The role of eHealth & mHealth
in diabetes care

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TABLE OF CONTENTS

PREFACE 4

SAMENVATTING 5

ABSTRACT 7

I. INTRODUCTION 8

II. BACKGROUND SECTION 11

III. METHODOLOGY 15

IV. THEORETICAL FRAMEWORK 18

V. FINDINGS 19

- The definition of eHealth depends on the users of the eHealth systems 19
- Different kinds of eHealth technologies have different kinds of effects on the diabetes patient 22
- The use of eHealth leads to an increase in workload for the nurses 25
- The nurse limits the use of eHeallth by the diabetes patient 26
- EHealth leads to more interaction between the nurse and the diabetes patients 27
- The use of mHealth does not lead to a definition of mHealth 28
- Mixed attitudes among the nurses about the development of mHealth 29
- The nurses have described requirements for the use of mHealth in the future 31
- The diabetes patient is more aware of mHealth compared to the nurse 32

VI. DISCUSSION 34

VII. FUTURE RESEARCH 42

VIII. CONCLUSION 43

REFERENCES 45

APPENDIX 50

PREFACE

Before you is my bachelor thesis, which is my final act as a student Health Policy and Management (Beleid & Management Gezondheidszorg). I have chosen this topic because I consider myself a proponent of innovation in healthcare. Since the number of diabetes patients is rising globally, I believe that these two topics are related to each other. From my point of view, innovation in diabetes care could stop the rising number of diabetes patients.

Writing this thesis wasn't easy. There were a lot of times during this process where I felt that the light at the end of the tunnel could never be reached. However, looking back at the entire process, I have not only learned a lot but overall I have enjoyed it.

I couldn't write this thesis on my own and therefore I would like to thank several people who have supported me during this process. First of all, I would like to thank my supervisor, Bethany Hipple Walters, MPH. Her knowledge and experience were very helpful during the research. I also want to thank her for always being critical towards my work. Most of all, I'm thankful that she has always challenged me to do better.

I would also like to thank my co-reader, Apostolos Tsciachristas, MSc, for taking the time to read my thesis and helping me at the beginning of this process.

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Finally I would like to thank my parents and my brother. Their support throughout this year has brought me to where I'm now. Without them I wouldn't be able to successfully finish my thesis. I owe them my gratitude.

Shannon Tan
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SAMENVATTING

Het groeiende aantal diabetespatiënten over de gehele wereld beïnvloedt de globale zorgkosten. De groei van diabetes kan wellicht worden beperkt door de leefstijl van de diabetespatiënten te veranderen. Zelfmanagement vormt het sleutelwoord wat betreft deze leefstijl. Zowel eHealth als mHealth kan de diabetespatiënt ondersteunen in zijn zelfmanagement. De gespecialiseerde verpleegkundige staat in contact met zowel de patiënt als deze vorm van technologie (eHealth en mHealth). Dit kwalitatieve onderzoek zal om deze reden de rol van zowel eHealth als mHealth binnen de diabeteszorg onderzoeken vanuit het perspectief van de gespecialiseerde verpleegkundige. De centrale netwerkdriehoek van dit onderzoek bestaat uit de diabetespatiënt, de gespecialiseerde verpleegkundige en technologie (eHealth en mHealth). De perspectieven van de verpleegkundigen worden nader geanalyseerd vanuit de actor-netwerk theorie. In totaal hebben acht ziekenhuizen in de regio Zuid-Holland/Utrecht hun medewerking verleend aan dit onderzoek. Van deze acht ziekenhuizen zijn twaalf verpleegkundigen geïnterviewd. De verpleegkundigen zijn geïnterviewd middels een semigestructureerde interview met open vragen.

De centrale bevindingen van dit onderzoek kunnen worden verdeeld in twee secties: de bevindingen met betrekking tot eHealth én de bevindingen met betrekking tot mHealth. De bevindingen op het gebied van eHealth laten zien dat (a) de definitie van eHealth afhankelijk is van de gebruikte eHealth systemen, (b) vanuit de perspectieven van de verpleegkundigen bezien hebben deze verschillende eHealth systemen andere soorten invloeden op de diabetespatiënt. (c) EHealth beïnvloedt de werk van de verpleegkundige, omdat de verpleegkundige te maken heeft met een hogere werkdruk, (d) de verpleegkundige beïnvloedt bovendien de interactie tussen eHealth en de diabetespatiënt door de vrije keuze van de patiënt wat betreft hun gebruik van eHealth te beperken en ten slotte (e) laat de laatste bevinding van eHealth zien dat het gebruik van eHealth leidt tot meer interactie tussen de verpleegkundige en de diabetespatiënt. Voor mHealth geldt echter dat (a) het gebruik van mHealth niet leidt tot een definitie van mHealth onder de verpleegkundigen, (b) dit betekent echter niet dat de verpleegkundigen geen mening hebben over de ontwikkeling van mHealth aangezien dit onderzoek laat zien dat de opinies van de verpleegkundigen variëren ten opzichte van elkaar. (c) Ondanks dat de opinies over deze ontwikkeling variëren, heeft ieder verpleegkundige voorwaarden gesteld aan het toekomstig gebruik van mHealth en ten slotte laat dit onderzoek (d) zien dat de diabetespatiënt meer op de hoogte is van mHealth in vergelijking tot de verpleegkundige.

Dit onderzoek laat zien dat ondanks het feit dat eHealth onder andere bestaat uit mHealth, beide technologieën andere rollen vervullen in deze specifieke netwerkdriehoek. De meest interessante bevinding van dit onderzoek is dat eHealth een zichtbare actor is.

Zowel de verpleegkundigen als de diabetespatiënten maken beide actief gebruik van ongeveer dezelfde eHealth systemen. MHealth kan daarentegen worden gekarakteriseerd als een actor zonder naam. Dit onderzoek laat zien dat mHealth zeker een rol speelt in dit netwerkdriehoek aangezien er een interactie is tussen mHealth en de relatie tussen de verpleegkundige en de diabetespatiënt. De verpleegkundigen definiëren het echter niet als een mHealth.

Volgens de verpleegkundigen in dit onderzoek heeft eHealth een zichtbare rol in diabeteszorg. MHealth heeft daarentegen een minder zichtbare rol, het is meer een actor zonder naam.

ABSTRACT

The number of patients with diabetes is rising globally, which impacts healthcare expenditures. Changing one's lifestyle by introducing self-management in the lives of the diabetes patients might stop this rise of diabetes. Both eHealth and mHealth could support the self-management of the diabetes patients. Since the specialized nurse is both in contact with the diabetes patient and this technology (eHealth and mHealth), this qualitative study examines the role of both eHealth and mHealth in diabetes care from the perspectives of the nurses. The central network in this research consists of the diabetes patient, the specialized nurse and technology (eHealth and mHealth) and therefore, the perspectives of the nurses will be analysed from an actor-network perspective. A total of eight hospitals and twelve nurses in the area of South Holland and Utrecht cooperated with this research. These nurses were interviewed using semi-structured interviews with open-ended questions.

The main findings of this research can be divided in findings regarding eHealth and findings regarding mHealth. The findings regarding eHealth are as follows: (a) the definition of eHealth depends on which kind of eHealth systems are being used, (b) from the perspectives of the nurses, different kinds of eHealth technologies have different effects on the patients, (c) eHealth affects the nurses by increasing their workload, (d) the nurse affect the interaction between the diabetes patient and eHealth by limiting the use of eHealth by the diabetic and (e) eHealth affects the relationship between the nurse and the diabetes patient, because there is more interaction between the two actors. As for mHealth, (a) the use of mHealth doesn't necessarily lead to a definition; (b) this doesn't mean that the nurses don't have an opinion about it since the nurses in this research have mixed attitudes towards mHealth. (c) Even though there were positive and negative attitudes, all of the nurses described requirements for whenever mHealth does play a role in the future and last (d) according to the nurse, the diabetes patient is more aware of mHealth than the nurse.

The results of this research show that even though eHealth and mHealth are related to each other, they both play a different role in diabetes care according to these nurses. The most interesting finding of this research is that eHealth is a visible actor in this particular network. However, mHealth can be characterized as an actor without a name. MHealth certainly plays a role within this network since it affects the power dynamics between the nurse and the diabetes patient, but the nurses don't define it as an actor. Therefore, mHealth is an actor without a name.

I. INTRODUCTION

If nothing will change, the number of diabetes patients in the Netherlands will increase to a shocking 1.3 million people in 2025. By then, the number has doubled itself compared to 2007 (RIVM. 2009).

The quote above indicates that diabetes will form a serious problem. This research will examine the role of technology to hopefully stop this rise in diabetes patients.

Diabetes Mellitus is a disease that can be described as a disruption in the balance between the level of blood glucose and insulin. There are two main types of diabetes: diabetes type 1 and diabetes type 2. According to the numbers of the International Diabetes Foundation (2012), there were approximately 371 million people diagnosed with diabetes globally. In the Netherlands there were almost one million people suffering from diabetes (IDF 2012). These numbers are still growing. In 2030 it is expected that 552 million are going to be diagnosed with diabetes. As seen in the quote above by the RIVM (2009), 1.3 million people in The Netherlands will suffer from diabetes in 2025. 90% of these people are suffering from diabetes type 2. This type of diabetes has grown epidemically (Novonordisk).

The costs are rapidly growing partly due to this rise in diabetes. In 2012, there were approximately one million people suffering from diabetes in the Netherlands. This number will continue to grow in the future. The economic loss related to diabetes can be expressed by physical numbers but also by productivity loss and a reduced economy growth (Novonordisk).

Lifestyle plays an important role in the development of diabetes type 2. An unhealthy lifestyle, fat around the abdomen and insufficient exercise are factors that stimulate the development of diabetes type 2. Though these aren't the only factors, these are the factors that can be dealt with by changing the patients' lifestyle (Janssen & Avendonk 2009). The estimations are that adjusting to a lifestyle that includes healthy eating habits and sufficient physical exercise could prevent 80% of these cases (Novonordisk).

Changing one's lifestyle can be reached through self-management education. Diabetes patients have the ability to change their lifestyle because self-management education could increase their knowledge about diabetes, increase both the independency level of the patient and the therapy adherence and last education could support the patient in changing their life (Notenboom et al. 2012). This self-management education could be supported by eHealth. EHealth can stimulate the level of self-management among the diabetes patients, because eHealth offers the opportunity to improve the treatment compliance among the diabetes patients and therefore offers a better outcome in diabetes

treatment. It also has the potential to empower patients more, which leads to a better understanding of their disease and treatment. EHealth could bring patients in contact with fellow peers, which not only provide in more information but also give them the understanding that they are not the only ones with this disease. All of this might support the self-management among the diabetes patients (Notenboom et al. 2012).

EHealth isn't the only intervention that could support the self-management among diabetes patients. MHealth is a new and emerging field that promises the same as eHealth, because mHealth is a part of eHealth. The term eHealth can be seen as a more general term. It consists of the following components (Mendoza et al. 2013):

- Mobile Health (mHealth)
- Health Information Systems (HIS)
- Telemedicine
- Distance Learning (eLearning)

As these bullets show, mHealth is a part of eHealth. Nevertheless, mHealth might have a different effect in diabetes care compared to eHealth. Mobile devices usually belong to one person (Ernst & Young 2012) and therefore it can provide a continuously monitoring of the diabetes patient and improve the lifestyle of the diabetes patient (Stroux 2012).

