of stakeholders with system developers as well as amongst themselves. Concerning the latter, Holland seems to already be moving in the right direction. One such promising development is the (regional) grouping of primary healthcare providers into 'zorggroepen'. Recently there is also an increasing emphasis on the importance of proper diabetes care. The creation of the NAD [42] is one initiative in trying to ensure the quality of this care, now and in the future.

The remote patient monitoring system can benefit from such groupings of care providers and healthcare stakeholders. Together they can share the total costs and benefits of this system. This can eliminate the problem of the person paying the bill while not receiving the benefits. Additionally, through a bigger combined budget larger investments could be made or smaller investments could be made more easily.

Getting a project past the pilot testing phase is very difficult and complex and even with external support initiatives will still be confronted with many difficulties before becoming widely accepted and successful. Each stakeholders, each member of the collaboration, will have to work and fulfil a specific role. During the interviews, some possible roles and actions that the various stakeholders could play were mentioned. These are described below.

Companies like T+Medical and Portavita are, of course, responsible for the developments of these types of systems, determining which functionality to implement and to ensure that the system is properly protected and secure. As mentioned before, it is also important that they actively market their system and provide stakeholders with information. Benefits should be made clear and concerns or reservations should be addressed in order to gain support for the system.

Patients often play a very passive role in the whole care provision process, yet they are a very important, if not the most important, stakeholders. Lack of information or the feeling that they cannot truly influence any decisions can cause patients to refrain from taking action. Here is where the informing activities of above can play an important role, as well as organizations for diabetics. Patients, and as an extension health insurance companies, are responsible for the demand of healthcare and by demanding this type of system they can help its' success and implementation.

Health insurance providers, and especially smaller ones like DSW, could support projects such as the remote patient monitoring system by assisting in the areas of consulting, guiding policy and finance. However, they will of course not support just any project. They have to be convinced of the usefulness and importance of the system. Diabetics (organizations) demand can help to bring relevant projects to their attention but cooperation and communication with care providers is also very important. Part of the reason is that people in the field have expert knowledge and are closer to the problem and can more accurately determine which solutions or initiatives might be helpful.

The government can do its' part by informing the population and by stressing the importance of finding effective methods of dealing with the problems of diabetes. Additionally, it has a very important role in providing the funding for projects directly or through organizations like ZonMW. This organisation could provide funding from the government budget as well as their expertise and experience related to healthcare innovations. They could also help to gather support for the system by actively approaching and informing specific stakeholders and parties that could help in getting the system implemented on a large scale.

9.6 Chapter summary

This chapter provided information on many aspects of the system based on responses collected during the various meeting with stakeholders. On the subject of system benefits interviewees mentioned its potential in taking over (certain) data collection, storing and providing activities. This helps in reducing the workload of healthcare personnel and improving efficiency, which is important considering the predicted increase in the amount of people with diabetes over the coming years. Additionally, as a result of the system there will likely be less redundant data, information will be more up-to-date available in higher quantities which will also be easily accessible. Diabetics themselves also benefit from such a system by giving them access to more information about the disease as well as their personal situation and progress. This could play an important role in enabling and motivating patients to self manage which in turn can have a significant impact on reducing the amount of diabetes-related complications.

There were also doubts and criticism about subjects such as the limitations of data analysis by the system and automated advice for diabetics. There was also uncertainty about the system's ability in allowing care providers to better prevent complications of diabetics. Several interviewees made clear that in general they believe that the system has the potential to only play a limited role in taking over tasks of medical personnel and reducing their workload. Lack of sufficient or generalizable evidence of the exact benefits and cost effectiveness of these systems does not help to take away any of these doubts or uncertainties.

With these potential limitations of the system in mind it was important to look at the scale on which such a system could realistically be used. Different (groups of) stakeholders can be expected to resist the system for various reasons. Whether this is a result of resistance for financial reasons, resistance to change the care provision progress, resistance due to a lack of motivation to self manage or whatever other reason does not really matter. The fact is that the system will not be interesting or useful to everyone. It is difficult to determine how large this group of people is, partly because it depends on the functionality that the system will provide and how it will be implemented and fit into the diabetes care process as a whole.

