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Table of Contents

ACKNOWLEDGEMENTS	iii
Table of Contents	v
1. INTRODUCTION	1
An Overview of the thesis.....	4
Definitions of some terms	6
2. A DIGITAL HEALTH SOCIETY	8
2.1. Telecare Technologies	9
2.2. Mobile health apps	14
2.2.1. <i>Gamification</i>	19
2.2.2. <i>Quantified Self</i>	24
2.3. Patients and Medical Knowledge	30
3. ACTOR NETWORK THEORY	39
3.1. The Concept of Scripts	40
4. THE RESEARCH QUESTIONS	42
4.1. Some Notes on Diabetes Miletus	44
5. THE “mySugr” MOBILE HEALTH APP	46
5.1. The Company	46
5.2. The mySugr Logbook App	49
5.2.1. <i>The Features of the Logbook App</i>	50
6. THE RESEARCH METHODOLOGY	70
6.1. On Qualitative Interviews	71
6.2. Approaching the Field	75
6.2.1. <i>The first contact</i>	76
6.2.2. <i>Expert Interview</i>	77
6.3. The Interviews	80
6.3.1. <i>Interviewing the Research Participants</i>	81
6.3.2. <i>Interviewing “mySugr GmbH”</i>	83

6.4. Approaching the Data.....	85
6.4.1. <i>On Grounded Theory</i>	86
7. ANALYSING THE DATA.....	87
7.1. The Case Studies	87
7.1.1. <i>Diabetics: non-users of mySugr app</i>	89
7.1.2. <i>Diabetics: users of mySugr app</i>	91
7.2. Becoming a user of ‘mySugr’ app.....	95
7.2.1. <i>Search Engines</i>	96
7.2.2. <i>Mobile Health App Testing</i>	97
7.2.3. <i>Medical Advisor</i>	99
7.3. Using ‘mySugr’ mobile health app.....	100
7.3.1. <i>Used features</i>	101
7.3.2. <i>Non-used features</i>	103
7.3.3. <i>The “Weekly Reports”</i>	105
7.4. User’s views and concerns	108
7.4.1. <i>On Data Privacy</i>	109
7.4.2. <i>On the role of the app in the self-care management of diabetes</i>	111
7.4.3. <i>On the changes in the self-care management of diabetes</i>	115
7.4.4. <i>On Users’ New Terminology</i>	118
8. CONCLUSION	120
References.....	124
References for the Figures	137
References for the Icons and Logos.....	139
Appendix – Annex Documents.....	141
Appendix 1 – Participant information Sheets	143
Appendix 2 – Informed Consent Form	146
Abstract (English).....	148
Abstract (German)	149

1. INTRODUCTION

Technologies used for medical or health care purposes are referred to as *health technologies* or *digital health technologies* (Lupton, 2015a). Digital health technologies have become in the 21st century, the recent amendment to patients' medical condition within healthcare systems (Brown & Webster, 2004). They have transformed the healthcare system into a healthcare industry, especially with the constant integration of innovative technologies – such as mobile devices (smartphones, tablets computers, portal technologies, etc.) measuring or sensor based devices (glucometers, pedometers, etc.) and social media platforms (Facebook, Twitter, Instagram, etc.) – availability and capability to connect to the internet (Miorandi et al., 2012). As a result digital health technologies have become extensively adopted in health care, receiving the attention of health care providers, engineers, developers, investors as well as patients (Cartwright, 2000).

In 2004, Sarah Nettleton introduced the notion of “e-scaped medicine” to discuss this innovative way of looking at medicine and medical practice. Recent innovations in these fields have seen the traditional elements that make up medical practice being replaced by modern elements of technology. She explained that “*e-scaped medicine thus captures the idea of a new worldview that resonates with discourses such as the information age. The spaces, sites and locations of the production of medical knowledge are now more diffuse and are invariably mediated by means of digital technologies*” (Nettleton, 2004:673). She did not suggest that innovative technologies would cause this novel view of medicine to emerge, but rather that these technologies would help to change the existing processes of medical practices. She projected that e-scaped medicine would help address issues confronting medical practice, especially regarding issues of big data (the informatization of medicine) which deal with collecting large sets of data for analyses in research studies; one major problem in this area is that the privacy of patients involved in a study may not be protected, as such, resulting in patients not being completely honest about their conditions and ultimately affecting the results of the studies. Nettleton also proposed that e-scaped medicine would bridge the compound relationship between doctors and patients (Nettleton, 2004). Digital health technologies have so far generated different ways of practicing healthcare, transforming doctor's means of diagnosing and treating their patients (e.g. electronic medical record) and connecting doctors and their patients with digital devices or social media as communicative tools

(Lupton, 2013a). Consequently, lots of considerations have been dedicated to the adoption of these digital health technologies (Zanaboni & Wootton, 2012), encouraging particularly patients to participate in the control and treatment of their health conditions and diseases particularly chronic diseases (Oudshoorn, 2012).

Digital health technologies often involve a large range of medical devices, for example, from telehealth devices, health game technologies (which are health technologies combined with game features for the entertainment of patients) to wearable devices; allowing people to care for their own health from any location as long as they are connected to the internet (Lupton, 2012). For instance, wearable devices (e.g. smartwatches) are digital devices which use internal sensors to track or monitor any activity or information required by its users, they are worn upon the body, for instance while running, walking or sleeping to record as well as monitor heart rate, travelling distance, body weight, steps, calories burned, etc. They provide detailed biometric information or data (Mouser Electronics, 2014). These wearable devices allow its users to set various alarm times as reminders to take actions such as exercise during the day, as well as allow users to share the data collected among their friends and family (Lupton, 2013a).

Mobile applications or mobile apps have recently joined the healthcare industry, providing countless types of apps found in many different categories – sport, health, fitness, wellness, medical, etc. – which are easily accessible (download for free) and available on the online market platforms known as the Apple App store and the Google Play store, the two renowned apps stores in the world (Pelletier, 2012). It was discussed that apps used for medical or health purposes are referred as ‘*medical apps*’ (Krieger, 2013), ‘*mobile health apps*’ or ‘*health apps*’ (Boulos et al., 2014). These apps are software programs developed to run on computers or mobile devices (smartphones) to accomplish specific task related to health management (Sherwin-Smith & Pritchard-Jones, 2012). With these apps citizens can monitor and proactively take care of their own health (Lupton, 2013d). As a result, these citizens become *users*, consisting in general of patients¹ and non-patients² engaging in the practices of

¹ Patients refer to people living with chronic diseases and using mobile health apps to monitor their health.

² Non-patients refer to people living without any disease; but using mobile health apps to monitor their health.

'self-care' by proactively monitoring as well as taking care of their own health (Mort et al. 2009).

The advent of digital health technologies has enabled its users to engage in self-care and self-monitoring practices (Langstrup Nielsen, 2003) but in turn have also lead users to self-tracking or quantified-self practices through the use of mobile health apps (Lupton, 2014c). In the introductory chapter of the book entitled "The Quantified Self: A Sociology of Self-tracking", Deborah Lupton defines self-tracking as "*practices in which people knowingly and purposively collect information about themselves, which they then review and consider applying to the conduct of their lives*" (Lupton, 2016:2). People engaging in these practices, for instance, could collect data regarding their respiratory rate levels, their temperature or their blood pressure on a daily basis. The practices of self-tracking is predicted to 'discipline' people's daily lives by monitoring, measuring or recording different elements as well as aspects affecting in general their bodies or their health. However, there are concerns regarding whether self-tracking practices are voluntary personal or being encouraged or enforced on people as ways of hidden "*surveillance*" (Michael & Lupton, 2016). For those reasons, diabetes patients are an interesting case to study, since they use a number of technologies such as blood glucose meters, insulin pumps and various forms of documentation to engage in the practices of '*self-care management*'³ on a daily basis regarding their health condition.

Mobile health apps, for example, hold the promise of supporting doctors to influence positive health behaviour changes among (type 2 diabetes) patients with the help of sensor technologies that not only allow patients to practice self-care but also send patients' medical data back to their doctors (Vervloet et al., 2011). They also hold the promise of providing effective doctor-patient relationships, allowing access to information needed to monitor patients' health at a distance (Oudshoorn & Pinch, 2008) as well as improving users' self-care or self-management practices (West, 2011). However, these apps while realising and developing much more than promised also process users' personal information as well as generate abundant amounts of data about their lifestyle and well-being (Dehling et al., 2015); stimulating social and ethical questions which are often touched upon the user's fundamental rights, such as the right to privacy and to physical integrity (Krieger, 2013). Scholars in the field of social

³ see section on "Definition of terms"

health, medicine & technology as well as social science have focused their research on the societal, political, privacy and security issues of digital health technologies; addressing either their concerns on the digital data (big data) generated by these technologies (Lupton, 2015a) or the potential benefits and costs of employing these health technologies in the treatment of chronic diseases affecting the population worldwide (Boyd & Crawford, 2011). However there are still questions and growing concerns, regarding how people are using these mobile health apps in monitoring their health. For that reason, the aim of this research study is to examine a mobile health app which aims to change diabetes patients practice of ‘*self-care management*’ and explore diabetics’ actual use of the app using the theories as well as the methods within the field of Science – Technology – Society studies.

The study of diabetes patients’ use of mobile health apps in the daily *self-care management* practices of their condition will provide an in-depth understanding of the role of mobile health apps *in* and *on* society. Inquiring how they actually use (or do not use) the app to control and monitor their health, my interest in the study of diabetes patients and the use of mobile health apps focuses on a particular mobile health app called “*mySugr logbook*”, developed in 2012 for diabetics’ and having over 200,000 registered users across Europe and the United State (as of 2015). The app is downloadable from the Apple app store as well as Google play store and is available in the categorization of medical apps.

An Overview of the Thesis

The thesis aims at shedding more light on the impact of new emerging health care technologies (in particular mobile health apps), with emphasis on the extent at which diabetes patients managed their medical condition on their own, regardless of its severity. To do just that the thesis is divided into different parts, consisting of the introductory section above where I presented the research study on the broader application of digital health technology within the healthcare system. I provided in brief the background knowledge of the research study as well as the interest of the research. The other parts listed in chronological order will be devoted to reflecting and discussing the state of the art, the sensitizing concepts, the research questions, the case study, the research methodology, the analysis of the data and the findings followed by the conclusions.

The State of the Art is entitled “*Digital health society*” which focuses on the notion that health technologies are not just matters concerned by doctors but patients as well as non-patients. In this section, I will elaborate with much more details using several STS and social science literatures about the different issues that are related to digital health technologies. I will first discuss one particular type of health technologies namely *telecare technologies* used on behalf of elderly patients and how scholars addressed issues regarding these technologies. This will open a discussion on *mobile health apps* in which I will discuss the debates as well as research studies conducted on the use of these health technologies. I will conclude the state of the art with a discussion on how patients manage their health conditions using medical knowledge and technologies.

The Sensitizing Concepts will elaborate on one particular concept and theory used in the field of STS to approach research studies. I will discuss Actor Network Theory also known as ANT. What the well-known theory entails will be explained along with examples used in various publications to conceptually frame the ideas of ANT. I will then explain and elaborate on the *concept of script* to conceptualize the research as well as use the concept to think through the analysis of the data.

The Research Questions will describe the various reasons why this particular research questions were examined. I will explain how the focus on the study of the use of mobile health app called mySugr Logbook was developed and elaborate on the actual research questions I will pose during the fieldwork. Here I will also provide a section to discuss in more detail the lives of people leaving with diabetes.

The Case Study will elaborate on the actual context of the mobile health app called mySugr Logbook. A detail description of the company behind the development of the app will be provided. I will also explain the various features of the app and will illustrate each feature using figures to describe its’ functionality.

The research methodology will describe the method used in the collection of the data. In this section, I will discuss in detail my experiences as a researcher in Austria and the various steps taken to acquire the data used to answer the research questions of this thesis. It will also elaborate on the challenges encountered when accessing the field as well as how research participants were contacted. A section will also be dedicated to elaborate on the method em-

ployed in analysing the data obtained. I invite you as you read this particular section through my journey in doing fieldwork.

The Analysis of the Data, will present the results obtained from the data collected. I will first elaborate on the lives of each diabetes patient interviewed case by case followed by how they encountered the mobile health app for the first time. I will then present how they used the mySugr Logbook focusing on their most used features as well as non-used features of the app. In this section, I will discuss the findings of the research and elaborate on the data obtained.

The conclusions will be where I discuss my research and take a look at all the discussions arising from the research project. I will share my opinion and open up questions that emerged during the analysis of the data and might be of interest to other researchers in the field of STS.

Definitions of Some Terms

The thesis encloses words that are used sometimes interchangeably along with some terms that might be unclear or unknown to the reader. Therefore in this section, these terms are explained regarding my inferred understanding and meanings only in the context of this research study.