Besides the existing field, eHealth, a new emerging field, mHealth, offers the same possibilities for diabetes patients. Therefore this research will research the role of both eHealth and its sub-category mHealth in diabetes care according to specialized nurses.

To be able to research this, the main focus is on the distinction between the roles of both eHealth and mHealth in diabetes care according to the specialized nurses. Keeping this in mind, the following question will be answered in this study:

'What are the perspectives of the specialized nurses on the roles that eHealth and mHealth could play in diabetes care?'

To be able to give an answer to this research question, the following sub questions will be answered as well:

1. How do specialized nurses define eHealth and mHealth?
2. What are the perspectives of the specialized nurses on the future of mHealth?
3. What are the effects of eHealth and mHealth on the relationship between the specialized nurse and the diabetes patient?

To answer all of these questions, the central approach in this research will be the qualitative approach. The specialized nurses will be interviewed using semi-structured interviews with open questions. This research is structured as follows:

- Chapter 2 will give some background information on this topic. It will clarify what the effects of eHealth and mHealth are in diabetes care according to literature.
- The used methodology will be described in chapter 3.
- Chapter 4 will continue with presenting the theoretical framework of this research. This theoretical framework is essential for analysing the results and determining the role of eHealth and mHealth in diabetes care according to the nurses.
- The findings of the methodology will be presented in chapter 5 where the main findings of this research will be divided in two sections, the first section presents the main findings on eHealth and the second section will do the similar for mHealth.
- These will then be analysed in chapter 6 by looking at the findings from the actor-network theory in the discussion. The discussion will also elaborate more thoroughly on the limitations of this research.
- The final chapter, chapter 7, will give the final conclusion of this research, which is the answer on the central research question.

II. BACKGROUND SECTION

To understand the role of eHealth and mHealth in diabetes care, this section will give some background information regarding this topic. It will address the differences between eHealth and mHealth. Also, this section will discuss the role of both eHealth and mHealth in chronic care and in diabetes care according to literature.

DIFFERENCES AND SIMILARITIES BETWEEN EHEALTH AND MHEALTH

This section will provide with a distinction between eHealth and mHealth. It will discuss the similarities and the differences between these key terms. Before these differences and similarities can be discussed, a definition of both eHealth and mHealth is given. EHealth can be defined as follows:

> *' eHealth is the use of information and communication technologies, for example the Internet, focused on the patient in its primary care process. Its aim is to improve the individual well-being and the quality of the overall healthcare system.'* (Timmer 2011).

The WHO (2011) defines mHealth as follows:

> *'Medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistant (PDAs), and other wireless devices. MHealth involves the use and capitalization on a mobile phone's core utility of voice and short messaging service (SMS) as well as more complex functionalities and applications including general packet radio service (GPRS), third and fourth generation mobile telecommunications (3G and 4G systems), global positioning system (GPS), and Bluetooth technology'* (WHO. 2011:6).

Eysenbach (2001) has given a definition of eHealth as well. In his definition eHealth was seen as an upcoming field. Since this definition is dated 13 years ago, this definition might be outdated. Therefore, the definition of Timmer (2011) is chosen for this research. As for mHealth, several definitions for mHealth are available as well. The definition of the WHO (2011) is chosen because it is the most extensive definition. The similarities between eHealth and mHealth will be discussed according to these definitions. EHealth and mHealth share common advantages. The patients are the central actor in both eHealth and mHealth (Van Bokhoven & Corneli 2013). Also, they both promise more cost-effectiveness in the healthcare sector. Where eHealth and mHealth share similar advantages, they also share some of the disadvantages. There are concerns regarding the safety and privacy of medical information when using these kinds of technologies (KPMG International 2012; Van Bokhoven & Corneli 2013). Another shared disadvantage is the lack of knowledge among physicians and patients (Bryson et al. 2005; Ernst & Young 2012; Whitten & Mair 2000).

There are also some differences between eHealth and mHealth. Where eHealth uses information and communication technologies such as computers and satellite communication for delivering healthcare services, mHealth addresses to mobile communications. According to the WHO (2011) there are almost 5 billion people who have access to some sort of mobile network. For eHealth there are still some concerns whether everybody has access to the Internet. Due to the wide range of mHealth it also has the ability to address every kind of person from different socio-economic background (Sharma 2011). Launching a new website with health-related information has been perceived as easier in comparison to health related mobile apps. The last difference between eHealth and mHealth is that a computer or laptop is less personal compared to mobile devices. This is supported by Ernst & Young (2012) where they argue that mobile devices belong to one person. So mHealth is more personal as patients hold their mobile devices with them during most of the time (Sharma 2011), which could benefit the patient's self-management.

In this way, mHealth can be seen as different form eHealth, because it uses mobile, smart phones and tablets, which are all mobile devices. Nevertheless, mHealth can also be seen as a sub-category of eHealth as can be seen in the report by Mendoza et al. (2013).

THE ROLE OF EHEALTH IN CHRONIC CARE IN PARTICULAR DIABETES

The rate of morbidity and mortality due to infectious and acute diseases has been reduced. These diseases have been replaced by long-term chronic illnesses that form an increased burden on the healthcare costs. In the past few years, new ways have been sought to reduce this burden. This subsection will explain the role of eHealth in chronic care in particular diabetes care.

According to Ekroos & Jalonen (2007), the goal in diabetes care is to maintain a good glycaemic control. A good glycemic control is necessary to prevent any kind of co-morbidity or/and any development of serious diabetes-related complications. This kind of care forms the biggest burden on the costs for diabetes care. The care of diabetes patients is mostly based on maintaining a good glycaemic control and therefore helping diabetes patients achieving and maintaining a healthy lifestyle (Ekroos & Jalonen 2007). Ekroos & Jalonen (2007) believe that eHealth can support diabetes patients in this matter. EHealth is an effective tool to empower and support patients in self-care (Ekroos & Jalonen 2007).

Self-management is important in order to maintain a good glycaemic control (Notenboom et al. 2012). According to Pacaud et al. (2012) and Notenboom et al. (2012) self-management leads to more knowledge about diabetes as a disease, a higher level of adherence and more motivation to manage diabetes. This could result in more motivation to

change to a healthier lifestyle, which on the long-term leads to a better glycaemic control and decreased complications (Pacaud et al. 2012; Notenboom et al. 2012).

According to Notenboom et al. (2012) the rise of eHealth can stimulate the level of self-management among patients. Pacaud et al. (2012) also support this notion. EHealth systems could replace some face-to-face education and follow-ups, improve the access to care by reducing the travel time and time away from family or work and finally increase patient's satisfaction. Therefore, eHealth systems could play a crucial role in diabetes self-management (Pacaud et al. 2012). The research of Pacaud et al (2012) shows that there is an indirect relationship between eHealth education and maintaining a good blood sugar level. On the first hand, eHealth education improves the self-efficacy. The improved level of self-efficacy leads to a better self-care behaviour, which leads to being able to maintain a better blood sugar level (Pacaud et al. 2012).

EHealth could also improve the medical adherence of diabetes patients through self-management (Notenboom et al. 2012). Adherence to the prescribed therapy is an important issue in chronic care. Especially chronic patients have a low level of medical adherence due to their lack of knowledge and poor engagement. EHealth interventions that improve the adherence among chronic patients are for example reminders to take the prescribed medication (Notenboom et al. 2012).

THE ROLE OF MHEALTH IN DIABETES CARE

The research by Stroux (2012) assessed all available information about the effect of mHealth in diabetes care. According to Stroux (2012) mHealth could have a great impact on diabetes care, because there are certain aspects within diabetes care that could be solved by mHealth interventions. For example, diabetes is a chronic condition that needs continuous supervision in condition management. Diabetes is also a disease that can be improved by changing the lifestyle of the patient. A final example is that diabetes has a global affect and it affects all income groups. Because mobile devices usually belong to one person (Ernst & Young 2012) and because mHealth could address a large population (McKinsey & Company 2010), these three points are good examples of why mHealth could support diabetes patients in their care (Stroux 2012).

The assessment by Stroux (2012) showed that mHealth interventions have a positive impact on the blood glucose control among diabetes patients by improving the self-management. The assessment also showed that mHealth is an effective tool when it comes to monitoring a patient's condition. To summarize the findings, one of the conclusions of Stroux (2012) is that mHealth has the potential to be effective, feasible and acceptable for

diabetes patients. MHealth interventions have a positive effect on the patients' blood glucose level and the mental wellbeing (Stroux 2012).

The research by Katz et al. (2012) conducted a self-management project supported by the use of cell-phones among diabetes patients. The primary aim of this research was to analyse the challenges during this intervention. Nevertheless, the effect of mHealth for diabetes patients during this project could be used to clarify the role of mHealth in diabetes care. According to the research of Katz et al. (2012) hospitalizations and visits to the emergency room were reduced during this project. The cell-phone support also improved the blood pressure and the condition of the feet and it helped reduce the blood sugar level. These effects were achieved by continuous monitoring the condition of the patients and glucose self-monitoring (Katz et al. 2012).

Within diabetes care, literature has shown that mHealth could play a role in continuously monitoring the condition of the diabetes patient and it could support the diabetes care by providing support in the self-management of diabetes patients.

III. METHODOLOGY

To be able to answer the central research question and the sub questions, this research uses the qualitative method as the central approach. According to Mortelmans (2009) a qualitative approach is appropriate when the research is revolved around the daily lives of the investigated subjects. This is the case in this research, since this research tries to look at the role of eHealth and mHealth in the network of the specialized nurses. This research tried to incorporate the perspectives of the diabetes patients as well. Nevertheless, due to lack of respondants this was not possible.
To look into this matter, the central question in this research is:

> ***'What are the perspectives of the specialized nurses on the roles that eHealth and mHealth could play in diabetes care?'***

In order to research the central research question, a total of 23 hospitals with a specialized diabetes department were contacted. The hospitals were chosen based on their location and it was required that the hospitals have a separate department for diabetes patients. Most of the hospitals (17 out of the 23 hospitals) are located throughout the area of South Holland. The list with all the contacted hospitals is included in the Appendix. The first contact happened through the e-mail. The e-mail was either sent to the general e-mail address of the hospital or to the e-mail address of the specialized diabetes department if available. Personalized letters were attached to the e-mail where the research was explained more thoroughly. If the hospitals didn't respond after a week, a second e-mail was sent. If the hospitals didn't respond to this second e-mail as well, the department was called after a week since the second e-mail was sent. During this phone conversation, the researcher introduced her first. The researcher then continued by asking the nurse whether or not they have received the e-mails. No matter the answer to this question, the researcher explained the research again and asked the nurse whether or not they are willing to cooperate with the research. This phone conversation gave more clarification on whether or not the nurses of that hospital were willing to be interviewed for the research.

Out of the 23 hospitals, eight hospitals were willing to cooperate with this research. Seven of these hospitals were situated in South Holland and it was a mix of academic and non-academic hospitals. A total of sixteen nurses cooperated with this research. One interview was a group interview with five nurses. Therefore, this research has interviewed twelve nurses in total.

The nurses were all interviewed using a semi-structured interview with open-ended questions. The interview guide can be found in the Appendix. After several interviews, it was

decided to add more questions to the interview to create more depth during the interviews. With the consent of the nurses, the interviews were all recorded using an iPad and notes were being taken with either a laptop or pen and paper.

Some of the nurses explained beforehand that they didn't have a lot of time available for the interview. For these nurses, the interviews were shortened to a maximum of 15 minutes and the interviews only addressed the most important questions.