In this regard several interviewees have mentioned that it could be best for the system to wait for certain new nation-wide concepts and developments in Dutch Healthcare to be successfully implemented and completed. By adjusting and fitting the system to such large scale standards or systems or by possibly making it a part of them, large scale acceptation and usage of the system would be much easier. Additionally it would reduce the negative impact, extra work or change in work method that the system could have on care providers.

It was mentioned however that the implementation of the system into these standards and systems is far from a certainty. Because of this, several other factors were mentioned that could help in making the system a success. These mostly focus on reducing the sources of resistance to the system so that acceptance by stakeholders will be more likely. This is not only important for ensuring a big enough user base but also because other stakeholders can help to reach large scale system implementation. Cooperating with these parties can be an important way of gathering finances or other resources. Note, however that it is a long and difficult road to success and simply gathering a bunch of interested people is not enough. Most interviewees mentioned that it is important that the various stakeholders work together and that each of them should put in a real effort to fulfil their own specific role. This could make all the difference in getting the system to be used on a truly large scale.

Chapter 10: Conclusions

10.1 Chapter introduction

This final chapter summarizes all the main research findings that were discussed in the previous chapters of this paper and provides the research conclusions. First the four research sub-questions are discussed and answered one by one. After this, a quick overview is provided on the personal lessons that were learned during this whole process. Once this is done, focus shifts towards the limitations of this research and the possibilities of follow-up studies. Finally, this chapter ends by answering the main research question and the thesis conclusions.

10.2 Main findings

This section, as stated above, discusses and answers the four research sub-questions that are described in section 3.3. Each question is described in their own separate paragraph(s).

"What is the current state and impact of diabetes (care) in Holland and what are the expectations for the near future?"

The amount of diabetics in Holland today is estimated to be in the range of 750.000 to 1.000.000, with an estimated average cost per patient between 1350 and 1900 euro every year. As a result, diabetes is a significant challenge to the Dutch healthcare sector and it takes up a large part of the sector's budget. There are increasingly strong concerns about the future due to the predicted 80 percent increase in diabetics before 2025. It is feared that the costs will become too high to handle or that, in combination with the aging of the population, not enough care providers will be available to provide proper healthcare to everyone.

Literature shows that there is an increasing interest in telemedicine systems as a means of improving healthcare quality, as well as increasing efficiency. In this manner, these systems could help to reduce the impact of diabetes and other chronic diseases on the Dutch healthcare sector. Additionally, it could help to support and improve existing processes which could improve the quality of care for patients. With regards to the environment and context in which the researched remote patient monitoring system would operate, it is important to mention several recent developments in the Dutch healthcare sector. These developments focus on collaboration of stakeholders, up scaling, introducing national standards and nation-wide systems in order to improve the quality of (diabetes) healthcare. They include the 'Zorggroepen', 'Keten dbc', the NDF care standard, the national action plan for diabetes (NAD) and the national Electronic Patient Dossier (EPD). These could provide new possibilities to the (implementation of) the remote patient monitoring system.

"What is the potential impact of a remote patient monitoring system for diabetics in Holland?"

Diabetes is incurable, yet in order to control the disease patients need to regularly self test, attend quarterly check-up meetings and undergo any number of treatments throughout their entire life. The remote patient monitoring system could reduce the impact that the disease has on diabetics by potentially reducing the amount of check-up meetings required. By enabling a digital two way information exchange between patients and care providers, test values can be easily transmitted directly to the medical personnel so that patients no longer have the responsibility of writing down and keeping track of all their own data. Additionally, this could enable patients to ask specific questions to their care providers without having to leave their home. The system can also be useful in empowering diabetics and providing them with an information source about their disease. Through data analysis, the system provides them with a progress overview and personalised advice for improvement. As a result, patients can become more able and motivated to self manage their condition which in turn can have a noticeable effect on reducing diabetes-related complications.