Actors: refers to people – users, diabetes patients, etc. as well as material objects – mobile apps, measurement devices, insulin, etc. framed as human and non-human actors participating in the understanding of the research study.

ANT: refers to Actor Network Theory and is used as sensitizing concepts and theory to conceptualize the actors throughout the research study.

Diabetes patients: is a term used to refer to diabetes patients, both type 1 and type 2 patients as well as any diabetes types who use (any) digital health solutions or tools to deal with their health condition.

Digital health Technologies: is a term used to refer to digital health objects such as artefacts, machines, apps, devices, etc. which are technologies used for healthcare, health education and public health purposes.⁴

Market stores: is also used as **apps market stores** and refers to the Apple app store and the Google Play store.

Mobile health apps: or health apps refer to any mobile apps available on the Apple app and Google play stores use exclusively for health and medical purposes.

Self-care management: refers to the general tasks or routines such as the measurement of blood glucose, the amount of carbohydrates eaten, the injection of insulin as well as any other actions taken by diabetes patients in maintaining and controlling their blood sugar level and improving their quality of life.

⁴ A definition given by (Lupton, 2015a)

2. A DIGITAL HEALTH SOCIETY

The healthcare systems have witnessed substantial transformation from simple home medicine and itinerant doctors with little training to multiple bureaucratic, scientific and technological systems (Armstrong, 1995; Jewson, 1976). The integration of innovative technologies has played important roles in this transformation, especially in delivering much improved quality as well as many more possibilities of care to our society (Webster, 2002). Researchers as well as health and technology experts have previously argued that the development and implementation of these innovative technologies would support and transform the healthcare systems in the management of diseases, especially chronic diseases (Pols, 2012). As a result, self-management programs for people living with chronic health conditions have become one of the main focuses of our contemporary health system management (Sparks, 2013). Stakeholders, policy makers, health experts, health providers as well as many other actors providing health care services have therefore been more concerned with improving and maintaining health in large populations and reducing future complications associated with chronic diseases instead of addressing them with cures (European Data Protection Supervisor, 2015; King, 2002). Since the beginning of the year 2000, more and more initiatives have been established both at the national and international levels to strengthen the healthcare system as the core components of the global health organization (WHO, 2012).

One major initiative observed concerns the adoption of ‘*digital health technologies*’ in the care of patients (Lupton, 2013d). These technologies are available and functional on “smart” health devices – such as wearable devices, telecare, smartphones, tablet computers, sensor-based technologies etc. – which are either mobile or connected portably to the internet that offer health related facilities to its users. Also, the emergence of these health technologies have led to the development of several buzzwords that are often used in reference to them such as *Health 2.0* (Lupton, 2013a), *eHealth* (Mort et al., 2009), *mHealth* (Chib, 2013) or *digital health* (Lupton, 2015a) captivating the attention of many scholars in various disciplinary field of studies. Also, it was argued that the application of digital health technologies further enhanced effective and efficient communication and interaction between doctors' and their patients (Hostetter et al., 2014) as well as helped patient’s especially those with chronic diseases stay healthy (Abrahamian et al., 2002; Wagner, 1998). Most recently, mobile health apps available for instance on Apple App Store and Google Play Store joined the digital

health industry. For example, some of these health apps are developed for the use of the medical practitioner (Huang, 2014) as well as medical students and their institutions (Payne et al.,2012). It was suggested that some doctors should prescribe health apps to their patients to self-manage their chronic health conditions (Husain, 2012). Additionally, research on the efficacy of these mobile health apps have shown that health apps impact patients by giving them more control over their own health (Swan, 2009).

Although, the use of digital health technologies were matters discussed within the healthcare sector, for example, connecting elderly age patients from their homes to their care givers in hospitals (Oudshoorn, 2011), we can observe with the integration of mobile health apps that health technologies are nowadays not used only at distance but used everywhere as soon as its users connect to the internet (Lupton, 2013d). The uses of these health technologies contain many aspects for open discussions particularly with the rapid expansion of mobile health apps available on the apps market stores. For that reason, I focused on three aspects of the use of digital health technologies directing my attentions particularly on the users of these health technologies.

The first aspect concerns telecare technologies used in the care of elderly people. I focused on what the technology is about and the important role of human and non-human actors in the healthcare system. The second aspect focused on the general notion of mobile health apps in which I discussed the ways in which these apps come to function. I also discussed the dimensions of gamification and the practices of self-care management developed by the use of mobile health apps focusing on the notion of “quantified-self” which are current ways of monitoring, measuring and visualizing the human body as well as sharing personal information and experiences with others. The third aspect concerns the patients of these digital health technologies. I discussed the important role patients played in medical knowledge when using these health technologies.

2.1. Telecare Technologies

Telecare is one example of a digital health technology that was introduced and used in many healthcare systems around the world (Joyce & Loe, 2010). Telecare technologies use Information and Communication Technology (ICT) in supporting and assisting patients (namely aged people) by means of automatic and remote monitoring sensors which minimiz-

es real time risk emergencies such as fall, fire detection, etc. (Fisk, 2003). These technologies enable patients to live independently in their own home and have become to be known as technologies that provide “care at a distance” (Pols, 2012). For example, the personal alarms also called “telealarm” is one model of telecare devices which consists of a button in the form of a pendant worn around the neck or on the wrist and has a base unit that works with the patient’s telephone. Once the button is pushed, an alarm call is triggered via the telephone line and the base unit receives a signal and links the call to a monitoring centre which will respond to the alarm call 24 hours a day; the centre is also available 365 days a year. Through others, medical practitioners and care givers evaluated and diagnosed their patients remotely prescribed treatments, quickly detected fluctuations in their patient’s medical condition at home and altered therapy or medications accordingly (Pols, 2011). It was argued that these telecare technologies transformed the healthcare system in providing clinical healthcare at a distance as well as delivering health information for both the care providers and their patients through the medium of these technological devices (Mort et al., 2009).

Many scholars have discussed important dimensions of the use of telecare technologies and have applied different approaches to illustrate the role of these technologies in the healthcare system. For instance, Nelly Oudshoorn, a professor of Technology Dynamics and Healthcare at the University of Twente in the Netherlands, focused most of her research interests around the issues of the development and use of innovative technologies in the healthcare system. She has written a book entitled *‘TeleCare Technologies and the transformation of Healthcare’*, where she recorded the different changes in healthcare and demonstrated how telecare participated in several areas of healthcare. She argued that telecare technology redefined the responsibilities and identities of patients as well as healthcare professionals, introducing a new category of healthcare workers by changing the kinds of care and spaces where healthcare is situated (Oudshoorn, 2011). In one of her studies, she introduced the notion of “technogeography of care” to explore the role of telecare technologies in changing the landscapes of healthcare (Oudshoorn, 2012). In that study, she focused on the places in which telecare technologies are used by analysing two telecare devices used in the United State (US) as well as other European countries (Germany, Netherlands, etc.) to monitor patient’s

heart failure⁵. The analysis showed that the place in which these telecare technologies were introduced play important role in redefining the spaces in which healthcare takes place. For instance, some patients accepted to use the telecare devices in their homes while others refused to use or have the technologies in their homes. Oudshoorn argued that *“telecare technologies introduce very explicit and forceful scripts for collaboration and interdependencies [...] they redefine the spatial dimensions of healthcare by (re)distributing care over multiple actors and locations”* (Oudshoorn, 2012:122). As a result, spaces have become important for shaping the application as well as the use of telecare technologies by different users giving different meanings to these telecare devices. In other words, the designers developed these telecare devices to monitor the heart failure of the patients in order to improve their lives as well as their care; however the use and the meaning of these devices in the US and Netherlands were accepted by users differently. The use and meaning given to particular technologies do not depend only on the developers but also on the space where the technology is placed and used. Therefore, she argued that *“spaces still matter, because the very places in which telecare devices are used shape how those technologies enable or constrain human actions and identities, including relationships among people and between people and technological devices”* (Oudshoorn, 2012:136). She also argued that telecare technologies *“mediate healthcare practices”* and *“affect the spatial dimensions of healthcare”* because the use of telecare technologies take place when the healthcare providers and the patients are not in the same place. This particular study helped me examine not only on the spaces or places where mobile health apps are used, but also on the role these apps play on how diabetes patients deal with their health condition.

Jeanette Pols and Dick Willems (2011) also analysed telecare technologies and evaluated the use of these technologies in the healthcare system. They studied the promises⁶ of telecare technologies and compared these promises with the actual practices carried out when using a “webcam-based technology” called the “telekit”, which was utilised in follow-up care in the Dutch healthcare system. Their study showed that in order to understand and evaluate a tech-

⁵ The two devices are a telecare system for heart-failure patients and an ambulatory ECG recorder to diagnose heart-rhythm irregularities.

⁶ The promises of telecare technology: improving healthcare, lowering costs, solving workforce shortage, etc.

nology one must explore the relationships between the users and the particular technology of study and to understand the characteristic of the technology one must also study the different ways the users employ the given technology. The authors therefore argued that *“rather than promises that technologies will, by their sheer installation, ‘fix’ something, there is a need for more modest accounts of technologies in practices, details about ways in which technologies are working, who is using them and what goals are brought into being”* (Pols & Willems, 2011:496). Because the actual “identity” of a technology is not the matter of the designers alone, different actors are involved in the process and the actual experiments in which users try to make the technology work should rather be the focus of study. The promises embedded in the telekit devices do not come to function only in the ways defined and inscribed by the developers, but the experiences of the users as well as the context in which their use of the devices enable the technology to work and fulfil their needs as well the generation of “other” promises. In this line of argument, I discovered that mobile health apps also hold for example the promises of supporting doctors to influence the health behaviour changes of their patients with the help of the apps installed on their mobile device (Vervloet et al., 2011). Deborah Lupton (2014) also stated that there is still little research on how people are using health and medical apps (Lupton, 2014a:609), therefore there is indeed the need in exploring not only the promises of mobile health apps, but to understand how people use it, in which context they use it and how they inscribe meanings to mobile health apps. The authors conclude by providing descriptive steps that might help in studying these sorts of technologies. They suggested that *“to evaluate a technology, we need to learn (1) how the technology is domesticated, or in its early stages: is tamed and unleashed, (2) to what kind of practices the processes of domestication lead and (3) the desirability of these practices”* (Pols & Willems, 2011:495). This insight provided the basis of exploring how mobile health apps are used or not used in realities, as well as assist in thinking about STS concepts and theory, in particular Actor Network Theory, that explore the possible actors involve in the process of learning about users-technology relations.

Again on the users of telecare technologies, some scholars in the field of STS after reviewing claims that telecare technologies coffer “personalised service” to improve the autonomy of elderly people and enhance their quality of life; argued that “neither (telecare) services nor users pre-exist the installation of the (telecare) services: they are better described as produced along with it” (Sanchez-Criado et al., 2014). These scholars conducted different

ethnographic studies on the practical and “*ethical consequences of the implementation and use of telecare devices for older people at home*” in Spain and the United Kingdom. They explored how telecare technologies are actually installed in practice and how elderly people use the services of telecare in their private homes. They observed while following the “installers” in their duties that the installations of the telecare devices consisted of three processes: a ‘technical’ phase where the installers perform the technical work by installing the telecare devices; a ‘relational’ phase where the installers answers the questions of the users regarding how to use the service of the devices and a ‘contractual’ phase where the installers urge the user to sign the contract forms. These phases determine whether the installations were successful (felicitous) or unsuccessful (infelicitous). They argued that “*installations of telecare devices at home enables us to approach what the services offer, not as the result of specific technological scripts shaping such users in advance or particular creative appropriations of technologies by active users, but instead as open processes of instauration through which “scripts” and “users” appear as effects of trajectories arranged through continuous performances by the technicians, the end users themselves, and their significant relations*” (Sanchez-Criado et al., 2014: 712).

We can observed that, these studies conducted by Sanchez-Criado et al. (2014), Pols and Willems (2011) and Nelly Oudshoorn (2012), the users of the telecare technologies that are referred to and focused on belong only to one particular group of people - aged or elderly or ‘older people’ as they are referred to in each study. These insights helped to understand that telecare technologies are developed and design for **only** elderly people. Another observation is that aged people using these telecare technologies are able to monitor their health while staying in their homes. With these lines of arguments, I asked what group of (young, adult or elderly) people might use mobile health apps and where might they used the apps in dealing with their health condition. While searching a variety of different literature in hopes for an answer, I decided to not focus on particular group of people, but rather focus on how people might become users of a mobile health app. However since then I have assumed that mobile health apps are installed on people’s mobile or portable devices, I decided to examine the place, the space as well as the context in which they encountered mobile health apps and used in dealing with their health conditions.