After the interviews were held, each interview was typed out in a transcript. Each transcript is then analysed by categorizing fragments in "codes". This research has a total of 34 codes. The list of codes is included in the Appendix. The coding process took place by reading every interview thoroughly. The codes were formulated by dividing the interview in fragments. Each fragment explains or represents a certain topic. These fragments were then summarized in a few words. These words represent a code. After coding the first interview, the codes from the first interview were gathered in a list. Next, the second interview was analysed. The fragments of the second interview were linked to the codes of the first interview. If the codes of the first interview weren't appropriate for certain fragments, new codes for these specific fragments were formulated and therefore expanding the initial list of codes. The third interview was approached in the same way and so on. The interviews were therefore coded through a deductive manner. The definition of deductive is that truth cannot be known. There is no 'rockbottom of knowledge' (De Vries 1995). If a research finds that there are a hundred white swans, this doesn't mean that every swan in the world is white. According to the deductive approach, one should try to falsify its hypothesis. The researcher should search for a swan with black feathers if his/her hypothesis mentions that every swan is white. Truth cannot be known. Theories could be set up, but these cannot be seen as the truth because according to the deductive approach these theories can always be falsified (De Vries 1995). The coding process during this research proceeded in the same manner. After coding the first interview, all of the codes were gathered in a list. When the second interview was coded, the list of codes served as a guideline but during the coding process the researcher assumed that it wasn't possible that every fragment of the second interview could fit in the codes of the first interview. The list doesn't describe the truth. The researcher assumed the same during the coding process of third interview and so on. Therefore, every time when the codes didn't correspond with the fragments, new codes were formed and therewith expanding the initial list of codes. Until the researcher has completed the coding process the initial list is only a draft version of the final coding list. This means that the initial list is not fixed. Based on the notion that if more nurses were interviewed the final coding list would have been more extensive and therefore assuming that the list of codes will never be finished.

After analysing every interview, the corresponding fragments of the different interviews were all placed in one document. When this step was completed, all the documents were read thoroughly in the hope of placing several codes under one main code. For example, ‘code X’ and ‘code Y’ both describe a certain topic. These topics are related to each other because both are for example the result of ‘Z’. Therefore, ‘code X’ and ‘code Y’ can be placed under the ‘main code Z’. The same process was repeated for all the codes. The codes were therefore brought under sub-codes.

Sub questions were formulated in the initial phase of this research. Nevertheless, the most interesting findings are presented and analysed in the rest of this research. These main findings were used to answer the central question. The main findings can be put in the following sub questions:

1. How do specialized nurses define eHealth and mHealth?
2. What are the perspectives of the specialized nurses on the future of mHealth?
3. What are the effects of eHealth and mHealth on the relationships between the specialized nurse and the diabetes patient?

This research has dealt with several ethical issues. Before the interview, all of the nurses were asked for their consent regarding the recording of the interview. The nurses were given the space to disrupt the interview any time when they had to discuss the status of patients with their colleagues. Second, fragments of the interviews with the nurses are used to support the main findings of this research. Anonymity is guaranteed by connecting the fragments to fictitious names. The findings are then being viewed from the actor-network theory to answer the central research question.

IV. THEORETICAL FRAMEWORK

The network between the diabetes patient, the nurse and technology (eHealth and mHealth) describes the central relationships in this research. This network describes not only interactions between human beings, but also interactions between human beings and materials (Law 1992). Therefore, this research assumes that patients, nurses and healthcare technology, in particular eHealth and mHealth, are related to each other and that this relationship works both ways. This means that patients and nurses influence technology, but technology influences patients and nurses as well. This relationship tends to evolve over time, which will lead to outcomes that can't be predicted.

The purpose of this research is therefore to explore these relationships. The outcomes of technology in the healthcare sector can't always be measured and therefore predicted. Technology is complex and unpredictable according to Berg (2001). Due to this complexity and unpredictability, it is neither a sector where a researcher can simply define technology. Technology can't be separated from the context of where it is going to be implemented (Greenhalgh & Stones 2010). Therefore, this research will focus on health technology in action, or as Timmermans & Berg (2003) called it: "*Technology-in-practice"* (Timmermans & Berg 2003). The aspiration of this research is to give more insight in the practice of e/mHealth and what kind of effects the interactions between the three actors has on the network.

Health Technology-in-practice can be examined in this research by using the actor-network theory (ANT). ANT revolves around networks made up of both humans and technologies (Greenhalgh & Stones 2010). Using ANT, as a framework, is suitable because actor-networks are highly dynamic and the outcomes or end-results of these actor-networks are unpredictable, which also accounts for health technology within the healthcare sector. This implicates that the focus is on the position of diabetics, nurses and e/mHealth within this network and how these actors empower each other.

Both eHealth and mHealth are actors in this research. According to one of the definitions by Mol (2010) health technology (eHealth and mHealth) is an actor, because it can make a difference, it has an effect on other actors (Mol 2010). How important health technology becomes depends upon how it develops during use within the network (Timmermans & Berg 2003).

To narrow the focus of this research, the emphasis is not on how e/mHealth develops over time and becomes an important actor within the network, but rather on the kind of actor both eHealth and mHealth is within this network and how the relationships between the actors tend to evolve due to the interactions between the actors.

V. FINDINGS

This section will present the main findings of the interviews with the twelve nurses divided in themes. The results of the interviews with the nurses can be summarized in a few main findings. These findings can be divided into two sections. One section shows the findings regarding eHealth and the second section show the findings regarding mHealth. The findings have shown that how the nurses in this research define eHealth is dependent upon the systems they use. As for mHealth, this research has shown that the use of mHealth does not lead to a definition of mHealth. According to the nurses in this research, different eHealth technologies have different kinds of effects on the diabetes patients. The effect of eHealth on the diabetes patient leads to an increase in the workload for the nurses. The nurses in this research also have the ability to restrict the use of eHealth by the diabetes patient. The last finding on eHealth shows that it leads to more and different types of interaction between the nurse and the diabetes patient. As can be seen in this research, the findings suggest that even though the nurses have different attitudes on the development of mHealth, they all have described requirements for the use of mHealth in the future. The final finding on mHealth has shown that the relationship between the diabetes patients and the nurses has changed due to mHealth. It has changed, because according to the nurses in this research the diabetes patient is more aware of mHealth compared to the nurse. These findings will be explained more thoroughly in the following paragraphs.

THE DEFINITION OF EHEALTH DEPENDS ON THE USERS OF THE EHEALTH SYSTEMS

The following section shows the interaction between the definitions of eHealth given by the nurses and the eHealth systems they use in their daily practice. These findings help reveal the kind of actor eHealth is in the network of the nurses.

When the nurses were asked to define the concept of eHealth, they were all able to do this. The nurses were asked to define eHealth and describe the eHealth systems that were being used in their organisation. Findings of this research suggest that the definition depends upon the eHealth systems the nurses are aware of. The following fragment shows how nurse Sarah defines eHealth: *“I define eHealth as no more face-to-face consults with the patient, but communicating with patient through the email or the patient portal”*

This quote of Sarah shows that according to her eHealth offers a new way of delivering care, as she says ‘no more’. Apparently, she believes that eHealth has the potential to change the traditional healthcare delivery. When nurse Sarah is being asked which kind of eHealth systems she uses in her everyday practice, her answer is as follows: *“We have a diabetes portal and we are trying to stimulate our patients to use that portal. We are aware of the fact*

that the use of the portal is probably going to save us time. It is not entirely true, because we do have a lot of contact by email with the patients. Email is very active; the only thing is that we are trying to quit with email. So, patients could ask their questions using the portal. The portal requires a login using your Digid so it is much more a secure network. We are more aware of the safety level of email and we are communicating this to the patient. We can't use the email to send medical information" The relationship between the given definition and the use of eHealth systems can be clearly seen in these fragments. She mentions the same types of systems in her definition of eHealth and therefore associating the concept eHealth with these two systems. Sarah does mention in her definition that eHealth is a new way of delivering care. This means that the organisation where Sarah works is offering this new way of healthcare delivery instead of the traditional manner.

In her daily practice Sarah uses more eHealth systems to interact with her patients, like computer software or Facebook. During the use of all of these technologies there is a physical distance between the nurse and the patient. EHealth therefore bridges this distance between the nurse and the patient. As could be seen in the article of Andreassen (2011), eHealth could bridge this physical distance because it has the potential to form a safety device for the diabetes patients. Using an e-mail address could give the diabetes patients the certainty that they are always able to reach their physician no matter the distance. According to Andreassen (2011) geographical distance and weather conditions are the two most important reasons that obstruct a face-to-face consult. These two issues can be overcome by the use of an e-mail address (Andreassen 2011). The same accounts for the use of the Internet. Internet could affect the relationship between the physician and the patient in five different ways. It could come to replace the traditional consultation between the nurse and the diabetes patient where they meet each other physically (Dedding et al. 2011).

The following quote shows the same connection. Nurse Meghan uses, as she describes, a live consult to bridge the same gap, which can be seen in her definition: *"Yes, well that is a very broad term. I define it according to the way I know and see it here. I see it as a possibility to communicate with the patient through a live consult, without face-to-face contact."*

The systems were all used to bridge the distance between the nurses and the patients, because at the time of use the nurse is working in her office in the hospital and the patient is on a different place. Face-to-face contact isn't as necessary anymore. Therefore their definition describes this particular aspect of eHealth. This corresponds partly with the definition given in the background section by Timmer (2011):

> *' eHealth is the use of information and communication technologies, for example the Internet, focused on the patient in its primary care process. Its aim is to improve the individual well-being and the quality of the overall healthcare system.'* (Timmer 2011)

It can be assumed that the information and communication technologies mentioned in the definition above are used to bridge the physical distance between the nurse and the patient as well. To clarify this, the first nurse mentions the use of DigiD[1], which uses the Internet to bridge this distance. The second nurse mentions live consult[2] to bridge the same distance. The general definition of eHealth by Timmer (2011) describes the use of information and communication technologies. Both these technologies can be seen back in the definitions of eHealth given by the nurses in this research.

Another part of this definition focuses on the well-being of the patient. The improvement of the well-being is only mentioned in one of the twelve definitions given by the nurses. The research by Hesse & Schneiderman (2007) could explain this finding. The main finding of this research was that used eHealth systems can be seen back in the definitions of eHealth (Hesse & Schneiderman 2007).

In line with the finding of Hesse & Schneiderman (2007) the assumption can be made that, in this research, the eHealth systems in the organisation can be traced back to the definition of eHealth given by the nurses in this research. This is an interesting finding, because this could explain why the improvement of the well-being isn't found back in all of the definitions of the nurses. It might be so that in this research, the use of information and communication technologies is more noticed more by the nurses than improving one's well-being, which leads to the absence of the well-being in the definitions. Nevertheless, this should be further investigated before making these kinds of assumptions. This finding also suggests that when nurses are using different eHealth systems, this would affect their definition. So the nurses are able to define eHealth by acquainting them with eHealth systems. This interaction determines the kind of definition the nurses give when asked about it.

[1] DigiD is a digital username and password to connect with governmental institutions.

[2] A live consult refers to a communication technology where the patient and nurse are in two different places. They are still able to see each other 'live' (seeing live images of each other) by using technology.