On the other hand, diabetes care is very complex and it is important to realize that the system is limited in both its ability to reduce physical visits with care providers and its ability to perform data analysis. Processes can only be automated to a certain extent and diabetes will still have to regularly meet with care providers, even when using this system. Additionally, many patients are known not to be very interested in their disease or motivated to self manage. A system that places more responsibility in the hands of the patient is probably not very helpful to these people. On top of that, patients might not support or use the system because they have concerns about privacy, prefer personal meetings or because they distrust IT in general. Additionally, some patients have to pay for their own test strips so there may be financial issues as well. These factors can limit the potential user base and impact of the system in Holland.

"What is the potential impact of a remote patient monitoring system for diabetes care providers in Holland?"

The system can play an important role in automating (certain) data collection, storage and providing activities. This helps in reducing the workload of healthcare personnel and in improving the efficiency and cost effectiveness of healthcare, which is important considering the predicted increase in the amount diabetics over the coming years. Additionally, as a result of the system there will likely be less redundant data, information will be more up-to-date available in higher quantities which will also be easily accessible at one central location. This could help to reduce medical errors as a result of faulty or lacking information as well as provide a better quality of healthcare by allowing medical personnel to select personalized and better fitting solutions of treatments for patients. Interviewee opinions however noticeably differ on for how many diabetics this would make a real difference.

Potentially the system could also help care providers to better prevent diabetes-related complications or catching them early as a result of more and updated information. This was however a major point of disagreement amongst the stakeholders interviewed. There was also criticism about the amount of automation and workload reduction that the system could really provide. As stated before, diabetes care is complex and much of the work must still be performed by people. Care providers might also be unwilling to use or support the system for a wide range of reasons. These can include resistance to (perceived) additional workload, resistance to having to change the method of care provision, fear of changes in the doctor-patient relationship, resistance to being logged and monitored or a resistance to IT in general. Finally, budget issues could play a role in reducing the support and usage of the system by care providers. These negatively affect the system's potential.

"For what reasons is this type of system not yet being implemented on a large scale in the Netherlands and what factors can contribute to realizing this implementation in the future?"

With the potential limitations of the system in mind it was important to look at the scale on which such a system could realistically be used. As stated earlier, different (groups of) stakeholders can be expected to resist the system for various reasons. Because these can significantly reduce the system's user base and success, it is important to look for ways to deal with this problem. Minimizing the (perceived) negative impact of the system on stakeholders could be one possible solution. In this regard several interviewees have mentioned that it could be best for the system to wait for certain new nation-wide concepts and developments in Dutch Healthcare to be successfully implemented and completed. By adjusting and fitting the system to such large scale standards or systems, a large user base could be acquired much more easily. Additionally it would reduce the negative impact, extra work or change in work method that the system could have on care providers.

It was mentioned however that the implementation of the system into these standards and systems is far from a certainty. Because of this, several other factors were mentioned that could help in making the system a success. These mostly focus on reducing the sources of resistance to the system. This is not only important for ensuring a big enough user base but also because other stakeholders can help to reach large scale system implementation. Cooperating with these parties can be an important way of gathering finances or other resources. Note, however that it is a long and difficult road to success and simply gathering a bunch of interested people is not enough. Most interviewees mentioned that it is important that the various stakeholders work together and that each of them should put in a real effort to fulfil their own specific role. This could make all the difference in getting the system to be used on a truly large scale.

10.3 Lessons learned

Performing the research and writing this paper have helped me to personally learn several new things. Over the last few months I have experienced the slow yet very rewarding process of learning to apply the theory of qualitative research in a real life situation. I learned how to better prepare and take interviews with experts by using a smaller list of broad and open questions instead of many very specific ones. Through experience I also learned to allow the interviewees enough freedom to spend attention on the aspects of the topic that they believe to be the most relevant yet not enough as to allow them to go off topic. I experienced how to perform data analysis and to recognize and select the information that is the most relevant.