Nelly Oudshoorn provided important insights into the role of telecare technology in the changing landscape of healthcare in which her “technogeographical approach” showed how

places play crucial role in shaping users-technology relations. However, the “sociomaterial theoretical” aspect of health technologies developed in Actor Network Theory (ANT) regarding the actual interactions and relations of “human actors and non-human actors” in the care of chronic diseases have not been discussed while focusing on “younger” or other group of users. Sanchez-Criado et al. also referred to the *concept of scripts* (which I discuss further on) introduced by Madelaine Akrich (1992) to argue that although scripts are embedded in telecare devices they do not shape the users, but rather the scripts, the users, the installers and other actors shape each other in relations. This means that in the study of user-technology relations, different actors play important role in the creation of the relations. Deborah Lupton (2014) also stated that “*technologies participate as material actors in relationships with human actors to configure human-technology assemblages*” (Lupton, 2014a:610). If technologies are indeed non-human actors participating in relationships with human actors (the users), then the study of diabetes patients and the use of mobile health apps will include actors such as the users, the developers of the app, the app and any other actor(s) influencing their relations.

On one hand the discussions on telecare technologies showed how significant it is to explore other groups of people using other health technologies such as mobile health apps to monitor their health condition. On the other hand the discussions showed that there is also a need to understand mobile health apps as (non-human) actors participating in the networks of relations. The discussions on telecare technologies lead to the opening up of the next aspect of digital health technologies used by patients as well as non-patients - mobile health apps.

2.2. Mobile Health Apps

Digital health technologies turned out to be central to the lives of people living with chronic conditions in various countries around the world (Cartwright, 2000). The introduction of ‘Information Communication Technologies’ (ICTs) touched many dimensions of people’s daily lives as discussed in the case of telecare technologies. However, mobile health apps which are software programs developed to run on a computer or mobile device to accomplish specific task related to health management, also joined the domain of digital health technology (Sherwin-Smith & Pritchard-Jones, 2012). These health apps allow people with chronic health conditions as well as people without any health conditions to proactively take

care of their own health via mobile or portable devices. As a result, an excess of health related apps have been developed for commercial use, for health care providers as well as for various groups of people in need of a healthy lifestyle (Lupton, 2012).

Mobile apps are designed especially for ‘smart’ mobile or portable devices such as smartphones, computer tablets and any mobile device supporting for instance the operating system of Google Android or Apple iPhone mobile platforms (Eddy, 2014). For that reason, mobile apps are in general available as well as accessible on the Apple App Store and the Google Play store the major app market stores (Dogruel et al., 2015). In 2012, Apple declared that more than 25 billion apps have been downloaded from its App Store (Miller & Monaghan, 2012), demonstrating as such that mobile apps are emerging and growing as an important sector on the online business market as well as raising important concerns. Since these apps are currently proliferating in the online marketplace they are grouped in several different categories ranging from health, fitness, sport, wellness, lifestyle, etc. to music, photography, entertainment, finance, etc. mobile apps (Comstock, 2015).

For mobile apps to be categorized as *medical* or *health* on the apps market stores there should be evidence of evaluation and clearance from a notified body such as the Food and Drug Administration (FDA) in the United State or regulatory bodies in Europe issuing a CE⁷ mark (Mosemghvdlishvili & Jansz, 2013). For instance, in 2013, the FDA issued guiding requirements to mobile health developers or companies offering mobile health apps services for approving and determining whether mobile apps would be categorized as medical apps. These requirements precisely included **“the establishment registration and medical devices”** which required that the medical apps’ developers or companies offering medical apps must register with the FDA and provide a list of medical devices they market; **“the pre-market submission for approval or clearance”** checks that the medical apps developers must prepare and submit to the FDA a consistent application (referred as premarket submission) with the risk classification appropriate to their app; **“the quality system regulation”** which stated that the medical apps developers must comply with the FDA system of quality regulation which required them to implement their systems and methods to design, produce and distribute health devices that are safe and effective, they are also required to verify and

⁷ Conformité Européenne (CE) is a key mark of a product’s or service’s compliance with relevant European Union legislation.

validate their apps in conjunction with the relevant mobile platform; **“the product labelling”** makes sure that all the medical devices including mobile medical or health apps must comply with the FDA’s device labelling requirements and finally **“the adverse event reporting”** which ensured that the medical apps are subject to the FDA’s medical device reporting regulation therefore requiring the developers to investigate each instance in which the app is believed to have caused or contributed to a death or serious injury, as well as each instance in which the app has malfunctioned in such a way as to place a patient at risk of death or injury. The developers of the app must also submit written reports to the FDA in connection with such instances (Underwriters Laboratories, 2014). However it was argued that before 2013, millions of mobile health apps have been developed and placed on the market; yet there have been little or probably no analysis of the production process, the content, the function or the use of these apps (Goggin, 2011). Do the evaluation and clearance obtained from the regulatory bodies such as the FDA for instance include the issues of user’s data safety or privacy as well? Do these guidelines take into account how users’ data is being stored? Where users’ data stored are and what do health app developers do with the users’ data? I believe questions regarding the categorization of apps as medical on the market stores as well as the clearance systems of these regulatory bodies need further investigation. However, in this particular research study, I am interested in the views as well as opinions of the users of mobile health apps regarding the privacy and safety of their data as well as how they think about where and how their data is stored.

Mobile health apps are argued to have great potential for improving the care of chronic diseases and for supporting patients with the management of their condition as well as for stirring healthy behaviours (Vervloet et al., 2011). Some of these apps are for motivating users on health regimes, lifestyle management or assisting patients with chronic health conditions for instance by calculating daily carbohydrates consumed, blood pressure, tracking daily steps, weight or blood glucose levels (Demidowich et al., 2012). In turn, these apps provide detailed feedback of this health data by either displaying them as numerical figures, progress bars, charts or through graphical and visual formats “easy” for users to read, understand or interpret (Whitson, 2013). Additionally these apps are capable of storing users health data for long periods of time and through this health data users can identify trends and share their data with their caregivers or friends (Lupton, 2014b). As a result, users are required and encouraged to make available their personal information as well as provide details about their health

conditions into the apps. As such creating huge amounts of data which is often referred to as “big data” (Michael & Lupton, 2016) which raises critical issues regarding data safety and data privacy of the users of these mobile health apps. For that reason, further studies are needed to understand the functions of these health apps especially how people individually integrate the use of these health apps into their lives and how users of these health apps provide detailed information about their health conditions.

The medical and public health literatures as well as many app market research reports focused most of their publications either on reviewing the effectiveness of the use of mobile health apps or analysing a little on the social and cultural as well as political roles played by these mobile health apps (Catford, 2011). However, Deborah Lupton (2014) shared more knowledge on the social and cultural as well as political roles of mobile health apps in which she analysed mobile health apps from the perspective of the sociomaterial approach⁸ and introduced the concept of “sociocultural artefact”. She explained that *“this approach acknowledges the combination of the material and non-material, the human and the nonhuman, the fleshly and the ideational in ever-changing configurations”* (Lupton, 2014a:610). Lupton’s approach is referred to as ‘heterogeneous networks’, which is not an uncommon term in the field of STS, to examine the relations between technologies (non-human) and its users (human). In order to understand the user-technologies relations existing between diabetes patients and mobile health apps, we need to study and think of mobile health apps as ‘actual’ human actors participating in relationships with human actors; however since these apps (technologies) are objects they are referred to as non-human. In order to comprehend the concept, Lupton focused her study on the case of health and medical apps ranked as ‘top apps’ on the Apple App store. She analysed ten ‘paid’ and ten ‘free’ health and medical apps that were listed in the charts of most popular apps on the Apple App store, taking into account the content of the text and the image used in the description of the apps. The study shows that most of these ten ‘paid’ health or medical apps were developed for the use of medical students to train and practice for their medical exams or for the use of care givers to facilitate their procedure of electronic health records and with some being developed for patients living with chronic conditions to self-manage either diabetes or high blood pressure. The paid health

⁸ Is rooted in Actor Network Theory and a section is dedicated to discuss with much details about its meanings

apps which were developed for the care givers or the medical students used in the descriptions of the apps complex medical terms which were often referring to the human anatomy or skeletal systems etc., which are difficult terms for non-medical person to comprehend, while the paid apps developed for the patients provided descriptive steps enabling users to record their health data and self-care for their condition. As for the ten 'free' health or medical apps, they were also developed for care givers, for medical students to understand for instance the fundamental basis of medicinal chemistry, genetics, etc., and the apps for patients were to assist them care for their condition or take decisions concerning their health. Lupton concluded that from the sociomaterial perspective mobile health apps are "active participants" shaping our human bodies and our personalities as part of heterogeneous networks that generate new practices and knowledge. These health apps provide visual representations of the human body (referring to the anatomical images provided by the medical apps) and provide also (using her term) new forms of digitised embodiment which provides more opportunity for people to access any medical information that were previously available only to care givers or health care providers (Lupton, 2014a). In this sense, mobile health apps provide innovative ways of representing the patient's own body since they are encouraged to self-monitor their own health. In other work by Lupton, she names patients participating in the care of their own health the "digitally engaged patient" (Lupton, 2013d), in which she argued that patients are advised as well as expected to engage in daily routines to monitor their bodies. In Lupton's research on the ten top ranked health or medical apps, she allows us to understand that on the apps stores (Apple App or Google Play stores) there are apps which people 'pay' for in order to use and apps which are downloaded for 'free'. I believe much more research is required not only on how apps are being categorised on the apps store but also on how developers decide on which apps are to be downloaded for free and apps which need payment.

The subject matter of mobile health apps is very modern and different fields of discipline such as health informatics, media technologies, diabetes science and technologies etc., have opened several discussions in their journals and made many publications available dealing with this subject. However, in the field of social science as mentioned above the topic of mobile health apps is new and many scholars in the field have initiated debates on the critical aspects of the topic. For instance, Deborah Lupton a multidisciplinary Centenary Research Professor at the University of Canberra (Australia) is one scholar who is known for her research interests on the topic of digital technologies, health and medicine etc. She has dis-

cussed various dynamics of the topic, touching on for example the sociocultural dimensions of medicine and risk (Lupton, 2012), technology and the body (Lupton, 2014d) as well as issues regarding data privacy and safety (Lupton, 1996). Many research studies are required on various dimensions of digital health technologies, especially on mobile health apps and how people which are patients and non-patients use these health apps. For that reasons, I analysed the payment system of the mySugr GmbH and look at the process which allowed the “mySugr Logbook” app to be categorised as a medical app. However, critical questions regarding mobile health apps are not only about whether people pay or download the apps for their daily use or why there are so many different categorisation of app on the market store. There are also questions regarding what mobile health apps provide its users, what keeps people using their apps and it is these questions that will shape the next element of mobile health apps.

2.2.1. Gamification

Mobile health apps assist patients as well as non-patients to engage in the self-care or self-monitoring of their own health by recording details of their user’s health data such as weight, blood glucose, insulin, etc., (Lupton, 2015a). However, some of these health apps are designed not only to record but also include games or challenges for user’s to keep up with their data entry (Lupton, 2014c). Jennifer Whitson (2013) referred these gaming and challenging activities as “*gamification*”. She argued that “*gamification is rooted in surveillance*” and through this gamification, “*surveillance is pleasurable*” (Whitson, 2013). Whitson, used examples from *Nike+*⁹ and *Foursquare*¹⁰ technologies to explain that users of these services are “*encouraged to expose their data in order to contribute to social action (e.g. sharing data in order to belong to a community interested in health or to share a social process)*” (Whitson, 2013:175). She continued in arguing that the data obtained from these gaming practices (gamified data) are used for “*target marketing*” without explaining further how these gamified data are being used for marketing purposes. However, she pointed out interest-

⁹ Nike+ is a sport device which measures or records the distance of a walk or run.

¹⁰ Foursquare is a mobile search app which recommends its users places to go regarding their favorite meals, entertainment places etc., according to their current location.

ing elements and values surrounded in the practices of gamification and these are the interests of my discussion.