DIFFERENT KINDS OF EHEALTH TECHNOLOGIES HAVE DIFFERENT KINDS OF EFFECTS ON THE DIABETES PATIENT (FROM THE PERSPECTIVES OF THE NURSES)

The nurses aren't the only ones who are using eHealth. The diabetes patients are using eHealth as well. The following findings are based on the answers given by the nurses. This section shows that introducing eHealth has different effects on the diabetes patient and that it changes the relationship between the diabetes patient and the nurse.

The use of e-mail by the diabetes patient

In the definitions of eHealth given by the nurses it seems that the nurses associate eHealth with, among others, the use of e-mail to communicate with the patient. This implies that the patients are using the same technology to communicate with the nurse as well as mentioned by nurse Jessica:

"Yes, yes. When I look at my own patients*, they tend to e-mail more than use the telephone to call me. It depends on if the patient is rather young who has a job or if it is an elderly living at home or even somebody who doesn't use the computer quite that much because these people are still there. But a lot of questions are being sent using e-mail..."*

E-mail enables the patient to ask questions to nurse even though there is a physical gap. The use of a phone might provide in a similar result but nurse Jessica specifically mentions that e-mail provides in this function. Nurse Rachel said the same:

"EHealth means that we are more accessible and more easy to reach. The mails are checked everyday. People e-mail us with questions about everything. We are also reachable 24 hours per day through the phone. But, for questions people don't want to use the telephone and use the e-mail instead..."

According to this quote, the use of e-mail influences the diabetes patient by lowering the threshold to ask question to their nurses. This implies that the use of eHealth has made access to knowledge easier for the diabetes patient. The use of e-mail provides diabetes patients with a different access to knowledge. According to literature, an e-mail address has the potential to guarantee access to knowledge and knowledge can be perceived as an instrument for the diabetes patients to be able to cope with and stay in control of their illness (Andreassen 2011). This would mean that in an indirect way, e-mail has the potential to help diabetes patient cope with their illness and stay in control of their diabetes.

Patients with chronic conditions indeed indicated that the use of e-mail has improved their understanding of their chronic condition (Baker et al. 2014). Due to this function of e-mail, patients tend to use e-mail more because it not only guaranteed access to more knowledge, but it also promised that patients would have quick access to this knowledge since patients could ask questions any time they desire instead of waiting for the phone consults on a predetermined period of time. The patients don't have to interrupt their work,

school day or anything else to phone to the nurse. With e-mail, the patients could contact the nurse at a time that suited them instead of the nurse. As with other forms of online services, patients could decide to use health services at a time that suit them the best (Notenboom et al. 2013). This shows that patients have more control on both their lives and how they incorporate health treatments in their life. EHealth could therefore be a symbol of fast access to more knowledge in diabetes care.

However, Andreassen (2011) also mentions that because eHealth can bridge the physical gap, it could also create more distance in the relationship between the nurse and the diabetes patient. The relationship becomes more distant (Andreassen 2011). Therefore, eHealth could indeed bridge the physical gap, but at the same time increase the distance in the relationship between them.

The use of the Internet and computer by the diabetes patient

E-mail isn't the only form of eHealth that is being used by the patients. The definition given by nurse Gina shows that the patients are also using the Internet.

"That is when patients are using the Internet to find information about what's wrong or what is possibly wrong with them. It is mostly the use of the Internet."

Gina also mentions that patients are using computer programmes to upload their medical data, for example one's blood sugar level, so it's visible to the nurses:

"We aren't active yet on Twitter and the same goes for Facebook. It is there and patients can post stuff. But we aren't active on it regarding diabetes. You also have DiaConnect, which is connected to every meter. People could download this program on their computer and download information from their meter with it. The program will write the blood sugar correctly if the patient has adjusted the time correctly. Using DiaConnect the patient can send us e-mails. It is some sort of read-out programme that every meter has."

Gina and the diabetes patients aware of the existence of websites like Twitter and Facebook. Though they are both aware of these websites, Gina differs from her patients. In comparison to her diabetes patients, Gina isn't using these websites for diabetes-related purposes. This particular computer programme Gina describes has several functions for the diabetes patient. It gives them access to their own medical information. It also makes the information more understandable for the nurses. Most of all, it relieves the patient of writing measurement in a correct manner. The diabetes patient cannot be kept responsible if the measurements aren't written correctly. It is most likely that the programme has made a mistake.

These two fragments show that the patients are using the Internet and computer programmes. The use of these two technologies isn't uncommon among diabetes patients.

Both are part of the inventory by El-Gayar et al. (2013) about IT-technologies used by diabetes patients. This inventory consists of four eHealth technologies in total. These four technologies were the Internet, cellular phone/devices, decision support and telemedicine. The computer programmes belong to the category telemedicine. (El-Gayar et al. 2013).

According to this research, the use of Internet holds the potential to empower the diabetes patient. Not only were they able to send their glucose levels or information about their medication and diet, they were also able to access their own medical record, receive direct feedback from the professionals, gain more knowledge about diabetes and the medication and ask for further details about health related issues (El-Gayar et al. 2013).

What is surprising is that these findings have shown that, according to the nurses, the effects of e-mail on the diabetes patient are different than the effects of the Internet. The only similarities are that both are used for contact with the nurse and to gain more knowledge. According to El-Gayar et al. (2013) the Internet, unlike e-mail, gives the diabetes patients the possibility to access their own medical record. The fragment about the computer programme has given the patients the ability to access and download the medical information from their meters, but also relieve them from certain responsibilities. The diabetes patients then had to use e-mail to send this information to the nurses. Even though this research shows that e-mail might have a different effect on diabetes patients in comparison to the computer programmes, computer programmes and e-mail do complement each other.

The role of eHealth in this research is dependent upon which kind of eHealth technology is used. Therefore, different kinds of eHealth technologies have different kind of effects on the diabetes patient, though it can be seen that in this research the use of all eHealth technologies tend to increase the contact between the nurse and the diabetes patient.

Nevertheless, the findings of the literature aren't quite similar as the findings of this research. El-Gayar et al. (2013) found that the use of Internet motivated the diabetes patients more to self-manage. The nurses don't agree with this finding by stating that patients sometimes feel that it is time-consuming. EHealth has to many disadvantages for the patients and therefore the patients didn't incorporate self-management in their daily lives. Because it is time-consuming, it has demotivated the patients to use eHealth. The next nurse mentions that the added value of eHealth has to be taken into account when it comes to consuming extra time of the patient: '*...I believe that you really have to look at that, also when it comes to eHealth. Where can you fit it in and does it makes things easier for the patient? Or is it just something different, and does it mean more time?'* So this nurse warns for the possibility that eHealth could be time-consuming. Her diabetes patients could therefore be demotivated to use eHealth. This is interesting since the nurses in this research show that besides positive effects, eHealth does have negative effects on diabetes patients. Since

most of the literature was a review and didn't take the perspective of the nurses into account, this could explain the difference between the literature and this research. Therefore, this topic needs to be further investigated.

THE USE OF EHEALTH LEADS TO AN INCREASE IN WORKLOAD FOR THE NURSES

The previous section showed that eHealth has an effect on diabetes patients in several ways. The results of the interviews also show that eHealth has an effect on the workload of the nurses. The next quote mentions this influence on the workload:

"It has changed my work. You can see things faster on the one hand, but on the other, it costs me more time. Patients give me an entire report with blood sugar levels within five minutes for which I have to make room for in my schedule to interpret, read and base my advice on this information. So I'm more occupied with it outside the consults. Measurement values used to disappear when the patient left the room and by then you were done with you job. But the patient leaves a lot more measurements that I have to look at later on."

This is interesting because one of the advantages of eHealth is to increase the efficiency of care delivery (Timmer 2011). Nevertheless, it seems that when eHealth is put into practice in the network of patients and nurses, it will lead to an increase in workload for the nurses instead of a more efficient care delivery. As Berg (2001) mentions, technology is complex. Efficiency increase may determine success of an implementation project, but whether or not this could be achieved is unpredictable (Berg 2001). The implementation of eHealth can't be fully planned and controlled and therefore this increase in workload couldn't be predicted before the implementation phase.

Gulzar et al. (2013) mentions the same increase in workload as the nurses in this research have pointed out. According to this article the use of eHealth poses several challenges. An increase in workload is one of these challenges (Gulzar et al. 2013). The workload for the nurses becomes heavier because the patients are used to receiving information or answers 24/7 per day for 7 days in the week (While & Dewsbury 2010). The patients want a guaranteed access to health-related information as mentioned by Andreassen (2011) and therefore put the nurses under pressure to be on stand-by whenever the patients want them too. It is therefore interesting to see that eHealth changes the attitude among the patients as regards to access to information and the work of the nurses.

The earlier mentioned nurse Jessica mentions the similar change in her work: *"At a certain time, I've noticed that people stopped calling even though it was important. I ask them: "Can you e-mail me?" and they respond: "Yes, of course." Okay, well do that then. Nowadays you ask if they can e-mail. If they find that difficult you ask them if they could call you. It has turned around you know."*

From the nurses' point of view, eHealth results in an increase in workload and alteration of the work because eHealth affects the attitude of the diabetes patient. It shows that it changes the relationship between the nurse and the diabetes patient since the increase in workload is to please the need of the diabetes patient to receive information quickly. The development of technology in other sectors has made the patients accustomed to quick access of information (While & Dewsbury 2010).

THE NURSE LIMITS THE USE OF EHEALTH BY THE DIABETES PATIENT

The findings above showed that there is a relation between on the one hand the nurse and eHealth and on the other the diabetes patient and eHealth. The results of the interviews with the nurses also suggest that the nurse is able to influence the relation between the diabetes patient and eHealth. This expresses itself in two ways.

First of all, the use of eHealth doesn't only shape the way the nurses define the term eHealth, it could also limit the patient's free choice. When El-Gayar er al. (2013) made an inventory of the used IT-technologies by diabetes patients it became clear that the free choice of the patients is limited. Not all the technologies that were being used by the diabetes patients were the result of their own choice (El-Gayar et al. 2013). Nurse Jenny mentions the following on this topic: *"The patient has a free choice. When someone is visiting for a consult and he or she should inject himself or herself with insulin a lot is going on in their lives...There are also patients who want me to choose for them.... I make a choice when they ask me to. You take a good look at the patient and think by yourself what meter could be best for them. I choose one from the five different meters and give that one to the patient."*
This nurse limits the free choice of the patient and therefore put restrictions on the interaction between the diabetes patient and eHealth. A glucose meter is a form of eHealth since the diabetes patients are using the meters to download information. It is interesting to see that in a time where it is believed that the patients are more empowered (Andreassen & Trondsen 2010) it seems that the nurses limits the free choice of the diabetes patient when it comes to choosing an eHealth system.

The fragment above shows that Jenny based her choice on how she looks at the patient. Her choice depends upon certain patient characteristics. Based on these characteristics, she chooses a certain meter for the patient and thereby limiting the free choice of the patient. Nurse Sheila relates the use of eHealth among her diabetes patients to one's age. This comes to show that the introduction of eHealth leads to categorisation of the diabetes patients.