I have become aware, more so than before, that putting in the extra effort can be really worth it. Making the choice to have six interviews instead of three really helped my thesis. It gave me access to more and also more varied information, which in the end was definitely worth it.

Finally, I have learned that the most enjoyable aspect of all this was to take interviews. I really liked being able to talk with various experts from different backgrounds and to find out how they look at this specific subject. This is definitely something that I will try to do again for my master's thesis.

10.4 Research limitations

Like all research, this paper too has its limitations. While it is great that contacts from six different organizations were willing to contribute to this research, there are still some other stakeholders out there who have not been approached to give their views and opinions on the potential of this remote patient monitoring system. Several interesting parties for further research could include the Dutch Ministry of Health, Welfare and Sport, General practitioner (organizations) and of course diabetics themselves.

A second limitation is that, at the time of writing, the type of system discussed is not yet successfully implemented on a very large scale (in Holland). If this does become a reality in the future it might be very interesting to find out and measure the benefits and disadvantages that it would provide. A comparison could possibly be made with those mentioned in this paper. From an economic perspective this could also be interesting, since it will allow researchers to investigate the exact costs and cost effectiveness of this type of system, which at the moment are not precisely known.

10.5 Thesis conclusions

In this final part of the thesis, all that remains is to answer the main research question:

"What are the possibilities of remote patient monitoring telemedicine systems for diabetes care in Holland?"

Diabetes poses a significant challenge to the Dutch healthcare sector. With 750.000 to 1.000.000 diabetics and an expected increase in this number by 80 percent by 2025, there are increasing concerns about dealing with the costs and being able to provide proper healthcare to all citizens. New solutions that can improve the quality and efficiency of (diabetes) healthcare are therefore very welcome. The researched remote patient monitoring system could benefit patients by reducing the impact that diabetes has on their life. This could be done by eliminating a percentage of the required physical visits with care providers as well by enabling digital communication between these groups.

The system can also provide diabetics with information about their disease, progress and personalized advice. This can enable better patient self management, which in turn could reduce complications. The system could benefit medical personnel through the automation of data-related processes, thus reducing their workload and allowing them to work more efficiently. In addition, it can provide them with one complete, updated and easily accessible database with patient records.

The system is however limited in its ability to reduce the amount of physical visits required and in its ability to provide (automated) data analysis. Additionally there are doubts about the real added value that the system would bring over existing practices and systems, especially for diabetics who experience relatively few problems. The potential user base and in effect the impact of the system could also be noticeably limited as a result of resistance from stakeholders. Reasons for this resistance can vary from stakeholder to stakeholder. These can include concerns about privacy, a preference for personal meetings, resistance to (perceived) additional workload, resistance to having to change the method of care provision, fear of changes in the doctor-patient relationship, resistance to being logged and monitored, financial reasons or a resistance to IT in general.

For the success of the system it is important to look for ways to deal with this problem. Minimizing the (perceived) negative impact of the system on stakeholders could be one possible solution. By adjusting and fitting the system to such one of the large scale standards or systems that are currently being introduced to the Dutch healthcare sector, a large user base could be acquired much more easily. Additionally it would reduce the negative impact, (perceived) extra work or change in work method that the system could have on care providers.

It was mentioned however that the implementation of the system into these standards and systems is far from a certainty. Because of this, several other factors were mentioned that could help in making the system a success. These mostly focus on reducing the sources of resistance to the system. This is not only important for ensuring a big enough user base but also because other stakeholders can help to reach large scale system implementation.

Cooperating with these parties can be an important way of gathering finances or other resources. Note, however that it is a long and difficult road to success and simply gathering a bunch of interested people is not enough. It is important that the various stakeholders work together and that each of them should put in a real effort to fulfil their own specific role. This could make all the difference in getting the system to be used on a large scale.