In order to understand the elements that are in the practices of gamification, Whitson first used Galloway's (2006) to define the term 'game' as "*an activity defined by rules in which players try to reach some sort of goals*" (Galloway, 2006). She then further explained borrowing from Salen and Zimmerman (2004) that play becomes visible because of the "*rigid structures*" designed in the rules given to the game (Whitson, 2013:165). Whitson also adopted Goffman's (1961) concept of 'interaction' during a game to explain how playing a game is social and how the places where a game is being played can be varied. Indicating that although game players interpret rules and negotiate their meanings as well as determine how to play and win a game; players can also set their own rules and decide on how to win a game and where to play a game. Therefore, she compared digital games with non-digital games and showed how the rules and the context in which players of non-digital games such as board games are defined and situated. She argued that rules are important in every game both digital or non-digital game and inherently games involve rules which determine what moves are acceptable and which ones are not. Defining the rules involved ahead of time means that games are by their very nature social and hence involve at least two or more parties and even in situations where an individual plays with or against himself, the player is "*interacting with the sets of cultural representations, expectations, norms, etc., embedded in the rules, processes and narrative of the game and the context of play*" (Simon, 2007:10). Whitson continued and explained that the rules in non-digital games are defined before players begin the game, in other words, the players of board games for example are aware of the rules as well as the various actions to take during the game in order to win; while the rules in digital games are hidden from the players who begin the game by using switches or buttons to stimulate the games as in the case of Angry Birds¹¹. As a result the contexts in which digital games are played in are not defined. In such cases, players could play their game in a place not designed for a specific game, referred to as a *non-game* setting. For example the players of Angry Birds could play the game wherever and whenever they wish to play. For that reason, Whitson defined gamification as "*play applied to non-play spaces which are represented by online*

¹¹ "Angry birds" is a video game which is available on the market apps stores and played on mobile phone or on the computer.

technologies [...] to make everyday tasks such as exercising, financial planning and socializing more enjoyable” (Whitson, 2013:166). Gamification is “enjoyable” because of the promises of receiving rewards such as badges, points, positive feedback, level-up, etc., (Grimes & Feenberg, 2012). From Whitson’s arguments and opinions, we can understand that gamification uses some elements of games which include rules to motivate and engage the players in a non-game context as in the case of the use of mobile health apps which are portable and usable anywhere and anytime for self-monitoring of health condition(s).

Simon McCallum (2012) used the case study regarding games developed for ‘dementia’ and discussed the notion of gamification, however with more focus on the dimensions of three types of games developed for health which I used to help me better understand gamification. The first type is the *games for physical health* which are games such as ‘Zumba fitness, Kinect Sports, etc., developed for players to engage and interact with their body via sports or fitness activities. He argued that these games “use sensors that require the user to move” as such these games define the rules and the actions for the player “to maximize benefit while minimizing risk” (McCallum, 2012:87). The second type is the *games for cognitive health* which are games such as ‘Brain Age, Lumosity, etc., developed for the players to think in order to strengthen their mental ability. These games consist of ‘questions or quiz constructed with images’ in which the players are either congratulated with text or sounds of cheering when they select the correct answers, or players are asked to try again with a silent warning sound when their answers are wrong. The third type is the *games for social and emotional health* which is games such as ‘Nintendo Wii’ developed to provide “shared experiences”; to encourage multiplayer to compete and collaborate to achieve their goals. McCallum explained that the development of games which are “specifically designed to achieve some change (such as a change in knowledge, attitude, physical ability, cognitive ability, health, or mental wellbeing) in the players is termed *Serious Game*” (McCallum, 2012:86). The goal of *serious games* is to encourage players to accept the objective set in the game. While he acknowledged that the term gamification is new and as such complex to state a specific definition, he referred to gamification as defined by Deterding et al. (2011) as “the use of video game elements in non-gaming systems to improve user experience (UX) and user engagement” (Deterding et al., 2011:1), a definition that was not helpful to my research as the term *video game* was not further explained. Instead, I suggest that gamification involves not only the use of *video games* that is if video games are referred to as video games played at home

such as PlayStation 4¹² or Xbox One¹³ with consoles or handheld devices for example. I believe that in the context of health games in which mobile health apps also include elements or features of games in their design, gamification should be discussed more by considering the **actions** as well as the **context** taken by the users of health apps. The act of using mobile health app for self-monitoring health conditions and participating or playing in the games or challenging and receiving rewards is what gamification entails. Nevertheless, McCallum explained that gamification practices engage users or players by *“applying a formula for adding points, achievement, feedback, social challenges and leader boards”* (McCallum, 2012:91) which is different from a game perspective in which people either win or lose the game. However, on the description of gamification established by Deterding et al., McCallum emphasized more on the *“user experience and engagement”* to suggest that games for health purposes *“will be part of personalized health care systems [...] that the data they generate will be used as part of the diagnostic systems, and the games will form an integral part of most treatment plans and will be integrated with all other forms of personal data”* (McCallum, 2012:95). We can observe that mobile health apps fit to his suggestions since the use of mobile health apps generate personal data as users or patients ‘feed’ in their detailed health information and games are included in the design of the app. Also we can observe that mobile health apps which provide or include games in the design of their apps engage the users not only in recording their health data but provide rewarding points or feedback encouraging them as such to use the app.

Deborah Lupton also discussed gamification in some of her research studies. According to her the use of ‘self-tracking’ technologies such as mobile and wearable devices, health websites as well as health apps apply and include concepts of gamification in the designs of the technologies to motivate users by rewarding them with points or money when commitments or challenges are completed or achieved (Lupton, 2014c). In order to explain the term gamification, Lupton also followed the description of Whitson on the term to explain that *“health and fitness apps draw on gamification whereby ‘playful frames’ are ‘applied to non-play*

¹² PlayStation 4 or PS4 is a video game with console developed by Sony Interactive Entertainment a video game company developer.

¹³ Xbox One is also a video game with console developed by Microsoft a computer technology company.

spaces' such that everyday tasks, such as running, become more enjoyable or more like a game" (Lupton, 2014b:41). Using the example of 'Zombies Run' which Arul Chib (2013) described as an *"immersive running game and audio adventure that combines music and voice-overs to motivate the user to run faster as the zombies get too close"* (Chib, 2013), Lupton explained that this game *"combines social media technologies with game play situations featuring zombies"* which encourages or exhorts players to participate in running races with other runners (the zombies) and monitoring as such players physical activity routines. While players participate in this game they engage and provide the elements needed to understand the notion of gamification which can be observed in the detail description of the game. Emma Witkowski (2015) explained that *"Zombies Run is a playful app which consist of GPS tracking, a linear story line, interval training and item collection which are surrounding the player who is the central character of the narrative; the player moves through missions under the lingering threat of being attacked by the zombies"* (Witkowski, 2015:2), from this perspective Lupton argued that *"such explanatory concepts reveal how applications engaging with gamification can neither be reduced to being simply oppressive, nor emancipatory"* (Lupton, 2014b:41). She explained that the players of this game *"might experience more pleasurable aspects of physical activity, such as exploration of local space through new running routes via the zombie play feature or new routes suggested by running apps [...],it may be possible (for players) to experience both, at the same time"* (Lupton, 2014b:41).

In the literatures provided by these scholars (Lupton, McCullum and Whitson), I observed similar elements and ideas being shared when referring to the notion of gamification and I believe gamification is a concept which is too complex to give a concrete definition as compared to game or play. However, in order to better understand gamification it is also necessary to take a close look at motivations which is the reason(s) one has for behaving in a particular way. In essence, the question being posed is *what drives behaviour?* Gamification answers this in a particularly useful manner in which there is a core of reward schemes integrated into the mobile health apps for example, such that individuals earn points for participation. This reward scheme keeps participants engaged and committed to the services of the apps. The promise of higher and higher rewards, along with scoring more points than anyone before (in effect the spirit of competition) keeps participants in the zone **iteratively** playing. Since this can alter behaviour, it is a necessary component in services that require high user engagement and participation. This perhaps more than any other reason, best explains why it

is used extensively in mobile health apps that promote the self-care and/ or self-management of certain chronic diseases such as in the case of diabetes.

I assume that for these reasons, the designers of self-care and self-tracking apps develop apps that incorporate contexts that are meaningful to users of the app, because in order for the concept of gamification to succeed, participants' interacting with these apps must include three attributes; the first being *the context* which can be the spaces, objects, story and behaviours that players encounter in these games; the second being *the participants* who are players of the game who inhabit the world of the game and the third being *the meaning* that is the value or significance each individual player derives from participating in the game and ultimately keeps the individual interested in the game. In the context of self-care and self-management of diseases, the stratagem of gamification works to first engage the individual in the recognition of his own condition. The object is to interactively and iteratively get individuals first interested in acknowledging the seriousness of their medical conditions without the drudgery that usually goes with it. Then proceed from the point of acknowledgement to the activities of managing the condition daily in a manner that gets rewarded (points) for appropriate actions taken and 'good' detections done. As a rule of the theory, the activities are repeated and encouraged in turn till the desired behaviour of self-care is ingrained in the patient and he or she looks forward to the next interaction with the app, maybe not necessarily to manage his or her condition, but to be rewarded points all the same for doing so.

2.2.2. Quantified Self

The advent of digital health technologies in particularly the use of mobile health apps empowered many people to engage in the practices of self-care, self-monitoring or self-tracking as discussed in the above sections. The practices of "self" attached with specific actions such as "tracking, recording, monitoring, etc.", are ways in which people often measure or record several and different elements of their lives affecting for example their bodies or their health as long as they use any health apps or health devices. Many terms are used to refer to or describe the practices by which people seek to monitor their everyday lives or bodies; these terms are referred to as *lifelogging* which consists of tracking personal activity – such as eating, sleeping, etc. – generated by people own lifestyle routines (Jones, 2015). Others have referred to the term as *self-care* which consists of patient individually taking control of their own health (Oudshoorn, 2011); and some to terms such as *self-tracking* and

quantified-self which refers to people gathering personal data such as physical activity, heart rate, body sleep patterns, etc., about themselves on regular basis, analysing the data recorded and obtaining the data displayed in meaningful ways (Lupton, 2013c). These terms are currently used in many fields and disciplines especially with the use of mobile health technologies. One can observe that whenever scholars or authors describe people's daily habits, they observed the amount of time people use when eating or the number of cups of coffee they consume per day for example to explain people's behaviour. The number of cups of coffee consumed per day or the quantity of protein or carbohydrates consumed are nowadays not only knowledgeable, they are interpreted in the form of charts or figures so as to give meaning to the reader as well as make available to anyone in need of this information.

In actual fact, the term "quantified-self" was first invented by the Wired Magazine journalist Gary Wolf (2009) who wrote an article entitled "*Know thyself: tracking every facet of life, from sleep to mood to pain, 24/7/365*". Wolf described various numbers collected on his own life which included the time he rose from his bed each morning to the time he spent exercising or consuming caffeine or alcohol in the past 24 or 72 hours. He claimed that "*Numbers are making their way into the smallest crevices of our lives*" (Wolf, 2009: 2nd p.), due to the use of digital health technologies devices (e.g. pedometers) collecting every details of our lives. He explained that social media such as Twitter or Instagram and many web services are also playing an important role in the collection of various elements such as pain, mood, prayers, etc., about people's lives. There are also many tracking devices for instance which assist people in following the sleeping pattern of their babies and present the data as graphs which can be compared with other children; many women observing their menstrual cycle can also use tracking devices such as "Clue" or "MyMonthlyCycles" to match their cycle chart with other women. He outlined that his slogan for the concept of the quantified self would be "*self-knowledge through numbers*" because through the collection of numbers each individual can observe and better understand oneself. When Wolf elaborated on the notion of the quantified self, he used the term self-tracking and referred to the term self-tracking as tools, as systems, as cultures and as movements which in all consisted of measuring the body, the mind, the movements, the diet, the menstrual cycle, etc. and sharing the data recorded with other people. We can observe that the notion of quantified-self involves the practices of tracking oneself (self-tracking) with tracking devices or technologies such as mobile apps for health, for sports, for fitness, etc., which assist people in monitoring, measuring or recording various

elements of their lives. However, the practices of self-tracking involve as well other concerns such as risks, privacy or ethical issues related to these practices.

Deborah Lupton (2016) interpreted self-tracking as “*practices in which people knowingly and purposively collect information about themselves, which they then review and consider applying to the conduct of their lives*” (Lupton, 2016:2). Academic scholars in the field of STS, En and Pöll (2016) referred self-tracking practices as “*recording (mostly quantitative) data about aspects of one’s self (or selves) with the aid of digital technologies*” (En & Pöll, 2016:38). With these various interpretations of self-tracking practices, we can observe that these practices involve important as well as various elements which result in these version of interpretation: self-tracking practices involve people collecting and recording (mostly quantitative) data about themselves with the aid of digital technologies which they review (process to obtain information) and apply to their lives. Let us explore the elements of self-tracking practices.