The nurses in this research are making assumptions on the capability of the diabetes patient to make use of eHealth. The following quote shows the same: *"Most of the patients*

are from the south of Rotterdam. They have a low level of education, belong to a low socio-economic class, often don't have a computer, don't speak the language very well and are not fit to manage their own illness which is required to work with eHealth I presume. So for that group: I don't feel that it is meant for them"

As this quote suggest, the more developed a patient is, the more likely it would be if the patient uses some form of eHealth. The research by Anderson (2004) confirms that these factors are predictors in the use of Internet. Age, income and education level are predictors of using the Internet for health-related issues in the research of Anderson (2004). This can be seen back in this research since the second nurse ties one's education level to their possible use of eHealth The introduction of eHealth in this particular network stimulates the nurse to categorize diabetes patients based on their characteristics. Based on these categories the nurses limit the diabetic's use of eHealth by assuming that certain characteristics determine whether or not a patient is capable of using eHealth.

EHEALTH LEADS TO MORE INTERACTION BETWEEN THE NURSE AND THE DIABETES PATIENT

As suggested earlier, the introduction of eHealth has implications for the relationship between the nurse and the diabetes patient. The literature suggested that eHealth could increase the distance in their relationship. The results of the interviews suggest otherwise. The findings of this research show that the introduction of eHealth leads to more frequent interaction between the nurse and diabetes patient and therefore contradicting the suggested distance in their relationship. The next quote supports this finding: *"You don't have less contact with patients because you're working with eHealth. From time to time you have even more intensive contact with patient.*

In what way do you feel that you have more intensive contact?

Well, you talk to them by phone, by e-mail and sometimes there are extra moments of contact to discuss the data they have sent to me."

Nurse Katrina mentions the following: *"I think that when people really start being active in coping with their diabetes, whether it is a consult or e-mail, it will be more intensive contact because someone has questions. But I believe that e-mail is more intensive. It is practically impossible to see a patient every week on a consult. It is simply impossible here. So I think the contact will be more intensive through the mail, but you will definitely answer the needs of the patient quicker than when you use the traditional system and see them during a consult."*

These quotes show that there is more frequent contact between the nurse and the diabetes patient. Lee (2008) has found the same increase in contact.

This finding is important, because it shows that the use of eHealth impacts the relationship between the nurse and the diabetes patients. Instead of questioning the professional status of the nurse, the diabetes patient is stimulated to contact and visit the nurse more often as found in this research and in the research of Lee (2008).

THE USE OF MHEALTH DOES NOT LEAD TO A DEFINITION OF MHEALTH

Like mentioned in the background section, mHealth offers many of the same possibilities as eHealth. Nevertheless, how the nurses define mHealth isn't the same as how they define eHealth. The results even show that the majority of the nurses (11 out of 12) weren't able to define mHealth.

"I don't know that term."

"MHealth, I have no idea what that is. "

"I have never heard of that. "

The article of Ehteshami et al. (2012) has shown similar findings. This article shows that professionals have a low awareness when it comes to mobile health technology and the related aspects to mHealth. This low awareness can be seen back in this research. What was surprising was that when the nurses were asked to point out the mHealth systems in their organisation they were able to do this even though they didn't know the term. They were able to tell exactly what kind of mHealth systems their organisation is using. However, the nurses in this research only gave advice on the existence of mHealth to their patients.

This interaction between the nurses and mHealth didn't result in knowledge to define mHealth. The following quote shows nurse Dana isn't able to define mHealth:

"I don't know mHealth."

Because Dana wasn't able to define mHealth, the interviewer told her that mHealth was almost similar to eHealth, but what was different is that mHealth uses mobile devices. The next question was what kind of mHealth systems are used in her organisation. Surprisingly, the following quote represents her answer on this question: "*We have developed an application, which was launched just recently...We advise people applications for their carbohydrates. If the patients have to count carbohydrates we have a book that contains with several carbohydrates applications that were selected by our dieticians. But I do recommend several apps. They can download those on their mobile cell phone, which makes things easier. "*

The earlier mentioned nurse Rachel didn't know how to define mHealth as well. The interviewer told her similar as what the interviewer told nurse Dana. MHealth was almost similar to eHealth, but what is different is that mHealth uses mobile devices. This has triggered nurse Rachel into telling the interviewer the following:

"If that is mHealth, we do a lot with apps in this organisation... But we have also collected apps for the children. They can download the Koolhydratenkenner on their mobile phone. So, we certainly do things with that. We also ask the parents if they have any tips for us and if they want to share these tips with us. Because apparently, the parents are searching everywhere for information. They are much more educated in these apps and they know where to find them. We want to be as far as them, but we don't have much time for that. The management wants that everything is more efficient and that the staff is being reduced. We don't have time to be occupied with these things. Suikerplein[3] will probably launch an app as well. That would be great. So if this is mHealth, we are certainly working with it."

Unlike with eHealth, the nurses don't use their knowledge or experience with the mHealth systems to define the term mHealth. The research of Ehteshami et al. (2012) also shows that the relation between the level of awareness about mHealth and the use of mHealth isn't significant. Therefore, it is quite possible that the nurses in this research are using mHealth technologies even though they aren't aware of the existence of mHealth. In this research, mHealth has a less visible role in comparison to eHealth according to the nurses. An explanation for this could be found in the fact that mHealth is a part of eHealth as can be seen in the article of Mendoza et al. (2013). Therefore, it might be so that the nurses don't see mHealth as a separate entity, but rather as an aspect of eHealth. Nurse Thea was asked to define the term mHealth. She answered as follows: *'Well, for me they are the same. I'm aware that they are both different terms, but to me, they are the same. They refer to both eHealth as mHealth'*. The answer of Thea shows that she sees eHealth and mHealth as one kind if technology. To her, mHealth and eHealth doesn't exist separately. Perhaps, this could explain why the nurses in this research weren't able to define mHealth. Nevertheless, further research needs to be done to draw conclusions on this matter.

MIXED ATTITUDES AMONG THE NURSES ABOUT THE DEVELOPMENT OF MHEALTH

The results of the interviews suggest that there is no unanimous attitude among the nurses towards the development of mHealth. The attitudes of the nurses can be divided in two sides. On the one hand there are nurses who feel that the development of mHealth is a positive development as nurse Rachel mentions: *"I think it is wonderful. At first, I didn't want to use this beautiful phone as well. I just recently did, last summer and I wish I done it before. I can take pictures, I can WhatsApp. A new world has opened up for me, which wasn't new for all*

[3] An initiative of the Radboud University Nijmegen. A collaboration with four other hospitals has lead to an encrypted website for patients, parents and nurses that requires a username and a password to login. On this website, users can make an individual profile, post status updates regarding their diabetes and ask questions

the youngsters but in which I lag behind. So, I really think it is beautiful and you can experience things with other people."

Nurse Sarah shares similar feelings: "*I think it's a positive development. The organisation of the healthcare system cannot continue in the same way. There are too few people to provide care and too many people who are demanding care. You have to change in order to be able to provide care in the future. Too make it more sustainable. And yes, I'm definitely interested in using mHealth"*

Nurse Sarah has a positive attitude towards mHealth and genuinely believes that mHealth has the potential to change the healthcare sector. The healthcare system cannot continue this way and according to nurse Sarah, mHealth has the power to make healthcare delivery more sustainable. Not only does she believes that mHealth is a positive development, she also believes that mHealth is necessary in order to deliver healthcare. It is interesting to see that even though Sarah believes that it is a necessary and urgent development, she wasn't able to define mHealth. Sarah is therefore aware of the existence of mHealth and that it has to be implemented, but she doesn't define it as an actor. Again, this might be explained by what nurse Thea mentioned in the previous section: mHealth isn't seen as a separate entity. Nevertheless, further research needs to be conducted on this matter.

On the other hand, not all nurses share the same opinion. Some of the nurses have their doubts about the development of mHealth as can be seen in the answer of nurse Sheila:

"I try to keep up, but I'm not 18 anymore. It doesn't go smoothly and I find it sometimes difficult. Well, I know I have to keep up and use my common sense to stop and question myself whether it is safe or not… "

It is interesting to see that, besides that some of the nurses find it a positive development; there are also nurses who feel that it is more of an obligation. It is interesting because this feeling of obligation or a negative attitude towards mHealth isn't uncommon. A common barrier in the implementation of mHealth is the adoption among its users, patients and nurses. According to literature, due to the empowering factor and the convenience it brings for the patients, the patients' adoption rate is much higher in comparison to the rate among the nurses. Though some of the nurses in this research have a positive attitude towards mHealth, professionals in general are more traditional than the patient as regards to alternative ways of delivering healthcare (Norris et al. 2009). In general, professionals, and in this case nurse Sheila, are more likely to resist mHealth technologies.

The sense of obligation nurse Sheila feels has evolved in a negative attitude towards mHealth. When she was asked how she would see the future with mHealth, she answered as follows: *"You can see the rise of all those apps and everybody is making one. They are also very cheap and sometimes for free, which makes me wonder how safe they are. I try to*

deliver this message to the patients as well: "Do you want that everything is out there on the streets or do you want that the medical officer has access to your files?" That is my concern and as long as nobody can prove to me that this concern is irrelevant, I will keep this concern"

In this fragment it is clear that Sheila questions the safety of all the apps. She expresses her fears here again. She doesn't keep her fears to herself. She warns her patients about it as well in the hope that her patients would think twice before using mHealth. Unless proven otherwise, she is determined to keep her fears. The future she sees for mHealth is therefore dependant upon the fears she will keep. Her attitude influences the potential future of mHealth in her eyes. This influences her readiness to use mHealth now and in the future, but also might influence the readiness of the diabetes patient to use mHealth since nurse Sheila is giving advice about it to her patients. So introducing mHealth in the network could either be perceived as positive and urgent or as negative development with consequences for the potential future of mHealth in diabetes care. Therefore in this research, the role of mHealth in diabetes care according to the nurses is uncertain.

THE NURSES HAVE DESCRIBED REQUIREMENTS FOR THE USE OF MHEALTH IN THE FUTURE

Even though not all of the nurses see a bright future for mHealth, all the nurses in this research have described requirements for the use of mHealth in the future. The results show that out of the twelve interviews, the most important requirements are safety, reliability and privacy.

According to Martinez-Pérez (2013), the reliability of the information provided with mHealth technologies is questioned due to the rapid rise of mHealth. As mentioned earlier, mHealth and the apps are on the rise. This competition among the developers of apps and as a result errors and bugs, jeopardizes the safety, privacy and reliability of the mHealth technologies (Martinez-Pérez 2013). The next quote is a good example of these conditions: *"I think mobile traffic is very vulnerable. You hear a lot about stolen phones or eavesdropping in the news. I would be very careful with that. In first instance we believed that e-mail was rather safe, but it now appears that it isn't. I don't think we can escape mHealth, but I do think we should all be alert about who is watching with us, who can access personal files etc."*

The endangered safety of e-mail is related to mHealth, which makes her question the safety of mHealth. The nurse definitely sees a future with mHealth, but there are requirements to this future. The number of safety protocols is growing, but this doesn't guarantee the safety, security and other concerns of the mHealth technologies (Norris et al. 2009).

The guarantees the nurses want regarding the privacy, safety and reliability are all concerns of mHealth in general. As seen in the background section, the concerns could also be applied on eHealth. Nevertheless, the nurses didn't see these conditions on the use of eHealth. Therefore, two assumptions could be made. The first one is that the introduction of mHealth could only lead to a role for mHealth in the network if these requirements can be guaranteed. Second, eHealth and mHealth play different roles in the network, since the role of eHealth isn't limited by requirements set by the nurses in this research.