In the end, the exact role, scale, impact and ultimately the success of such a remote patient monitoring system will depend on how the system would be implemented and the specific additional functionality that it will provide, outside of the core processes of collecting, storing, monitoring and making available of patient data. The system could provide significant benefits and the potential for large-scale usage of the system is there, but time will have to tell to what degree this potential will actually be realized for diabetes care in Holland.

References

1. MedicineNet.com is an online, healthcare media publishing company. Diabetes description: http://www.medicinenet.com/diabetes_mellitus/article.htm
2. The Dutch Central Bureau for Statistics (CBS) online press release. (18-03-2009). The press release article is available at: http://www.cbs.nl/en-GB/menu/themas/gezondheid-welzijn/publicaties/artikelen/archief/2009/2009-2718-wm.htm?Languageswitch=on
3. Slobbe LCJ, Kommer GJ, Smit JM, Groen J, Meerding WJ, Polder JJ. (06-06-2006). "Kosten van ziekten in Nederland 2003. Zorg voor euro's – 1". Report by the Netherlands National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu or RIVM). RIVM rapport 270751010. ISBN: 9069601451
4. Slobbe LCJ, Kommer GJ, Smit JM, Groen J, Meerding WJ, Polder JJ. (2008). "Kosten van ziekten in Nederland 2005. Zorg voor euro's – 8". Report by The Netherlands National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu or RIVM). RIVM rapport 270751019. ISBN/ISSN: 978-90-6960-199-1
5. Report by the Netherlands National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu or RIVM) (2006). Online publication of a follow up report on the costs of diseases in 2003 (reference 3). Available online at: http://www.rivm.nl/persberichten/2006/Diabetes_zorgkosten_2003.jsp
6. The Dutch diabetes fund is an organization aimed at providing information about and generating funds for diabetes (research) in Holland. Diabetes statistics: http://www.diabetesfonds.nl/Diabetescijfers
7. Baan CA, Schoemaker CG, Jacobs-van der Bruggen MAM, Hamberg-van Rheenen HH, Verkleij H, Heus S, Melse JM. (12-05-2009). "Diabetes tot 2025. Preventie en zorg in samenhang". Report by the Netherlands National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu or RIVM). RIVM rapport 260322004. ISBN: 9789069602264
8. The Netherlands National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu or simply RIVM), is a Dutch research institute that is an independent agency of the Dutch Ministry of Health, Welfare and Sport. Diabetes statistics: http://www.rivm.nl/vtv/object_document/o1260n17502.html http://www.rivm.nl/vtv/object_document/o1473n17502.html
9. Shared press release on diabetes by The Dutch Central Bureau for Statistics (CBS), in association with the Dutch pharmacists' branch organization (KNMP) and Dutch Diabetes Federation (NDF). (12-11-2007). Available at: www.knmp.nl/download-bestanden/knmp-vandaag-2/publicaties-knmp/nieuws-en-persberichten/Persbericht%20CBS_KNMP_NDF_12nov07
10. The Netherlands National Institute for Public Health and the Environment or RIVM (see reference 2 for additional information). Their website also provides information and statistical data on weight problems in the Holland at this location: http://www.rivm.nl/vtv/object_document/o1254n18950.html
11. The Dutch Ministry of Health, Welfare and Sport. "Aging". Web article available online at: http://www.minvws.nl/en/themes/senior_citizens/ageing/
12. Stephan H. Schug. (20-2-2008). "Sustainable Telemedicine: Paradigms for future-proof healthcare". European Health Telematics Association (EHTEL). Available at: http://www.nitel.nl/Plaatjes/EHTEL_Telemedicine_Report_2008_vfinal.pdf
13. Doortje Boshuizen, Hanneke de Graaf. (12-2008). "Zorg op afstand met behulp van ICT. Deelproject: Inventarisatie van praktijkvoorbeelden en stimuleringskansen". Nictiz: the National IT Institute for Healthcare in the Netherlands. Available at: http://www.nictiz.nl/uploaded/FILES/Zorg%20op%20Afstand/Rapport%20Zorg%20op%20Afstand.pdf
14. The Council for Public Health and Health Care (Raad voor de Volksgezondheid en Zorg). (2002). "E-health in zicht". Advice report on E-health, requested by the Dutch Minister of Health, Welfare and Sport. Available online at: http://www.rvz.net/cgi-bin/adv.pl?advi_relID=18&chap_relID=5&last=1&stat=N
15. Elizabeth A Krupinski. "Telemedicine for home health and the new patient: when do we really need to go to the hospital?" Studies in health technology and informatics. (02/2008; 131:179-89). ISSN: 0926-9630
16. TE Barnett, NR Chumbler, WB Vogel, RJ Beyth, H Qin, R Kobb. "The effectiveness of a care coordination home telehealth program for veterans with diabetes mellitus: a 2-year follow-up." Am J Manag Care (Vol. 12, No. 8; 02/2006; 467-474).