The first element of self-tracking practices involves “*people*” who in this particular context of my discussion refers to men and women, patients and non-patients regardless of age, marital status or race. The question being posed to open the discussion is why do people engage in the practices of self-tracking? En and Pöll (2016) considered the accounts as well as reflections of people’s self-tracking experiences and explained that people engaged in these practices with the idea of discovering their habits and improving aspects of their lives (En & Pöll, 2016). They described how Miles Klee who is one of the authors of the Kernel magazine for instance downloaded more than two self-tracking apps to gather variables of his sexual activities in order to improve the quality of his sex life (Miles, 2015). They argued that self-tracking involved multiple practices and when these practices involved the use of digital devices such as wearable pedometers, smartphones apps etc., “*risk-taking and risk awareness, social and individualised norms and the impetus of optimisation*” become part of self-tracking practices. Therefore, they claimed that although improvement might seem to be the dominant goal of many self-tracking engagements, they suggested *queering* self-tracking by approaching the discussions about self-tracking practices with critical questions that regard not only the processes of the practices but critical perspectives touching for instance gender or sexuality issues. In their own words they “*understand queering as carrying forward the legacy of antinormative criticism by activists and academics, performed through the questioning and destabilising of social norms, including those pertaining to gender and sexuality*” (En & Pöll,

2016:50). In the attempt to discover why people engaged in self-tracking practices, Deborah Lupton (2015) also explained that people indeed used mobile apps to track their sexual and reproductive activities. In one of her research studies, she reviewed apps related to sexuality and reproduction available in the online market apps stores. She explained that *“for instance some of these are designed for medical or health education to provide information on contraception, sexually transmissible diseases (STDs), premature ejaculation etc. Also these apps claimed either to calculate the calories burned during sexual intercourse, to help with sex addiction, to provide sex jokes or outlining sexual positions or assisted people to determine their risk of contracting HIV or other sexually transmissible diseases or to self-diagnose these conditions”* (Lupton, 2015b:6). These apps are developed for various reasons and with these varieties of promises, people might indeed engage in the self-tracking practices of their sex lives. However, people engaging in self-tracking practices not only to quantify elements about their sex life. Other research studies as well as reports have shown that people engaged in self-tracking practices because of their interest in, for instance, improving various aspects of their lives such as their physical activity (suitable for athletes), heart rate, sleep, mood, eating habits, as well as anything one might wish to track (Boesel, 2013). All the same, the point I want to raise in this discussion is that self-tracking practices involve people regardless of their gender, age, race, health status, etc., with one or more goals to achieve for their health conditions or their lives in general.

The second element of self-tracking practices consists of ***“collecting and recording (mostly quantitative) information about themselves”***. The people who are engaged in self-tracking practices are referred to as “self-trackers” (Lupton, 2014c) with it being argued that there are various categories of engaging in self-tracking practices as Deborah Lupton explained in her introductory book on ‘Quantified Self A Sociology of Self’. She explained that *“some self-trackers simply collect information about themselves as a way of remembering and recording aspects of their lives, or to satisfy their curiosity about the patterns in their behaviours or body metrics that they may uncover. Others take an approach that is more specifically goal-oriented, seeking as they do to reflect on and make meaning out of the information they choose to collect and to discern patterns that will work to improve features such as their health, physical fitness, emotional wellbeing, social relationships or work productivity. Some self-trackers collect data on only one or two dimensions of their lives, and only for a short time. Others may do so for hundreds of phenomena and for long periods”* (Lupton,

2016:2; Whitson, 2013). From Lupton's explanation, we can again observe that self-trackers are not specific people as discussed above; these people might be patients with various diseases or non-patients engaging in self-tracking practices for one or many reasons as explained by Lupton above. However, it is important to understand that people engaging in self-tracking practices might be involved in single or multiple activities or actions such as monitoring, measuring or recording various elements of themselves.

The third element of self-tracking practices people engage with in order to collect and record quantitative data about themselves is "***the aid of digital technologies***". Debora Lupton (2015) mentioned a number of digital technologies people engage with in their self-tracking practices; these are digital media, online websites, social media platforms (*Facebook, Twitter, Instagram, etc.*); wearable devices embedded with wireless or sensor devices (*Nike+, pedometers, iWatch etc.*); mobile apps (*RunKeeper, Foursquare, MyFitnessPal, etc.*) smartphones (*iPhone, Samsung Galaxy, Sony, etc.*) with accelerometers, microphones, cameras, gyroscopes and compasses (Lupton, 2015b:4-5). These digital technologies (and accompanying devices) assist people in their self-tracking practices. As can be observed, these technologies are digital technologies that are not all intended for health monitoring purposes but have been co-opted into doing so. And have become leading technologies in engaging people in the quantified-self movement. Also, as discussed earlier, En and Pöll (2016) explained that Miler Klee downloaded three different self-tracking apps (Intima, Love Tracker and Track My Sex Life) onto his smartphones in order to collect data on his sexual activities (En & Pöll, 2016:37). We can observe that Klee's smartphone is actually one of the elements which enabled him to have these apps; the internet is another element which helped him download and install these apps on his smartphone. These apps with their inscribed features are also elements which play important roles in collecting or measuring Klee's sexual activities. Again Klee is also an important element in the overall tracking process. Therefore, we can understand self-tracking practices as practices involving and engaging various actors which consist of human (Miler Klee, people) and non-human (smartphones, apps, internet, electricity, etc.) actors in networks of relations as authors of Actor Network Theory suggested (Latour, 1990; Law, 1992; Sismondo, 2010).

The fourth element to discuss in self-tracking practices is the "***review of the data collected or obtained and applying changes to one's life***". It was argued that the arrival of the internet led to many developments in our society especially in the healthcare sector. For in-

stance, the access to the World Wide Web now called ‘Web 1.0’ allowed many people to interact on health and medical websites to discuss their illnesses as well as diseases on online discussion groups (Lupton, 2014a); the advent of digital technologies referred as ‘Web 2.0’ permitted not only to have access to these medical platforms but allowed people to contribute to health websites as well as share with each other (as well as with their doctors) various details of their health and medical information (J. Davis, 2012). As discussed earlier people use various digital health technologies such as smartphones, apps, wearable devices, etc. when engaging in self-tracking practices. We also observed that these technologies specifically the wearable devices are able to connect wirelessly which allow these devices to collect as well as record various body functions and daily routines. The question is how do these technologies record or save this data which is later viewed or reviewed to improve one’s life? Again, Deborah Lupton (2013c) explained that *“individuals’ bodily movements and geographical location can be identified and recorded remotely using the GPS systems and accelerometers that are embedded within these technologies [...] ski goggles, headbands, wristbands, adhesive patches, sports shoes, bathroom weight scales, pyjamas, fitness clothing and even toothbrushes with tiny digital sensors implanted in them are now available [...] for body functions and indicators as blood glucose, body temperature, breathing rate, blood chemistry readings, body weight, blood pressure, heart rate, sleep patterns, cardiac output readings and even brain activity, can all be monitored using portable wearable and internal sensors, woven into clothing or laminated onto ultrathin skin interfaces and placed anywhere on the body”* (Lupton, 2013c:394). I believe these *“tiny digital sensors”* as well as the GPS system are important technologies playing important roles in the ways peoples’ bodies functions are beings recorded and stored. For that reason more research studies are needed to uncover how these digital sensors process people’s health data as well as enquire whether the practice of self-tracking is *surveillance* or not.

The quantified-self movement focused not only on the importance of numbers collected or measured; the digital technologies used in self-tracking practices with their sensors are automated, facilitating as such the measurement and the monitoring of people’s everyday life routines. Self-trackers have the possibility to access their data generated anytime through their digital technologies and share their information with others by searching or tagging options. As a consequence, much data is created at the same time people engage in self-tracking practices. I assume the accessibility and availability of this data is not only available to the

self-trackers, but available to other actors such as the developers of these digital technologies devices as well as third parties such as partners or companies linking with the developers. Do self-tracking practices or belonging to the quantified-self movements show a discrepancy from “surveillance” in which people’s information are collected and monitored by others? Since many people provide their personal information when using digital technologies that are embedded with sensors or cameras to monitor their bodies and health, these people may sometime have no knowledge of where data collected from them is stored and what are the purposes of the data collection by others might be. Therefore, I believe there is a need to draw attention to the ethical, moral and political aspects of these self-tracking practices. For that reason, I examined the ‘mySugr Logbook’ health app to understand the type of data collected from diabetes patients and asked users about their views as well as opinion regarding where their data collected are stored.

2.3. Patients and Medical Knowledge

The advent of the internet in the 1990s played important roles in how people searched as well as informed themselves about their health and integrated the information obtained into their lives (Castells, 1996, 2001). In 2002 several surveys conducted in the US (e.g. American Life Project) and in Europe (e.g. Datamonitor) reported that many people used the internet as ways of obtaining their health information instead of asking their care givers or doctors (Fox & Rainie, 2002). However, around that year, scholars as well as policymakers during their public debates were more concerned about the advantages as well as the disadvantages of the use of the internet among a group of people referred to as lay people. As result, the concept of the *digital divide* was often mentioned for example to explain concerns regarding the inadequate use of the internet or the limited access to the internet for lay people which involved the unemployed, immigrants, refugees, elderly, women, etc., in the society (Bakardjieva, 2001; Warschauer, 2004). Wyatt et al., (2005) referred to these particular groups of people as the “*digitally excluded*” and explained that although some people might be excluded from the use of the internet or have no access at all to the internet, the reason might be because of an individuals choice clarifying that there are different categories of internet users (see Wyatt et al., 2002) in which some may decide to use the internet and others may decide to not use the internet. Wyatt et al., (2005) also argued that the information

provided by the surveys as well as the concerns of the policymakers regarding these digitally excluded are insufficient to understand the use of the internet; also research on how people experienced the internet for their health information were unexplored and they suggested more research studies that would examine people's daily life routines and experiences of using the internet for health information (Wyatt et al., 2005). For that reason, they focused their study on the role of the internet used in the ageing lives of men and women who searched the internet to inform themselves about their erectile dysfunction and menopause conditions. In order to reflect on the concept of the digital divide, they described with *the concept of access* what might affect the digitally excluded from the use of the internet and explained that *access* to the internet for health information first means that people have the ability to find their health information online and second have the ability to make sense of the information obtained. In the circumstance where lay people needed these abilities to *access* the internet, she suggested *the concept of the warm experts* introduced by (Bakardjieva, 2001) which are ways people make use of their families, friends, neighbours to become familiar with the use of the internet, to facilitate access to the internet. However, she explained that "*warm experts are vital, not only in helping people to incorporate computers and the internet into their everyday practices, but also in helping people to understand the relevance of medical literature and other health information for their own situations*" (Wyatt et al., 2005:213-214). Although Wyatt et al., (2005) presented no discussion on the actors involved in the *network of heterogeneity* suggested by ANT which include both human and non-human actors; we can observe in their study how medical knowledge is important to lay people in accessing health information. Also we can observe how human actors (lay people, warm experts) and non-human actors (the internet and the medium people use for accessing the internet) play important role in providing health information.

When we think about how people particularly lay people have access to the internet as well as how they use the internet in our contemporary world, we can observe enormous changes in regard to medium people nowadays use as well as the rapid accessibility and availability of health information. For instance, the development of mobile phones as well as the introduction of social media and the use of digital health technologies for health care purposes enabled people to not only have access to the internet and seek for *warm experts* as discussed earlier for their health information, but to be part of the *digitally included* with medical expertise. In these days, everyone can have access to the internet via mobile phones

and as discussed earlier, many smartphones include apps which make it possible to suggest multiple services for user's health condition according to their preferences or lifestyle. We can also observe that many of these lay people are patients or are people who are related to patients who in turn serve as *warm experts* to not only themselves but as well as other lay people in sharing their health information among each other via social media. We can also observe that the search of health information and the understanding of the data or information related to health started long time ago and continue even in our present time as more concern are raised regarding whether the health or medical related knowledge of lay people can be used as expert medical knowledge (Henwood et al.,2003; Pols, 2014).

The use of the internet for health purposes generated various analysis as well as views and positions among many scholars on lay people's use of the internet for health information purposes. Nettleton et al., (2005) classified these views in three groups. The first position is termed "*celebratory and empowering*", scholars viewed lay people's use of the internet for health information as empowering lay people (Broom, 2005) and argued that the internet developed better relations between patients and their health professionals (Light, 2001) and provided opportunities for lay people to develop health expertise and have their ways of resisting medical decisions or practices they see as risky as discussed in the case of vaccinations program (Streefland, 2001) see also the case of HIV/AIDS debates (Gillett, 2003). The second is "*concerned and dangerous*" where this group of scholars viewed lay peoples' use of the internet as dangerous for their health expertise and questioned the validity as well as the origin or the source of the health information available on the internet (Hirji, 2004). The third is termed "*contingent and embedded*"; scholars adopting this position viewed lay people as capable of deciding about what constitutes suitable information when it comes to their own health arguing that the internet is used for seeking help as well as advice on specific health conditions (Nettleton et al., 2005). We can again observe that the search for health information generated different views as well as position regarding the expertise of patient medical knowledge.