THE DIABETES PATIENT IS MORE AWARE OF MHEALTH COMPARED TO THE NURSE (FROM THE PERSPECTIVES OF THE NURSES)

The findings of the interviews show that the shifting power balance mentioned by Ball & Lillis (2001) is clearly visible when it comes to the diabetes patient, the nurse and mHealth. Unlike with the use of eHealth where the nurse is still seen as the expert when it comes to found information, it appears that the diabetes patient has more knowledge about mHealth compared to the nurses. It is not the nurses who are educating the diabetes patients. It is the other way around: *"… We also ask the parents if they have any tips for us and if they want to share these tips with us. Because apparently, the parents are searching everywhere for information. They are much more educated in these apps and they know where to find them. We want to be as far as them, but we don't have much time for that… "*

As nurse Sheila mentions: "*I notice that these apps are being searched for and found by the patients. Patients make me aware of these apps very often. A lot of apps obviously are foreign. I always look across someone's shoulder to observe what he or she is doing with these apps."*

She continues with: *"I always ask the patients if they have found something. If they do, I ask them if they could show it to me. In this way I stay up-to-date of all the available technologies. Sort of at least."*

All of these nurses mentioned that the patients were educating them one way or another about mHealth. The knowledge of the patients in general is expanding according to Spencer et al. (2011). Professionals are more in contact with this knowledge than before. For example, educators have tried to incorporate the expertise of patients in the curriculum of students. This offers the students to enrich their knowledge and encounter new learning experiences that they wouldn't normally learn. The interaction between the two should be an interaction between two experts where the professional has the medical knowledge and the patients have the experiential knowledge (Spencer et al. 2011).

According to the nurses in this research, the diabetes patients have the knowledge about where to find mHealth applications and how to use them. The diabetes patients have

used this knowledge to educate the nurses about it. It is interesting that because of mHealth, the balance has shifted to a situation where there are two experts; the nurse is the expert on everything diabetes-related and the diabetes patient is an expert on mHealth. This indicates a change in the relationship. The traditional situation where the nurse yields more power over the diabetes patient is slowly changing. When the nurses are asked about their relationship between them and the diabetes patient, most of them didn't see this hierarchical relationship. They rather see themselves as peers with an expertise on diabetes as the following quote shows:

"... I try to approach the patients as if they were on the same level as I am. Is more of a friendship, but sometimes I try not to be too friendly. I still have to educate them. Nevertheless, I truly value this kind of contact I have with my patients. I don't believe it would benefit them if I would act as if I know everything..." The nurses don't believe that it would benefit the patient or the prescribed treatment if the diabetes patient would feel that the nurse is towering above them. Therefore, the nurses in this research adjusted their relationship to this assumption. They genuinely hope that the diabetes patients don't see them as professionals that have a higher rank in the hierarchy, but they want to be perceived as accessible.

As this quote shows, the nurse sees the relationship she has with a patient as a friendly relationship, but she does keep in mind that this relationship cannot be too friendly because a nurse has to educate the patient. Therefore this quote is a nice example of the nurse as a peer with an expertise. Though the nurses want to be perceived as accessible, they are still aware of their function, which is to educate the diabetes patient. Besides considering themselves as a peer with an expertise, the nurses also see themselves as a coach: "*I believe that the role of the nurse is more of a coach."* This is interesting to see because the change in the relationship between the nurse and the diabetes patients in this research is visible. The diabetes patient and the nurse are more on the same level. This could mean that the interaction between the nurse and the diabetes patients has changed due to mHealth. The potential role of mHealth, from the perspective of the nurse, could therefore be changing the traditional professional-patient interaction into an expert-expert interaction. The traditional situation where the nurse yields more knowledge is changing into a situation where there are two actors that hold knowledge over a certain area.

VI. DISCUSSION

Thus far, this research has approached the role of both eHealth and mHealth in diabetes care from the perspectives of the specialized nurses in the Netherlands. This perspective has shown that nurses define eHealth and mHealth differently, because the nurses in this research were able to define eHealth, which cannot be said for mHealth. As can be seen in this research, eHealth has several effects on diabetes care according to the nurses. It affects the diabetes patients and their attitude, the nurses and their workload and the interaction between the nurse and the diabetes patient. It is interesting to see that this research shows that even though the nurses couldn't define mHealth, they do have an opinion about the development of mHealth. Roughly speaking, there were nurses who find it a positive development and there were nurses who thought that it was a negative development. This attitude influences the kind of future they foresee for mHealth in diabetes care. However, no matter the kind of attitude the nurse has, all of the nurses in this research believed that mHealth could only play a part in diabetes care if it was a safe and reliable technology that holds privacy into account. MHealth is even perceived as an urgent development by some of the nurses. It has to be implemented, but only if it can guarantee safety, privacy and reliability. Last, this perspective has shown that both eHealth and mHealth influence the relationship between the nurse and the diabetes patient. The relationship has evolved due to eHealth and mHealth. It is nice to see what the perspective of the nurses in this research can tell about the role both eHealth and mHealth have in diabetes care. However, what can this perspective tell us about the influence both eHealth and mHealth have in the network of diabetes patients, nurses and technology?

This research shows what Berg (2001) mentions in his article: technology is both complex and unpredictable. Both eHealth as mHealth are unpredictable because it leads to different effects in diabetes care. It is also complex since the nurses didn't know how to define mHealth, even though mHealth was used in their daily practice. However, the assumption that both eHealth and mHealth are complex and unpredictable can only pointed out by looking at technology (eHealth and mHealth) from the perspectives of the nurses. Why technology (eHealth and mHealth) is complex in this particular network could be explained by looking at what kind of actors both eHealth and mHealth are in this network. . It can be explained by looking at the findings from an actor-network theory. A network doesn't exist only of interaction between human beings, but it exists also of interactions between humans and other materials (Law 1992). Therefore, within this research the diabetes patient, the specialized nurse and technology (eHealth & mHealth) are being seen as actors within a network. They are being seen as actors in this research because they do something and can make a difference in this network (Mol 2010). Looking at these findings from the actor

network perspective, this research suggests that eHealth has a more visible role in diabetes care according to the nurses where the role of mHealth is less visible. This is important, because it helps to understand the interactions in the network. Several interactions play a role within this network. This research shows that in this particular network these interactions could be either active or passive interactions. The nurses in this research indicate that the diabetes patients and themselves are using almost similar eHealth systems. Both the nurses and the diabetes patients are actively using these eHealth systems. The same cannot be said for mHealth. The answers suggest that the diabetes patients and the nurses are interacting with the same mHealth technologies. Nevertheless, the same answers show that the diabetes patients are the only ones who are actively using these mHealth technologies. The nurses in this research are more passive users. They merely give advice about the use of it to the patients. This might suggest that according to the nurses in this research, eHealth is a more active actor where mHealth is a more passive actor in this particular network.

THE VISIBLE ACTOR – EHEALTH

As this research shows, the nurses have the knowledge to define the term eHealth. The findings suggest that the nurses didn't obtain this knowledge through a piece of paper. As could be seen, knowledge is more of less a social product as mentioned by Law (1992). Since eHealth plays a role in the network of the nurses, the knowledge about eHealth is formed through the relationship between the nurses and the diverse eHealth systems. This knowledge forms the base of their definition of eHealth. In line with Law (1992), this knowledge about eHealth embodies a material form. If these materials somehow would disappear, this would disrupt the network (Law 1992). This would mean that if eHealth were to disappear, this would disrupt the entire network. The other actors, in this case the nurse and the diabetes patient, have to put a lot of effort in substituting eHealth to reduce the disruption of their network (Mol 2010). The definition of eHealth could therefore change if the eHealth systems would somehow disappear.

The relationship between the nurse and eHealth doesn't only form the knowledge of the nurses; it also has an effect on the relationship between the nurse and the diabetes patient. The interaction between eHealth and the diabetes patient affects the attitude of the diabetes patient. During the time when Ball & Lillis (2001) were conducting their research, patients were behaving more like consumers. These consumers want more control over their lives. The 21st century patient is different from the 20th century patient (Timmer 2011). The diabetes patient has changed their attitude because they want fast access to knowledge and therefore expect that the nurse is stand-by 24/7 per day (While & Dewsbury 2010). As the nurses in this research point out, they increased their workload to satisfy the needs of the

diabetes patient. As seen in this research, their work doesn't end when the patient leaves the room. They have to continue their work because the patient left his/her measurements behind that they have to take a look at later on. The actor eHealth enables the other actor, the diabetes patient, to influence the work of the nurse. EHealth therefore changes the relationship between the diabetes patient and the nurse. The research of Ball & Lillis (2001) has shown that the power scale between the professional and the patient is shifting towards a balance due to eHealth. This research has shown that the power balance between the nurse and the diabetes patient is affected by eHealth and therefore suggesting changes in the relationships within this network. This is important because the role of eHealth isn't only empowering patients or enabling patients to ask questions. It is giving the diabetes patients the possibility to change their relationship with the nurse by influencing the workload of the nurses. Moreover, eHealth doesn't make the diabetes patients question the professional status of the nurses in this research (Lee 2008).

This change in the relationships leads to another effect in this research. It doesn't lead to the fear of deprofessionalization as hypothesised by Lee (2008). The use of eHealth may lead to deprofessionalization since patients might rely less on the professional when it comes to health-related information (Lee 2008). The nurses in this research suggest otherwise since they experience more frequent contact between them and the diabetes patient due to the patient's use of eHealth. Communication between actors in this network has to be mediated through another actor or network, which in this case is eHealth. In this particular case, communication through eHealth is necessary for the relationship between the nurse and the diabetes patient (Law 1992). It is mentioned by Lee (2008) that the use of eHealth has made the patients more self-aware and are more likely to turn to the opinion of the professional (Lee 2008). In this analysis, the patients feel that the professionals could give them the answers on their questions due to their use of eHealth (Ball & Lillis 2001). Therefore as can be seen in this research, the use of eHealth isn't only necessary to maintain the relationship between these nurses and diabetes patients, but it also strengthens their relationship.

THE LESS VISIBLE ACTOR - MHEALTH

Where eHealth takes a visible position within this network, this doesn't account for mHealth. The role of mHealth is less visible compared to eHealth. This might be caused by the fact that mHealth is a relatively new area of expertise or that mHealth isn't seen as a separate entity. The findings show that even though the nurses weren't able to define mHealth, they were using it in their daily practice. It is possible that mHealth is less visible from the perspectives of these nurses or that the nurses see it as a part of eHealth because it is being forgotten as a technology.

Due to this relatively low awareness, the nurses in this research weren't able to detect mHealth as an actor. Apparently, according to these nurses, mHealth runs so wide and deep in their network that they are taken it for granted. This leads to a phenomenon called punctualization (Law 1992). Punctualization is a process where a technological actor becomes invisible due to its success. Other actors only pay attention to the output of the technological actor instead of its complexity (Law 1992). This supports the findings in this research, since the nurses mentioned recommending applications to the diabetes patients without knowing how to define mHealth. MHealth is seen as necessary development, but the nurses couldn't define mHealth. This comes to show that the nurses recognize mobile applications but aren't aware of the general definition of mHealth. It is being perceived as a necessary development without being aware that this development is called mHealth. If this finding would be compared to the analysis of Law (1992), this would mean that the nurses only recognize the output of mHealth, the mobile applications and the urgency of the development, without being aware that this output is the result of mHealth. This makes mHealth less visible.