17. Stanley M. Finkelstein, Stuart M. Speedie, Sandra Potthoff. “Home Telehealth Improves Clinical Outcomes at Lower Cost for Home Healthcare”. Telemedicine and e-Health. April 2006, 12(2): 128-136.
18. PAM van Paassen Consultancy BV. (05-2004). “E-Health. Marginaal of integraal? Rapportage rond de stand van zaken rond de toepassing van e-health in de diabeteszorg”. Report made at the request of The Health Care Insurance Board (Het College voor zorgverzekeringen or CVZ).
19. dr. W.H. Salzmann. (24-06-2004). “Zorg met ICT. Een strategische verkenning aan de hand van diabetes mellítus”. The Health Care Insurance Board (Het College voor zorgverzekeringen or CVZ). Report reference number: 24047636.
20. Charles R Doarn. “The last challenges and barriers to the development of telemedicine programs”. Studies in health technology and informatics. (02/2008; 131:45-54). ISSN: 0926-9630
21. Rifat Latifi. “The do's and don't's when you establish telemedicine and e-health (not only) in developing countries”. Studies in health technology and informatics. (02/2008; 131:39-43). ISSN: 0926-9630
22. The Dutch Ministry of Health, Welfare and Sport. “Diabetes”. Web article with general information on the problem of diabetes in Holland. Available online at: http://www.minvws.nl/dossiers/diabetes/
23. “Succesfactoren Telemedicine” & “Faalfactoren Telemedicine”. Online publications by the ‘Nederlands instituut voor Telemedicine’ or NITEL. Available online at: http://www.nitel.nl/telemedicine/succesfactoren/ http://www.nitel.nl/telemedicine/faalfactoren/
24. The Federation of Patients and Consumer Organisations in the Netherlands (NPCF). Article related to the award for Portavita’s diabetes system: http://www.portavita.nl/bedrijf/publieksprijs_npcf.html
25. Nictiz - the National IT Institute for Healthcare in the Netherlands. HL7 V3 care standard: http://www.infoepd.nl/ufc/file2/informatiepunt_sites/ellen/899ca25bf751deef4e18aff69aa5615a/pu/20090618_1430_MiZ_Results4CareHL7v3_en_eDiabetes.pdf
26. The ‘Huisartsen Informatie Systeem’ or HIS is a (patient) information storage system used by many general practitioners in Holland: http://www.nivel.nl/oc2/page.asp?pageID=10827
27. Bu D et al. “Benefits of information technology enabled diabetes management.” Diabetes Care. 2007 May 30(5): 1137-1142
28. Chase et al. “Modem transmission of glucose values reduces the costs and need for clinic visits.” Diabetes Care. 2003 26(5): 1475
29. Julie Cheitlin Cherry, Tracey P. Moffatt, Christine Rodriguez, Kirsten Dryden. “Diabetes Technology & Therapeutics”. December 2002, 4(6): 783-791. doi:10.1089/152091502321118801.
30. Jaana M, Pare G. “Home telemonitoring of patients with diabetes: a systematic assessment of observed assessments.” J Eval. Clin. Pract. 2007 April 13(2): 242-253
31. Leisenfield B et al. “Telemedical care reduces hypoglycemias and improves glycemic control in children and adolescents with type 1 diabetes.” Diabetes Technol. Ther. 2000 Winter 2(4): 561-7.
32. American Telemedicine Association (June 2006). “ATA’s Federal Policy Recommendations for Home Telehealth and Remote Monitoring”. Publication available at: http://www.americantelemed.org/i4a/pages/index.cfm?pageID=3335
33. Virtual Medical Care, or WebVMC (31-5-2007). “North Carolina Community Telehealth Program Achieves Impressive Results Using Telehealth Solution from WebVMC”. Publication available at: http://www.businesswire.com/portal/site/google/?ndmViewId=news_view&newsId=20070531005291&newsLang=en
34. Shea S, Weinstock RS, Starren J et al. “A randomized trial comparing telemedicine case management with usual care in older, ethnically diverse, medically underserved patients with diabetes mellitus.” J Am Med Inform Assoc. 2006; 13(1): 40-51.
35. Thompson DM, Kozak SE, Sheps S. “Insulin adjustment by a diabetes nurse educator improves glucose control in insulin-requiring diabetic patients: a randomized trial.” CMAJ. 1999; 161(8): 959-62.
36. Wong FK, Mok MP, Chan T, Tsang MW. “Nurse follow-up of patients with diabetes: randomized controlled trial.” J Adv Nurs. 2005; 50(4): 391-402.
37. Piette JD, Weinberger M, McPhee SJ. “The effect of automated calls with telephone nurse follow-up on patient-centered outcomes of diabetes care: a randomized, controlled trial.” Med Care. 2000; 38(2): 218-30.
38. Kim HS, Oh JA. “Adherence to diabetes control recommendations: impact of nurse telephone calls.” J Adv Nurs. 2003; 44(3): 256-61.
39. Birmingham OwnHealth (09-2007). “Successes and learning from the first year”. Publication available at: http://www.ehiprimarycare.com/img/document_library0282/BirminghamOwnHealth_-_successes_and_learning_from_the_first_year.pdf