The emergence of computers and smartphones capacity to connect to the internet turned our contemporary society into the age of digital information (Takahashi & Tandoc, 2015). We can observe people using social media connected to the internet to explore and examine scientific knowledge as well as health management information. The internet and the information age enabled people to have access to any kind of health or medical information, raised

as such many concerns regarding lay people ability to identify the risks involve in searching for health information. Nettleton et al., (2005) in their research study explored how parents and their children discuss how they “*do and do not use the internet as a resource to assist in the management*” of chronic diseases such as asthma, eczema, and diabetes. The research participants disclosed various ways people talk about how they searched for health information on the internet. The study showed that for instance, most parents used search engines such as *Google, Yahoo* and *Ask Jeeves* or copied URLs¹⁴ from newspapers, magazines, television or other sources as their strategies to acquire better knowledge regarding the chronic conditions of their children, they also reflected on why they looked on particular platforms and not others. Nettleton et al., (2005) termed this strategies of searching as “*rhetorics of reliability*” to describe why these parents trusted some internet health information platforms and not others, they explained that these parents are “*well aware of the various debates around the reliability and trustworthiness of health information on the internet and thus the potential of compromising their position as sensible users [...] the parents are thus able to use talk about their use of health information on the internet to provide occasions where they can construct accounts of themselves as careful and responsible parents*” (Sarah Nettleton et al., 2005). From this study, we can observe that people using the internet for health information are aware of the risks embedded in the use of internet and are capable of deciding on how to use it or not. We can observe that although the internet might be the primary source used to search for health information the medium used in acquiring these information about health are nowadays different especially in this present day where smartphones are everywhere and anywhere available. The question I posed is concerning the users of mobile health apps, whether mobile health apps users are aware of the risk involve in using health apps and whether the risks involved in the use of mobile health apps especially in the case of patient with chronic conditions are related to medical knowledge.

As mentioned earlier, the topic of patient or lay knowledge is an ongoing debate among scientists, experts and scholars in various fields of study. Some argued that patient knowledge can be understood as a method of practical knowledge that patients use to translate medical

¹⁴ Uniform Resource Locator (URL) is an online address showing the location of a web resource which is different from a web address; in general a web browser displays the URL in an address bar. See also (Eysenbach & Köhler, 2002)

knowledge into their daily life with their health conditions (Pols, 2014); others argued that patient knowledge can participate in the construction of medical knowledge (Arksey, 1994). Annemarie Mol and John Law (2004) also discussed medical knowledge in which they focused their study on the body, explaining that the human body is both *object* and *subject* to medical knowledge and that “*we all have and are a body [and] as part of our daily practices, we also do (our) bodies*” (Mol & Law, 2004:45). They examined the strategies used by diabetes patients to treat *Hypoglycaemia* complications when it occurs and suggested that in order to understand the body of diabetes patients for example, instead of asking, “*What is hypoglycaemia?*” and receiving answers from the perspective of care givers in hospitals or obtaining explicit knowledge; one should rather ask “*how is hypoglycaemia done*” to better understand each elements involve in the actions a diabetes patient takes when feeling ‘bad’ and in measuring his or her blood glucose level to know how hypoglycaemia occurs in the body. The experiences of the patient are important to acquire knowledge for that reason they argued “*knowing is a practice*” (Mol & Law, 2004:46), which indeed is embedded in the action as well as enacted in the body of the patient measurement. Knowing how someone feels in this context can help takes action of *doing* the body differently. Understanding the *embodiment* of the users of mobile health apps for instance would enlarge our understanding of the kind of knowledge diabetes patient employ when doing and having hypoglycaemia or hyperglycaemia.

Some patients searched for health information using the internet to better understand their own health condition as discussed earlier. However, it was argued that patient searched for health information to better understand science medical knowledge; as such lay knowledge is not coming only from the internet or other source but from medical experts as well. Helen Lambert and Hilary Rose (1996) for example studied how people use knowledge to manage their disease and considered in particular the ways patients with a genetic metabolic disorder make sense of the medical science they encounter. The study showed that “*most people actively apply their own general knowledge, clinical observation, and knowledge of personal and family medical histories to make sense of new medical information, and try to apply it effectively and appropriately in the risk reduction strategies that constitute management of this 'disembodied' disorder*” (Lambert & Rose, 1996). Patients in this case select their medical knowledge from what they observed and heard from their doctors. Patients take into ac-

count medical knowledge which they believe relevant to their individual health situation or condition.

Another study conducted by Busby et al., (1997) in the sociology of medical science and technology field focused on understanding the medical knowledge of lay people and professional experts on musculoskeletal disorders which is a chronic disease causing pain in the muscles or the joints (Busby et al., 1997). They suggested that “*the concept of wear and tear*” to explain the knowledge connection between medical expert knowledge and lay knowledge. The study showed that the lay people assigned the cause of their health condition to their professional work and explained their symptoms to the pain they experienced at work, demonstrating as such that there is a relationship between their body and their daily work routine. Lay knowledge about the disease and understanding of musculoskeletal disorders are “*grounded in a detailed interpretation of the nature of work [...] also the social processes of pressure and constraint which constitute the reality of labour*” (Busby et al., 1997:93). The professional expert in their reflections focused more on elements as well as factors such as ageing, their role in doctor - patient relationships, their challenges and their limited capacity to intervene in the health conditions of their patients. Busby et al., (1997) argued that “*lay perspectives is an attempt to develop a body of knowledge that draws on a variety of sources in order to inform processes of interpretation and action [while the] expert knowledge in this setting too is a curious mixture of homely moralising and arcane scientism which varies depending on the context in which it is being employed*” (Busby et al., 1997:94). Lay people or patients interpreted their medical knowledge according to their personal health experience and focused on their bodies a knowledge doctor may not comprehend since they don't feel or experience the muscles or joint pain their patients' experienced. The authors suggested that “*Knowledge, whether it is produced by lay or professional experts, is forged in social relationships*” (Busby et al., 1997:83). Medical knowledge is gained in this context not only depending on how people interpret the information they received, but also how the health expert interpret the diagnoses. In this case two types of knowledge are defined, namely the explicit and the tacit knowledge. The explicit knowledge refers to codified knowledge which is found in documents written by health experts and the tacit knowledge refers to individual knowledge or experience-based knowledge which the patient experience and know through the bodies (Collins, 2001; Polanyi, 1966).

Lay people expertise regarding medicine as well as health related issues remain open discussions in many field of studies, the knowledge of lay people remain viewed as different from that of scientific experts since lay knowledge does not share scientific practices (Michael, 2009). However, in STS it was argued as well as suggested that lay people engagement in scientific debates have shown valuable knowledge as well as developed ideas that changed the course of action (Wynne, 1989). Again in STS the relations between lay knowledge and science experts is studied by bearing in mind the Sociology of Scientific Knowledge (SSK) which is concerned with the person who succeeds in gaining others trust (Sharpin, 1994); another dimension of SSK for instance suggested that knowledge should involve *heterogeneity* elements as well as studied as socially negotiated and situated (Lambert & Rose, 1996; Lynch & Woolgar, 1990); taking into account the human and non-human actors involve in producing knowledge as well as taking into account the context in which knowledge is shared. STS scholars argue in general that technology transforms society and society in turn transforms technologies, the reason for this argument comes from the fact that the society has its values, its needs, its problems and its challenges, scientists study these problems and collect data on them to build models as solutions. For that reason, (techno) science for example, plays a prominent role in the society, people searching for solutions for their health conditions employ these technologies and somehow influence the use of these technologies. We are intertwined into science, information, technology and communication networks, which becomes subject to our motion of biological as well as technical materials. Additionally, we have complex and contradictory views of our everyday life as well as our future and as a result we are shaped by our personal knowledge and daily experiences as well (Michael, 2006). The advancement of technology has affected the treatment of diabetes as well as the patients care rather than the diagnostic aspects of the disease (Marcus, 2002). Digital health technologies introduced in the treatment of people living with chronic disease increased the attention on patients who are users of health technologies (Mackay et al., 2000). On one hand, we observed from the discussions above that lay people received numerous attentions regarding the search for health information via internet and these attentions raised concerns and public debates on questioning patient medical knowledge. On the other hand, I want to draw our attention on these technologies used by lay people or patient in search of medical knowledge – the users.

Users of innovative technologies such as digital health technologies used for patient health conditions also received numerous attentions. It was argued that “*we cannot take the use of a technology for granted*” and that the role of the users in the development of a technology is a central point to start with (Oudshoorn & Pinch, 2003). Nelly Oudshoorn and Trevor Pinch (2013), in their book entitled “*How Users Matter: The Co-construction of Users and Technology*” aimed at understanding and discussing all that users do with innovative technologies to show and explain how both users and technologies are co-constructed for that reason they posed several questions such as: “*how users are defined and by whom [...] are users to be conceived of as isolated autonomous consumers, or as self-conscious groups? How do designers think of users? Who speaks for them, and how? Are users an important new political group, or a new form of social movement? In short, what general lessons are to be drawn from a renewed focus on users in today’s technologically mediated societies?*” (Oudshoorn & Pinch, 2003:2). These questions are fundamental in STS especially for addressing the issues regarding user-technology relations. Oudshoorn and Pinch (2003) suggested different approaches as the *Social Construction of Technology* (SCOT) developed by Pinch and Bijker to explain the connection between designers and users as well as technology which they explained as shaping agents also referred to as social groups (Pinch & Bijker, 1984). The *Feminist* approach focus on the users especially on the missing views of women regarding their use of technology. Diverse concepts were introduced to draw the attention on the dimensions of the bodies involved in the use of technology and Donna Haraway renown article on the “*Cyborg Manifesto*” in which she used “*cyborg*” as a metaphor to call our attentions on the interaction and realities of the socially constructed hybrids of machines and organisms (Haraway, 1987). Another is the *Semiotic* approach introduced by various STS scholars to understand the design process of innovative technologies as well as how users are configured. Scholars such as Bruno Latour, Madeleine Akrich, Steve Woolgar, Nelly Oudshoorn and many others developed and introduced various notions; for example a very common notion is the concept of “*script*” which described how technologies participate in developing heterogeneity networks which consist of human and non-human actors (Akrich, 1992). The last approach suggested by Oudshoorn and Pinch (2003) is the Cultural and Media studies which focused more on the cultural context in which technologies are developed and used as well as on the consumers (Lury, 2011).

My interest in this research project is to contribute to STS by following the semiotic approaches to user-technology relations. For that reason, I focused on how diabetes patient become users of mobile health app, exploring the source where they encountered their mobile health apps, examining the kind of medical knowledge users of mobile health apps develop as well as the role of the users in the development of mobile health apps. However, in order to understand the entangled relations between the user and the mobile health apps, it is essential to explore the identity of each actor involved in this relationship. This leads us to the next section in which I discuss Actor Network Theory (ANT) in more depth.

3. ACTOR NETWORK THEORY

Science – Technology – Society studies (STS) is an academic discipline that draws from interdisciplinary social science fields such as history, sociology, political science, psychology, anthropology, etc. to study the relations between science, technology and society. Science and technology are important elements in our contemporary world, they are currently central to the experiences and meanings given to how people interpret and interact with both elements on a daily basis. What are the relations between people and technology, what are the interrelations between science technology and society and how can we get a comprehensive overview and make sense of these entanglements? These are some of the questions in which different concepts are used to discuss and approach topics in this field. For that reason, the study is anchored onto one of the theories rooted in the field of STS: Actor-Network-Theory (ANT).

ANT developed from the work of John Law (1986), Michel Callon (1991) and Bruno Latour (1992) with a variety of concepts and approaches that can be applied to different topics within the field of Social Science Studies. Their work suggested that social relations – for instance the relations of diabetes patients with mobile health apps – exist within what is called the *'heterogeneous networks'*. The concept suggests that humans (e.g. people) and non-humans (e.g. any objects or things) belong to a system of associations or relationships which construct our scientific knowledge (Sismondo, 2010). In other terms, ANT suggests that in order to increase for example, our knowledge and acquire an in-depth understanding of the relations between diabetic's users and mobile health apps, it is essential to analyse both the users as well as the mobile health apps bearing in mind that they are in the same way significant in the process of our study. Hence, ANT explains the development of innovative technologies as continuous interactions in which the social and the technical or the humans and non-humans influence each other mutually in what is referred to as actor's networks.

Mike Michael (2000), a professor in sociology explained that *"there are no humans in the world. Or rather, humans are fabricated - in language, through discursive formations, in their various liaisons with technological or natural actors, across networks that are heterogeneously comprised of humans and nonhumans who are themselves so comprised. Instead of humans and nonhumans we are beginning to think of flows, movements, arrangements, relations. It is through such dynamics that the human (and the nonhuman) emerges"* (Micheal, 2000:1). His statement means that the social relations of humans are not shaped or formed

only because people interact with other human being, but rather because people interact with objects, papers, money, machines, etc. which are referred to as non-human actors.