Even though these particular nurses couldn't define mHealth and mHealth can be punctualized according to Law (1992), it certainly forms an actor within this network. Concerns of safety, privacy and reliability regarding mHealth are common among the nurses in this research. These concerns aren't ungrounded. Waegemann (2010) notices the danger of safety and privacy as well. The development of mHealth might be exciting, but security and privacy issues need to be resolved first (Waegemann 2010). The research by Whittaker (2012) found that opinions about privacy and security of the health data provided by mHealth varied, but that majority feels that high-level guidance and widespread discussion needs to take place before mHealth technologies are implemented in organisations. It is interesting to see that the nurses in this research believe that mHealth could only play a role in the future if the mHealth technologies have proven that these concerns are misplaced. The relationship between actors is mutual, so interactions work both ways (Law 1992). In this research, the role of mHealth is therefore affected by a two-sided relationship between the nurses and mHealth through the requirements that has been established by the nurses. The nurse, as an actor, shapes mHealth as another actor. These requirements of the nurses determine whether or not mHealth can be an actor in this particular network. These interactions also have an effect on the kind of actor mHealth will be in the future. Due to the requirements, mHealth is going to be a safe and reliable actor that values privacy.

A network also means that there is a relationship between the diabetes patient and mHealth. Since the nurses were the only ones who were interviewed in this research, this particular relationship isn't researched. Nevertheless, the answers of the nurses suggest that the diabetes patient is more aware of mHealth and is actively discussing this knowledge with

the nurses. As mentioned by these nurses, the diabetes patients are a step ahead. The nurses in this research show that the diabetes patient is keeping them up-to-date regarding mHealth. As can be seen earlier, the power balance (Ball & Lillis 2001) between the nurse and diabetes patient is changing due to eHealth. The interaction between mHealth and the nurses and diabetes patients is changing the same power scale as well. Instead of the nurse educating the diabetes patient, it is the diabetes patient who gives education to the nurse in this research. Therefore, the actor mHealth has empowered the diabetes patients according to the nurses in this research. The relationship between the diabetes patients and the nurse has changed due to mHealth. In this research, the traditional relationship where the nurse yields more power over the diabetes patient has changed. Due to mHealth, the balance has shifted to a situation where there are two experts; the nurse is the expert on everything diabetes-related and the diabetes patient is an expert on mHealth (Spencer et al. 2011).

IMPLICATIONS ON THE POSITION OF THE SPECIALIZED NURSE

According to this research, eHealth is a more visible actor in comparison to mHealth. The findings have also shown that both eHealth and mHealth affect the nurse in their job performance. It might be interesting to look at how technology (eHealth & mHealth) affect the position of the specialized nurses in comparison to other physicians since this research looks form the perspective of these nurses. So how do these two actors affect the position of the nurse?

Tjora (2000) has showed that a Norwegian Medical Emergency Communication (AMK) Centres changed the relationship between the nurse and the doctor. This research might be seen as outdated since it is dated from the year 2000. Nevertheless, these centres make use of telephone and radio communication systems as well as GPS to track down the patient. According to the definition of the WHO (2011), mHealth exists of GPS as well. Therefore the research of Tjora (2000) can be used to analyse the changing position of the nurses due to mHealth.

The nurses in these AMK centres have access to these means in order to evaluate whether or not the patients need urgent care. Due to this objective the hierarchy between the doctor and the nurse becomes more of a blur. The doctor doesn't diagnose the condition of the patient anymore. When a patient calls to the AMK centre, the nurse has to decide whether the condition is urgent or not and therefore has the authority to diagnose the patient's condition. Moreover, when a nurse does perceive one's situation as urgent and send the patient to see the doctor, the doctor is dependant on the information provided by the nurses. What this research shows is that the nurse has taken over the task of diagnosing a patient's condition from the doctor. Moreover, it is not the nurse who is dependant on the doctor. It is the other way around. (Tjora 2000). This is made possible through the means

mentioned earlier. Apparently mHealth as an actor has the ability to shift the tasks between the nurse and the doctor even though Tjora (2000) doesn't mention the term mHealth.

In the article of Tjora (2000) it was the nurse who was using technology. The relationship between the nurse and the doctor can also change when the doctor uses either eHealth or mHealth. The research of (Torppa et al. 2006) investigates the implications of the use of teleconsultations on the interaction between the patient, nurse and doctor. In this situation it was the doctor who could be seen on the screen and the nurse and the patient who were in the same room. The nurse was physically beside the patient in the room and was interacting together with the doctor on the screen. The results of Torppa et al. (2006) showed several things. The most interesting findings are that the nurse is both the secretary of the doctor and the communicator for the patient. Moreover, because the doctor was only visible on the screen this gave the nurse the opportunity to redirect the consult in the direction the nurse thought was best for the patient. According to the observations of Torppa et al. (2006) the nurse had intervened the interaction between the patient and the doctor several times to redirect the consult. The patient was also more likely to turn to the nurse for more questions instead of to the screen towards the doctor. The result of this was that the doctor felt uncomfortable and left outside. The doctor has turned into an outsider (Torppa et al. 2006).

What this analysis shows is that both eHealth and mHealth as actors has the potential to change the position of the nurse in relationship to the doctor. It gives the nurses the opportunity to diagnose the patient's condition and to intervene a consult between the doctor and the patient to direct the consult into what the nurse perceives the best for the patient. By introducing eHealth and mHealth in diabetes care it could change the position of the specialized nurse as an actor. It changes the network between the specialized nurse and the doctor given the nurse the opportunity to replace the position of the doctor and making the doctor feel left outside.

OVERALL ANALYSIS

This analysis has shown that both eHealth and mHealth has changed the relationship between the diabetes patient and the nurse when both are an actor in this particular network. Within this network, eHealth can be seen as a visible actor where mHealth is less visible because the nurses aren't aware of the name mHealth. Nevertheless, even though eHealth is a visible actor, it changes the relationship in a less visible way compared to mHealth. Due to eHealth, the nurses in this research had to increase their workload to satisfy the needs of the diabetes patient. However, the workload of the nurses might increase due to another factor. It doesn't necessarily have to be caused by eHealth and the effect eHealth has on the attitudes of the diabetes patients. MHealth on the other hand changes the relationship in a more visible manner. As can be seen in this research, the diabetes patient is more aware of mHealth and the patients are educating the nurses about this. This change in the relationship is more visible to eye. Even though eHealth and mHealth differ in their visibility, they both have the potential to influence the position of the specialized nurse. They have the potential to give the nurses the opportunity to replace the tasks of the doctor and making the doctor feel left outside.

LIMITATIONS

This research isn't without limitations. The first limitation is that the role of eHealth and mHealth described in this research is only applicable among these particular nurses. Other nurses who weren't interviewed don't necessarily share the views of these nurses. Therefore, this research isn't able to draw general conclusions on the roles of eHealth and mHealth in diabetes care.

The second limitation is that this research uses the actor-network theory as the central theoretical framework. The central network in this research is that of nurses, diabetes patients and technology (eHealth and mHealth). Due to lack of respondents, the diabetes patients aren't taken into account in this research. Therefore the perceptions of the diabetes patients and how both eHealth as mHealth interact with the diabetes patient aren't researched. To be able to fully understand the effects of the actor-network on this particular network, the diabetes patients should be heard as well. To reduce this limitation, this research has asked the nurses how they see the relationship between the diabetes patient and technology. Nevertheless, the actor-network theory doesn't come to its full potential in this research. Future research is required to fully understand the relationship between the diabetes patient and technology in diabetes care from the actor-network perspective.

Triangulation can be summarized as the use of three different qualitative methods to make sure the conducted research is valid. Due to the short period of time, this research focuses only on interviews with specialized nurses in diabetes care. This research therefore didn't fulfil the requirement of triangulation. This limitation is partly reduced by interviewing nurses all over the area of South Holland. Nevertheless, the research still lacks in its triangulation.

Another limitation of this research is the manner how the nurses are interviewed. Before the interview, all of the nurses mentioned that their time is scarce and therefore asked if the interview could be kept short. Therefore, several interviews were shortened and only addressed the main topics. This has limited the nurses in their answers and they weren't able to fully express their perceptions.

The fifth and final limitation is that the interviewer has influenced the answers about mHealth. To prevent the interview from ending when the nurses didn't know how to define mHealth, the interviewer had given them a short definition of mHealth. This triggered the nurses in their answers about the mHealth systems they use in their daily practice. Without this 'intervention' by the interviewer, it is possible that the interview would proceed in another direction.

VII. FUTURE RESEARCH

Since this research isn't without limitations there are several suggestions for future research. First of all, diabetes patients have to be included to fully understand the interactions and the dynamics of power within this particular network. The group of diabetes patients should be as diverse as possible in order to capture the broad perspective of the diabetes patients on the role of both eHealth and mHealth.

Another suggestion is to fulfil the requirement of triangulation. This research only interviewed the nurses on this matter. To have a triangulated research approach, future research could consider observing several practices of eHealth and mHealth, analysing documents etc.

The final suggestion is to future research should increase the number of interviewees. The results of this research are limited because it only captured the views of twelve nurses. In order to be able to generalize effects, future research should consider contacting hospitals all over the Netherlands instead of the area of South Holland.

VIII. CONCLUSION

There are differences to be found in the way nurses define eHealth and mHealth. Roughly speaking, the nurses in this research were able to define eHealth, but they weren't able to define mHealth. The way the nurses define eHealth depends upon the eHealth systems they know and use. The interaction between the eHealth system and the nurse leads to knowledge, which in this research is a social product (Law 1992). It is a product of the interaction between the nurse and technology, in this case eHealth. Being a product means that it is subject to change. If changes were to occur, this would influence the knowledge of the nurses. This knowledge is at the base of their definition of eHealth. What is most interesting is that all of the nurses in this research were able to define eHealth but when it comes to mHealth they didn't know what mHealth was. After telling the nurses what mHealth exactly means, they could all point the mHealth systems the organisations were using even though they didn't know what it was at the beginning. Therefore, in this research, mHealth is being punctualized (Law 1992). In other words, this research shows that the nurses are aware of the results of mHealth (e.g. mobile applications), but aren't aware that what causes this result is called mHealth. This comes to show that the nurses in this research are defining eHealth and mHealth differently. This could influence the role both eHealth and mHealth could play in diabetes care according to the nurses.

Even though the nurses weren't able to define mHealth, this doesn't rule out that they don't have a certain attitude towards the development of mHealth. This research shows that these nurses have a positive or a negative attitude towards mHealth. Some of the nurses might believe that mHealth is a necessary development while others more feel that it is an inevitable development. Nevertheless, all of the nurses feel that mHealth only could play a role in the future if the mHealth technologies have proven that concerns about safety, privacy and reliability are misplaced. These requirements have two consequences. First, the requirements of the nurses determine whether or not mHealth will be an actor in this particular network. Second, these requirements affect the kind of actor mHealth potentially will be. MHealth could be a safe and reliable actor that values privacy. The requirements the nurses have set determine the role mHealth could play in diabetes care.