40. Delftse Post, weekly newspaper (12-12-2008). “Zorg-op-afstand volgens Chris Oomen”. Interview with chairman of the board of directors Chris Oomen of DSW health insurance provider about the possibilities of care-at-distance systems.
41. “Independer Cunsumenten Monitor” Annual consumer survey by independent website www.Independer.nl which rates Dutch health insurance providers. The survey is being performed since 2003. Most recent results: http://weblog.independer.nl/persbericht/independer-%E2%80%9Csalland-best-gewaardeerde-zorgverzekeraar%E2%80%9D/ (2008) http://www.independer.nl/thema/contact/pdf/ICM%20Zorg%20oktober%202007-2.pdf (2007) http://www.independer.nl/thema/contact/pdf/Bijlage%20persbericht%20Serviceniveau%20grote%20verzekeraars%20blijft%20achter%20bij%20kleintjes.pdf (2006)
42. ‘Nationaal Actieprogramma Diabetes’ or NAD, is a committee of important diabetes stakeholders that has been put together at the request of the Minister of Health, Welfare and Sport, Ab Klink, in 2009. The committee was put together to advise the ministry on how to best handle the growing problems of diabetes. More information about the NAD: http://www.diabetesfederatie.nl/start/nad/nationaal-actieprogramma-diabetes/download-3.html
43. “Costs of diabetes in Holland in 2005 per age group (in millions of euro)”. Generated with the online analysis tool for the total costs of diseases in Holland in 2005. Made available by the Netherlands National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu or RIVM) at this location: http://kvz2005.rivm.nl/dynamic/tool.aspx?ref=kvz_v2l1b1p4r1c0i0t1j0o1y2a-1g0d25s54z0f0w9
44. Article published by website disruptivebanking.com. This article is available online at this location: http://www.disruptivebanking.com/2009/01/