Although ANT carries “*theory*” in its name, it is also looked at as a method for doing in-depth research that explains the significance of science and technology in the idea of modernity (Latour, 1993), and analysing the heterogeneity of actors which include both human and non-human actors without discriminating any of the actors (Sismondo, 2010). Also, as mentioned earlier, ANT involves a variety of concepts and as such can be applied to different topics as well as context. Therefore, for analysing user practices and user-technology relations in the context of diabetes patients and the use of mobile health apps, I approach the research bearing in mind Madeleine Akrich’s concept of *scripts*.

3.1. The Concept of Scripts

The concept of scripts originated from Madelaine Akrich’s (1992) and draws attention to how technological innovations contain scripts and enables the relationships between people and objects. In her renowned articles entitled “*the De-scription of Technical Objects*” Akrich states that the designers or the engineers of technologies inscribed in their technologies *scripts* which are based on their ideas of who the users, also referred to as projected users or virtual users, will be. However, when the technologies are in the possession of the users, they discover new ways to use the technologies, as such; they influence the design process of the technologies by changing the intended use or ‘*initial scripts*’ inscribed by the designers of the technologies. To better explain the concept, Akrich compared technologies to film, and suggested that “*like a film script, technical objects define a framework of action together with the actors and the space in which they are supposed to act*” (Akrich, 1992:208). She suggested that the use of technologies shows the differences between the intended script and the actual script since in the development stage of technologies, the engineers predicted the interests as well as the behaviour of future users, however in the end; users achieve the goals of the technology by helping themselves in various ways. As a result, the concept of *script* describes how technological innovations “*participate in building heterogeneous networks that bring together actants of all types and sizes, whether humans or nonhumans*” (Akrich, 1992:206).

Analysing the *scripts* inscribed in “mySugr logbook” app would provide meaningful explanations about the establishment of the app as well as describe the ways the designers of the app viewed their projected users or virtual users. It would also help in comparing the projected users and the real users of the app by focusing on how the real users in practice use the app and what *scripts* they in turn inscribed in the app as they use it. Also, it was argued that the concept of *scripts* enables scholars to understand the *identities* of the users of innovative technology as for example in the case of Christina Lindsay (2003) who confirmed that users can indeed have multiple identities. In her study, she narrated the story of the TRS-80 personal computer and described the changing roles of users as designers, producers, marketers, distributors and technical supporters (Lindsay, 2003). Her idea is that users are not only having the status of being users, but can also perform different duties which are more or less attributed to the designers of the technology.

Bruno Latour (1992) also pointed out that the network actors can exist only when human and non-human actors remain connected. This means that each actor needs to act and perform certain tasks as well as delegate other tasks to other actors and these actions develop into a network of dependent actors which Latour referred to as script or scenario (Latour, 1992). Approaching the research with ANT and analysing the scripts embedded in the mobile health app (mySugr logbook) would help understand the relationship between the social and technical object, the humans and the non-humans.

The human and non-human actors considered during the research study, for instance, consisted of the diabetes patients, the users of the app, the developers of the app, the mobile health app of interest (mySugr logbook), as well as any other materials considered as actors were analysed. The principles of ‘heterogeneity’ highlighted the relationship between human and non-human actors in the self-care and self-management of the disease.

4. THE RESEARCH QUESTIONS

My initial interest was in understanding how people (whether patients or non-patients) choose and use apps downloaded from the Apple App and Google Play stores. While reviewing literatures on the use of digital health technologies, I discover that many scholars especially Annemarie Mol (2008) focused on the practices of care. Her book “*The Logic of Care: Health and the Problem of Patient Choice*” in which she questioned what care is as well as how it is organised and practiced in the treatment and life of diabetes patients, focuses on an ethnography research on diabetes in the Netherlands. Reading how Mol explored the nature of these practices of care enthralled my interest in the lives of diabetes patient.

In the book, Mol compared and examined two ways of dealing with the disease: *the logic of choice* and *the logic of care*. The logic of choice leaves the responsibility to the patient. It makes the patient completely responsible for the consequences or the results of the treatment because it was the choice of the patient. To better understand this, let’s consider a patient who is diagnosed with cancer and is given two options: chemotherapy and surgery. If the diagnosis is sudden we can imagine how frightened this patient will be, and at this point in time, asking the patient to make a decision about how to treat the cancer is in line with the logic of choice. Whatever the patient chooses would be the responsibility of the patient, if the result is “good” the choice of the patient caused this outcome; and if it results in death, it will be the fault of the patient because it was the patient’s choice that caused it. However, the logic of care is more supportive of the patient. While the logic of choice “abandons” the patient to make the decision almost alone, the logic of care offers encouragement, support and consolation to the patient and requires the medical caregiver to help construct a course of action that will affect the treatment in the best possible way. In the example of the cancer diagnosis above, the logic of care will require the doctor to look closely at the diagnosis and offer a treatment that is personalized to the patient; which pays a lot of attention to what has been learnt from the patient instead of what has been learned generally from this type of cancer. It can be argued that this makes a case for personalized medicine. In Mol’s terms “*care activities move between doctors, nurses, machines, drugs, needles and so on, while patients have to do a lot as well*” (Mol, 2008:32), she analyses the practices of care as shared work between human and non-human actors – following as such some STS literature and notions of user-technology rela-

tions. Her focus on care enlarged my interest to explore and understand how people living with diabetes self-care for their condition when using health technologies

I was interested and focused on understanding the daily life experiences of diabetes patients with mobile health apps and how they adopt diabetes self-care behaviour in making lifestyle changes needed to improve their health with respect to the condition. While developing the scope of the study and searching for a specific digital health technology to examine, I received the wise recommendation of my supervisor on “mySugr GmbH” which is a company offering mobile health app services to diabetes patients. I was first intrigued by their logos and icons, their mission statement “*We make diabetes suck less!*” as well as the description of their various app services and products. Second, the monthly growth of their users who are obviously diabetes patients was fascinating and motivated me in following the development of the research interest. Third, I learned that the company is located in one of the districts of Vienna which is convenient and plays an important role in the choice of the research method. I was finally convinced on the research study and interested in examining the users of this app. Therefore, the concrete research questions I pose in regard to my master thesis are as follow:

How do diabetes patients (in the Austrian context) use and integrate ‘mySugr logbook’ app in their daily routines and what is the role of the app in their practice of self-care and self-management of the disease?

In an effort to conduct the research and acquire comprehensible answers, it was important to first develop further set of questions which would allow me to choose a method convenient for the data collection. Therefore, I asked the following two set of sub questions:

1) How do users of mySugr logbook integrate the app in their lives?

With this first sub-question I wanted to explore, while thinking about the concept of ‘script’ introduced by Madeleine Akrich (1992), how users contextualise and make meaning of the app in their lives. I needed to understand the complex entanglement of the app by exploring in detail the features as well as functionalities imbedded in the “mySugr logbook” app. In Akrich’s terms “*we have to go back and forth continually between the designer and the user, between the designer's projected user and the real user, between the world inscribed in the object and the world described by its displacement*” (Akrich, 1992: 208-209). I wanted

to analyse the actual scripts of the app as well as user's exemplifications and understand the relationships between the users and the app.

2) *What changes have users encountered since using the app?*

Literatures on medical and health apps argued that these health apps provide detailed information on specific medical condition and treatments; others identify health risks and assist in patient self-care managements. For instance, Deborah Lupton (2014) stated that "*apps are marketed to lay people to provide medical and health information or assist them in self-tracking of their bodily functions and activities*" (Lupton, 2014:608). With this statement, let's assume for example that mySugr logbook app assist diabetes patients in their daily self-care management with the disease. Diabetes on the other hand is a condition which requires the attention of the patient multiple times during the day, therefore with this question; I wanted to discover the various changes in the lives of the users. I wanted to compare their past lives without the app and their current lives with the disease and using the app.

4.1. **Some Notes on Diabetes Miletus**

The number of people living with diabetes in Austria according to the *Österreichische Diabetesgesellschaft* (ÖDG)¹⁵ is at this present time estimated to be between 573,000 and 645,000 people. This figure includes roughly 430,000 people that are medically diagnosed, along with an approximation of 143,000 and 215,000 undiagnosed people (Austrian Diabetes Report 2013). Furthermore, diabetes represents one of the leading chronic diseases causing death in Europe (World Health Organization, 1998, 2011)

Diabetes Mellitus is a condition that affects how the body uses glucose, usually called blood sugar. Blood sugar is vital to one's health and is an important source of energy for the cells of the body that make up the muscles and tissues; it is also the brain's main source of energy. Having diabetes means that the pancreas does not produce enough insulin as in the case of type1 diabetes or the body cannot effectively use or react to insulin it produces properly as in the case of type2 diabetes. Insulin is a hormone produced by the pancreas

¹⁵ ÖDG is the Austrian Diabetes Association

which regulates blood glucose – on the other hand a high or low level of glucose in the blood can lead to serious health complications (Alberti & Zimmet, 1998).

The overall management and treatment of the disease concentrates primarily on keeping the blood sugar levels as close to normal as possible, without causing *hypoglycaemia*¹⁶ or *hyperglycaemia*¹⁷. The essential part of its management is based on the individual daily practice of self-care management which is a way to minimize complications and maximize a healthy lifestyle. However, keeping track of diabetes may sometimes be challenging especially with its risk factors - physical inactivity, use of tobacco and alcohol, high blood pressure and cholesterol, stress, depression, and obesity - and also when one does not have a clear picture of how some actions such as nutrition can or might affect the blood glucose level. For these reason, diabetes patients are advised to exercise and consume a healthy diet as well as record in logbooks the details of their nutrition as well as diabetes therapy on a daily basis (World Health Organization, 2011).

¹⁶ hypoglycemia refers to low blood glucose levels

¹⁷ hyperglycemia refers to high blood glucose levels

5. THE “mySugr” MOBILE HEALTH APP

The “mySugr GmbH” is a mobile app company that specialises in mobile health apps for people with diabetes. The company is offering mobile health apps on online platforms and services to people living with various types of diabetes with the idea of supporting diabetes daily therapy. The company has, therefore, developed several mobile health apps which are registered as medical devices with the CE mark given by the Medical Devices Directive 93/42/EEC¹⁸ and the Food and Drug Administration (FDA)¹⁹. For that reason, the mobile health apps of the company are explicitly available in the ‘*medical categorization*’ on the Apple App and Google Play stores.

Although, the company provides several mobile health apps services which are rich cases to explore in the context of user- technology relations; this study focused only on one particular mobile health app known as “mySugr Logbook” or “Logbook”. According to the company’s “User Manuals” the Logbook app is designed for people over the age of 18 years due to company’s regulatory approval for that age range. Specifically, the app is for people who have type 1, type 2 or other types of diabetes and are proficient with digital technologies; since the app is accessible only via the internet and needs to be downloaded on iOS and Android supported mobile phone devices or accessible through the user’s personal computer.

5.1. The Company

The mySugr GmbH is a company located in the seventh district of Vienna (Austria) with a branch also in San Francisco (United States). The company was founded in 2012 by four people, namely Frederick Debong (Community Relations Lead), Frank Westermann (CEO), Gerald Stangl (Design Director) and Michael Forisch (Quality Management). The interesting story about the development of the company is that of the two of the four co-founders, (namely Frank & Fredrik), who live with type1 diabetes. They both grew frustrated by the lack of tools available on their smartphones for managing diabetes; those available at the time

¹⁸ This is the regulatory body in Europe

¹⁹ This is the regulatory body in the United States

were not as well designed and attractive as most mobile health apps on the online app stores and so together with the other two co-founders they started building the mySugr team.

The mySugr team consists of 35 people (as of 2015) with about half of them living with diabetes, to be precise, type1. They are mainly people from Austria, but also have people from Germany, Sweden, France, Italy, US and the UK working for the company. Their shared idea is to focus on ‘*changing the daily diabetes therapy*’ by offering products and services to encourage people living with the disease to change their mindset and to treat the disease using a combination of mobile health apps, social gamification and keeping the users motivated on a daily basis.

The products and services of the company are available in English, Italian, French and German language and are divided into two categories: the diabetes apps and the web services. The diabetes apps consist of *mySugr logbook*, which is the main focus of the research analysis, which allows people who have type1, type2, gestational diabetes or other types of diabetes to manage the disease on a day- to-day basis by entering their detailed information in the app. The **mySugr Junior** is an app that makes it possible for children with diabetes type1 to be more independent also in their day-to-day lives with the disease and teaches them in a playful way how to deal with their condition. The *mySugr Importer* is an app which helps its users to transfer the blood glucose data from their diabetes meter directly into the diabetes logbook. The *mySugr quiz* is an educational app which helps its users to test their knowledge and learn more about the disease. The web services (as of 2015) consisted of the *mySugr Academy*, which is a training program on type2 diabetes. It includes educational videos, useful tips and tricks to train users on how to manage the disease.