According to the nurses in this research eHealth has several effects in diabetes care. It has an effect on the diabetes patient, the specialized nurse and the relationship between these two. The findings of this research have shown that different eHealth systems have different kind of effects on the diabetes patient. E-mail enables the diabetes patients to ask questions. The Internet offers the same, but is could also give the diabetes patient more insight in their

medical record. Computer programmes on the other hand could relieve diabetes patients from any responsibility regarding how to write down their measurements properly. EHealth in general changes the attitude of the diabetes patient. Nowadays, diabetes patients are expecting that the nurses are available to them for 24/7 per day. Through the diabetes patients, eHealth influences the nurses. They increase their workload to satisfy the needs of the diabetes patient. This results in the final influence of eHealth according to this research, namely the influence on the relationship between the diabetes patient and the nurse. The way the nurses are trying to satisfy the needs of the diabetes patient by increasing their workload indicates that the relationship between these two has changed due to eHealth. Also, the existence of eHealth in the network leads to more frequent contact between the nurse and the diabetes patient. It can be even said that the use of eHealth is necessary for this kind of relationship between the nurse and the diabetes patient described in this research. This shows that eHealth changes this relationship and that it is necessary to maintain this particular relationship.

Even though the nurses couldn't define mHealth, the perspectives of the nurses in this research have shown that mHealth affects diabetes care in several ways. The nurses in this research mention that their diabetes patients were more aware of mHealth than they were. Therefore, the nurses stay up-to-date with the help of the diabetes patients. The relationship has shifted to a balance where there are two experts; the nurse is the expert on everything diabetes related and the diabetes patients is an expert on mHealth. This means that mHealth has changed the traditional relationship where the nurse yields more power over the diabetes patient.

These main findings according to the nurses in this research show that, within the network of diabetes patient, nurse and technology, eHealth has a different role in diabetes care compared to mHealth. EHealth has a visible role according to the nurses, whereas mHealth has a less visible role. The most surprising finding of this research is that mHealth could be seen as an actor without a name. The actor mHealth exists and certainly has an effect on the relationship between the nurse and the diabetes patient, but the nurses in this research aren't aware that what constitutes this effect is called mHealth. Compared to eHealth, the nurses are aware that eHealth changes the relationship between them and their diabetes patient. This influences the role both eHealth and mHealth could play in diabetes care. Even though the nurses are aware that eHealth affects the relationship with the patient and that eHealth is a visible actor, the change it constitutes on the relationship is less visible compared to the change of mHealth. Nonetheless, eHealth plays a visible role in diabetes care where mHealth has a less visible role. It is a role without a name.

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APPENDIX

APPENDIX A – LIST OF HOSPITALS

Name Hospital	Diabetes Zorg Haaglanden - Behandel- en kenniscentrum	**Name Hospital**	St. Antonius Diabetes Centrum
Address	Westeinde 160 2812 HH Den Haag	**Address**	Soestwetering 1 3543 AZ Utrecht
Name Hospital	Diabetescentrum Ikazia Ziekenhuis Rotterdam	**Name Hospital**	Diabeter
Address	Montessoriweg 1 3083 AN Rotterdam	**Address**	Haringvliet 72 3011 TG Rotterdam
Name Hospital	Havenziekenhuis Rotterdam	**Name Hospital**	Vlietland Ziekenhuis
Address	Haringvliet 2 3011 TD Rotterdam	**Address**	Vlietlandplein 2 3118 JH Schiedam
Name Hospital	Ijssellandziekenhuis	**Name Hospital**	Sint Franciscus Gasthuis Rotterdam
Address	Constantijnweg 2 2906 ZC Capelle a/d Ijssel	**Address**	Kleiweg 500 3045 PM Rotterdam
Name Hospital	Albert Schweitzer Ziekenhuis	**Name Hospital**	Diabetesplein - Reinier de Graaf Ziekenhuis
Address	Albert Schweitzerplaats 25 3318 AT Dordrecht	**Address**	Reinier de Graafweg 2-11 2625 AD Delft
Name Hospital	Universitair Medisch Centrum Utrecht	**Name Hospital**	Diabetescentrum Vumc
Address	Heidelberglaan 100 3584 CX Utrecht	**Address**	De Boelelaan 1118 1081 HZ Amsterdam
Name Hospital	Diabetesplein - Erasmus Medisch Centrum	**Name Hospital**	Maasstad Ziekenhuis - Diabetes Expertisecentrum
Address	s-Gravendijkwal 230 3015 CE Rotterdam	**Address**	Maasstadweg 21 3079 DZ Rotterdam
Name Hospital	Diaconessenhuis Leiden	**Name Hospital**	Groene Hart Ziekenhuis
Address	Houtlaan 55 2334 CK Leiden	**Address**	Bleulandweg 10 2803 HH Gouda
Name Hospital	Hagaziekenhuis - Diabetes Polikliniek	**Name Hospital**	Beatrixziekenhuis
Address	Leyweg 275 2545 CH Den Haag	**Address**	 4200 AB Gorinchem
Name Hospital	Lange Land Ziekenhuis	**Name Hospital**	Isala Diabetescentrum
Address	Toneellaan 1 2725 NA Zoetermeer	**Address**	Dokter van Heesweg 2 8025 AB Zwolle
Name Hospital	Diakonessenhuis Utrecht	**Name Hospital**	Bronovo
Address	Bosboomstraat 1 3582 KE Utrecht	**Address**	Bronovolaan 5 2597 AX Den Haag
Name Hospital	Amphia Ziekenhuis	**Name Hospital**	
Address	Langendijk 75 4819 EV Breda	**Address**	

APPENDIX B – QUESTIONNAIRE IN ENGLISH

1. How would you describe the term eHealth?
2. What kind of influence does eHealth have within the diabetes care in your organisation?
    a. How were you made aware of the use of these eHealth technologies?
    b. What do you mean with quality systems?
    c. How many professionals are using this forum?
    d. Do the patients listen to you advice regarding eHealth?
3. What are the advantages and disadvantages of eHealth?
4. What kind of eHealth systems do you use?
5. How do you value eHealth and has this developed over time?
6. Based on what grounds have you decided to use these eHealth systems?
    a. Why have you chosen for these grounds?
    b. How valid are these grounds according to you?
    c. What was the decisive reason?
7. How has eHealth changed your work?
8. What is your attitude towards these changes?
9. How would you describe the patient's use of eHealth?
10. How is the patient being notified of the use of eHealth?
11. How does the patient feel towards the use of eHealth?
12. Do you have improvements regarding eHealth for your hospital?

13. How would you describe the term mHealth?
14. What kind of role could mHealth possibly play in your hospital?
15. Do you see a future for mHealth within your hospital?
16. Are there any requirements mHealth has to fulfil before it's being implemented?
17. To which extent do you believe that the patient will make use of mHealth?
18. How do you feel about the development of mHealth and are you interested in using mHealth?
19. How would mHealth affect your work?
20. What are the possible advantages and disadvantages of mHealth?
21. How would the patient be notified if the hospital decides to use mHealth?

22. How would you describe the relationship between you and the patient?

23. To which extent does eHealth or mHealth influence this relationship?

- **a.** eHealth
- **b.** mHealth

24. To which extent is the patient capable of using both eHealth as mHealth?

25. To which extent is the patient willing to use both eHealth as mHealth?

26. To which extent do you feel that you are capable in keeping up with developments regarding eHealth and mHealth?

27. How do you stay up-to-date regarding technology in healthcare?

28. Are you willing to receive more education on this matter?

29. What would be the perfect eHealth technology or mHealth app?

- **a.** To which extent will people make use of this?
- **b.** What are the advantages of your ideal technology/app?

APPENDIX C – QUESTIONNAIRE IN DUTCH

1. Hoe zou u het begrip eHealth omschrijven?
2. Wat voor invloed heeft eHealth binnen de diabeteszorg in uw instelling?
    a. Hoe is gebruik van deze vormen van eHealth naar u gecommuniceerd?
    b. Wat bedoelt u met kwaliteitssystemen?
    c. Hoeveel professionals maken gebruik van de forum?
    d. Gaan patiënten in op uw adviezen om gebruik te maken van eHealth?
3. Wat vindt u de voor- en nadelen van eHealth
4. Welke eHealth systemen gebruikt u?
5. Hoeveel waarde hecht u aan eHealth en is dit in de loop van de tijd verandert?
6. Op basis van welke gronden heeft u deze geselecteerd en welke afwegingen speelden een rol hierbij?
    a. Waarom deze gronden?
    b. Hoe betrouwbaar acht u deze gronden?
    c. Wat gaf de doorslag?
7. In hoeverre heeft eHealth de uitvoering van uw werk veranderd?
8. Wat is uw houding tegenover deze veranderingen
9. In hoeverre maakt de patiënt gebruik van eHealth?
10. Hoe is de patiënt op de hoogte gebracht dat er gebruik wordt gemaakt van eHealth?
11. Wat is de houding van de patiënt tegenover het gebruik van eHealth?
12. Heeft u verbeterpunten wat betreft het gebruik van eHealth binnen dit ziekenhuis?

13. Hoe zou u het begrip mHealth omschrijven?
14. B. Wat voor rol zou mHealth kunnen spelen binnen de diabeteszorg in uw instelling?
15. Voorziet u een toekomst voor mHealth binnen diabeteszorg binnen deze instelling?
16. Zijn er bepaalde voorwaarden waaraan voldaan moet worden wanneer mHealth geïmplementeerd wordt?
17. In hoeverre zouden u patiënten gebruik maken van mHealth?
18. Wat vindt u van de ontwikkeling van mHealth en bent u geïnteresseerd in het gebruik van mHealth?
19. Op wat voor manier zou mHealth invloed hebben op uw werkzaamheden?
20. Wat vindt u mogelijke voor- en nadelen van mHealth
21. Hoe zou de patiënt op de hoogte worden gebracht als het ziekenhuis gebruik zou maken van mHealth?

22. Hoe zou u de relatie omschrijven tussen u en de patiënt?

23. In hoeverre heeft uw gebruik of het gebruik door de patiënt van e/mHealth invloed op deze relatie?

a. eHealth?

b. mHealth?

24. In hoeverre is de patiënt in staat om gebruik te maken van zowel eHealth als mHealth?

25. In hoeverre is de patiënt bereid om gebruik te maken van zowel eHealth als mHealth?

26. In hoeverre acht u uzelf in staat om de ontwikkeling van zowel eHealth als mHealth bij te benen?

27. Hoe blijft u op de hoogte van recente ontwikkelingen omtrent de technologie in de zorg?

28. Staat u open voor meer educatie omtrent technologie in de zorg?

29. Wat zou voor uw de perfecte eHealth toepassing of mHealth app zijn?

a. In hoeverre denkt u dat mensen deze toepassing/app zal gaan gebruiken?

b. Wat zijn de beoogde voordelen van deze toepassing?

APPENDIX D – CODES

- Definition of eHealth
- EHealth systems within the organisation
- Influence eHealth on organisation
- Influence eHealth on work performance
- Attitude towards influence eHealth
- Introduction eHealth among nurses
- Reason use eHealth/mHealth
- Perceived advantages eHealth
- Perceived disadvantages eHealth
- Attitude patient towards eHealth
- Communication towards patient about eHealth
- Proposed improvements towards eHealth in organisation
- Use eHealth by patient according to the nurse
- Lack of knowledge in defining mHealth
- MHealth systems within organisation used by nurses
- Influence mHealth on organisation
- Future for mHealth
- Conditions for mHealth in the future
- Potential influence mHealth on work performance
- Attitude towards development mHealth
- Potential advantage mHealth
- Potential disadvantage mHealth
- Notification use of mHealth towards patient
- Use mHealth by patient according to the nurse
- Perceived value e/mHealth
- Perception of own capability in using e/mHealth
- Attitude towards education about technology
- Relationship with patient
- Influence e/mHealth on relationship
- Transfer of information
- Education
- Education by patient
- Safety
- Ideal mHealth app/eHealth technology