The company has different types of business models. They have a business-to-customer’s model (b2c) also known as ‘freemium’ model in which they offer free use of the mySugr logbook basis and apply a subscription based fee to the Pro version of their products and services. They also have different business to business models (b2b). The *licensing* business model is a business arrangement in which the mySugr company allows other business companies, partners such as Sanofi, Medtronic, SVA, etc. as well as companies offering products or services for diabetes treatment the right or permission to sponsor the mySugr apps. The *advertising* business model is a model in which the mySugr company collaborates with other companies and advertises their blood glucose checking devices, books etc. to their users. The *integrated* business model is a model in which the mySugr company combines other compa-

nies' products or services, such as their hardware and diabetes connected devices into the mySugr system. The company has also received funds ('over € 1 million in investment') from its various partners and investors such as Hansmen Group, XLHealth, Austria Wirtschafts Service, Sanofi, Dinno Santé, Medtronic, etc., which are supporting their innovative ideas in the management of the disease.

The company is registered with the Food and Drug Administration (FDA) in the United States and certified with a CE mark in some European countries. With these certifications, the company is therefore required to meet the highest of data security and reliability standards; as such the company adheres to ISO 13485 and also follows ISO 62340²⁰ for the software development of its products and services. The medical data of the mySugr users are stored in the company's databases running on Amazon Web Services (AWS) which is based in Europe and in the United States.

In 2012, the company launched their first app which was called "mySugr Companion" with the vision to transform the treatment of diabetes into an easy daily positive self-management of the disease. The app motivated people living with diabetes to follow their therapy with the idea of gamification which consisted of having daily challenges, winning points and receiving immediate feedback on their blood glucose levels. The number of downloads during that year, was estimated to be around 150,000 users. In 2014, the company improved the design of the app and changed the name of the app to "mySugr companion 2.0", allowing its users to record more than just their blood sugar levels and playing games, and in addition to record also the amount of insulin taken, carbohydrates eaten and detailed notes of activities. The estimated number of users in that year through downloads was around 200,000 users. In 2015, the company changed the name of the app to what is currently known as, "mySugr Logbook", with the same ideas and services as the first app but with clearer policies and newer design and features. The company has 385,000 users as of June 2015, of which around 16% are Austrians.

²⁰ ISO 13485 and ISO 62340 are regulatory guidelines and policies given to the company to develop and distribute their products and services as well as protecting the data of their consumers. These regulatory guidelines and policies given to the company are different in each country; however these two were given by the FDA and the European regulatory body in Europe.

5.2. The mySugr Logbook App

The mySugr logbook is a mobile health app that has a similar purpose as a diabetes manual logbook which is a book or a booklet in which diabetics write down details about their tested blood sugar levels before and after their meals, the amount of carbohydrates eaten and the therapy taken. This manual logbook helps diabetics to learn how food, insulin or medication therapy as well as any activity or action taken affect their blood sugar levels, which helps to make decisions to better treat the disease each day. The mySugr logbook app is a ‘digital book or booklet’ available on the market apps stores and downloadable for both use on the web (webpage via internet) or on the mobile device of the user. The app has various features, allowing its users to record their blood sugar level, the amount of insulin taken, or other diabetes-related information digitally. The users can even upload pictures of their meals; add details about their (actual) mood and their locations according to their personal settings. From the data gathered the mySugr logbook provides the user with immediate feedback in the form of graphical analysis that helps users to learn how their daily diabetes routines (testing of the blood sugar before and after meals, injecting insulin) affected their blood sugar and their condition. The app also aims to help users to stay motivated with its challenge options, which assists users to set personal goals and earn points for every detail entry made in regards to the self-care management of the disease.

The mySugr Logbook is an approved registered medical device certified in Europe and in the United State and developed according to the “international ISO 13485” code which means that the company is bound to certain regulations and must abide by each country’s local medical device registration requirements. The app has been tested and cleared by regulatory bodies known as the Food and Drug Administration (FDA) in the US and the notified body in the European Union who issued the CE mark. This also means that the products and services of the company comply with international guidelines of quality assurance for production and distribution of medical devices. Also, as mentioned earlier, the company adhere to ISO 13485 and follow ISO 62340 for their software development, which requires them to follow detailed guidelines and specific standards.

The mySugr Logbook is available for users in Europe: Austria, Germany, France, Italy, Spain, Belgium, Ireland, Poland, Switzerland, the UK, Netherlands, Finland, and Denmark. In North America: United States, Canada. In Africa: Algeria, Angola, Botswana, Burkina Fa-

so, Gambia, Ghana, Kenya, Congo, Madagascar, Mauritania, Mozambique, Namibia, Niger, Nigeria, Senegal, Sierra Leone, Zimbabwe, Swaziland, Tunisia. In Asia: Hong Kong, India, Singapore, Sri Lanka and also in Australia, Grenada, Virgin Islands, Montserrat, New Zealand, St. Kitts & Nevis, Brazil.

5.2.1. The Features of the Logbook App

The mySugr company offers two versions of the mySugr logbook app. The first version is referred to as the basic mySugr logbook and is free to download. It includes basic features and functions that any diabetes user needs to manage his or her diabetes daily. The second version is referred as the mySugr logbook Pro and is subject to a fee of € 3 per month or €30 per year, it includes more features with extended functionalities which allow the users to control their daily diabetes management more extensively and make sense of their data in specific context. Users are granted to use the logbook Pro for a free testing period of two weeks, after this two week the user can decide to pay the monthly or yearly amount to use the app; they can also use vouchers²¹ if they own or receive one or have unlocked the app for free when they participate in the challenges provided by the app. Let us explore and analyse the various options of the mySugr logbook with its features in details.

The start-up

In order to use the app, the users are required to download and install the app on their desirable device. Users are also allowed to uninstall the app whenever they desire. They can access the app both on their mobile phone and on their computers which is referred to as the ‘web’ version of the app; however, some features of the app (e.g. tags, search button, etc.) are exclusively available for mobile phone use and not on the web with a personal computer. The configuration of the app consists of creating an account and registering the user profile as well as adding the personal information of the user (See Figure 1).

²¹ The mySugr voucher is a small paper slip with a code which can be entered at <https://mysugr.com/voucher/>; and a patient can get the voucher from a hospital or company. In the case of Austria, Sanofi Avenis (a company) have purchased licenses of the Pro package of the application which means that the staff of Sanofi when visiting a hospital (such as AKH, Hietzing, LKH Graz etc.), gives the vouchers to the clinical staff and they can then give it to patients they think could benefit from the services of the app.

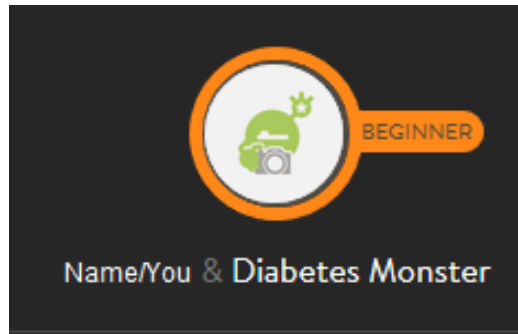


Figure 1: The header of the mySugr Logbook navigation bar

Figure 1 shows the first header of the logbook navigation bar which is displayed on the start-up screen of users' devices. When the user clicks on the icon with the 'Beginner' or the section 'Name/You & Diabetes Monster', the user is then directed to the settings of the app, where he or she is required to create an account. The information of the user's account consists of an e-mail address, a password and a name to the 'diabetes monster'. The user can later configure his or her profile by adding his or her insulin therapy as well as other detailed information of his or her choice as shown in figure 2.

Profile



UPLOAD PICTURE

Email address	<input type="text"/>
First Name	<input type="text"/>
Last Name	<input type="text"/>
Sex	<input type="text" value="-"/> ▾
Birthdate	<input type="text" value="-"/>
Diabetes Type	<input type="text" value="-"/> ▾
Year of Diagnosis	<input type="text" value="-"/>

Figure 2: The User Profile Settings

Figure 2 shows a detailed display of what the user of the Logbook app provides in the settings of his or her profile. The user can enter his or her personal details such as name, email

address, gender, date of birth, type of diabetes (type 1, type 2, gestational diabetes²², LADA²³, MODY²⁴) and the year of diagnosis. The user can also upload pictures of themselves or use the icon of their '*diabetes monster*'.

The diabetes monster is a concept developed by the mySugr co-founders representing the users' daily relationship with the disease. The idea is that once a person is diagnosed with the disease, diabetes is and becomes a monster which is a lifetime companion to the patient whether he or she likes it or not. It is therefore the mission of the patient to take care of his or her monster (which is the disease). The diabetes monster is represented in the app by an avatar or an icon which can become a *friendly monster* when the user takes care of his or her therapy or becomes an *unfriendly monster* when the user does not adhere to the daily therapy. When the patient for instance, does not check his or her blood glucose levels regularly and does not take any insulin the disease becomes difficult to control and at that particular time the patient has the constant presence of 'feeling bad and sick' which is the unfriendly monster. The diabetes monster reacts to the blood sugar levels of the user by changing colour and it also moves when the user touches it or swipes the screen to another screen. According to the blood glucose levels of the user during the day as well as the user's blood glucose target range²⁵, the diabetes monster changes to various colours. For example, when the monster becomes red it means that the blood glucose (sugar) level of the user is high and not in its target range; when it is green, it means the blood glucose level of the user is in its target range and when it is orange, it means that the blood glucose level of the user is not in good condition but does not fall in to the high levels as shown in Figure 3. The diabetes monster is a way of reminding the user to control his or her condition on a daily basis.

²² Gestational diabetes is very common in women during their pregnancy; it is a condition in which pregnant women have high blood sugar.

²³ Latent Autoimmune Diabetes of Adults (LADA) is known as a form of diabetes type1.

²⁴ Maturity Onset Diabetes of the Young (MODY) is another form of diabetes which is different from the type 1 and type2 diabetes.

²⁵ The target range is in general based on individual diabetes patient and also varies according to each country; in Austria for instance before each meal the patient has to check his or her blood sugar level and the result which is the target range has to be between 90 – 160 mg/dl as shown on figure 2.1.

Therapy

Insulin therapy	No insulin ▼		
Blood Glucose Units	mg/dl ▼		
Measure carbs in ...	Grams ▼		
1 carb unit is	1 g		
Hypo	70 mg/dl		
BG target range	90 mg/dl	to	160 mg/dl
Hyper	180 mg/dl		
Measure body weight in ...	kg ▼		
Body weight target	50.0 kg	to	80.0 kg
HbA1c unit	Percent ▼		
Blood pressure (syst.)	100 mmHg	to	120 mmHg
Blood pressure (diast.)	60 mmHg	to	80 mmHg
Steps (Target)	7000		

DISCARD
SAVE

[LOG OUT](#)

Figure 3: The User Diabetes Therapy Settings

Figure 3 is the continuation of the user profile settings as shown on Figure 2 which shows the configurations of the diabetes therapy where the user manages their personal details in relation to their diabetic condition. One particular detail that can be inputted is how the user injects insulin, with the user choosing from three available options, a pen or syringes, a pump or no insulin. They can also set how they measure their blood glucose unit whether in milligrams per decilitre (mg/dl) or millimoles per litre (mmol/l). Diabetes patients in their treatment are asked to also measure the amount of carbohydrates (carbs) they consume, with the user profile settings allowing the users to choose how they measure their carbohydrates intake, either in grams, in carb portions or in exchanges.

Additionally, the users of insulin pumps can enter their basal rates and decide whether they would like the rates of insulin taken displayed as graphs or whether they would like the rates displayed in a specific range of time, for example, in 30-minutes increments. The users of oral medications (users of pills) can enter the exact names of the medicines which they take and they can later select or search for that particular medicine in the app, since the app saves all given information.

The Logbook

The logbook is ‘actually’ the user’s daily diabetes logbook, in which he or she records data such as current blood glucose levels, carbohydrates consumptions, exercise, insulin dosage injected etc. to improve the his or her diabetes therapy. The section provided for the logging of the data is also referred to as the dashboard or the home screen with various functions. The data logged in the app provides feedback presented as ‘analyses’ and ‘weekly report’ which helps the user to better self-care and self-manage his or her condition. The logbook has features such as ‘tags’ and ‘challenges’ which helps the user to stay motivated (see Figure 4 and 5).

The screenshot shows the 'LOGBOOK' data entry screen. On the left, a large green plus sign is labeled 'Logging'. Below it, text reads: 'Add a new log entry by entering data into the fields on the right hand and then pressing the "Save" button.' On the right, a vertical list of input fields is shown, each with a small icon to its left. The fields are: Location, Date (02/21/2016), Time (8:16 AM), Blood glucose (mg/dl), Carbohydrates (g), Meal description, Food Type, Insulin (food), Insulin (correction), Activity (h:mm), Activity description, Note, Tags, and Blood pressure (systolic and diastolic mmHg).

Figure 4: The mySugr Logbook Data Entering (1)

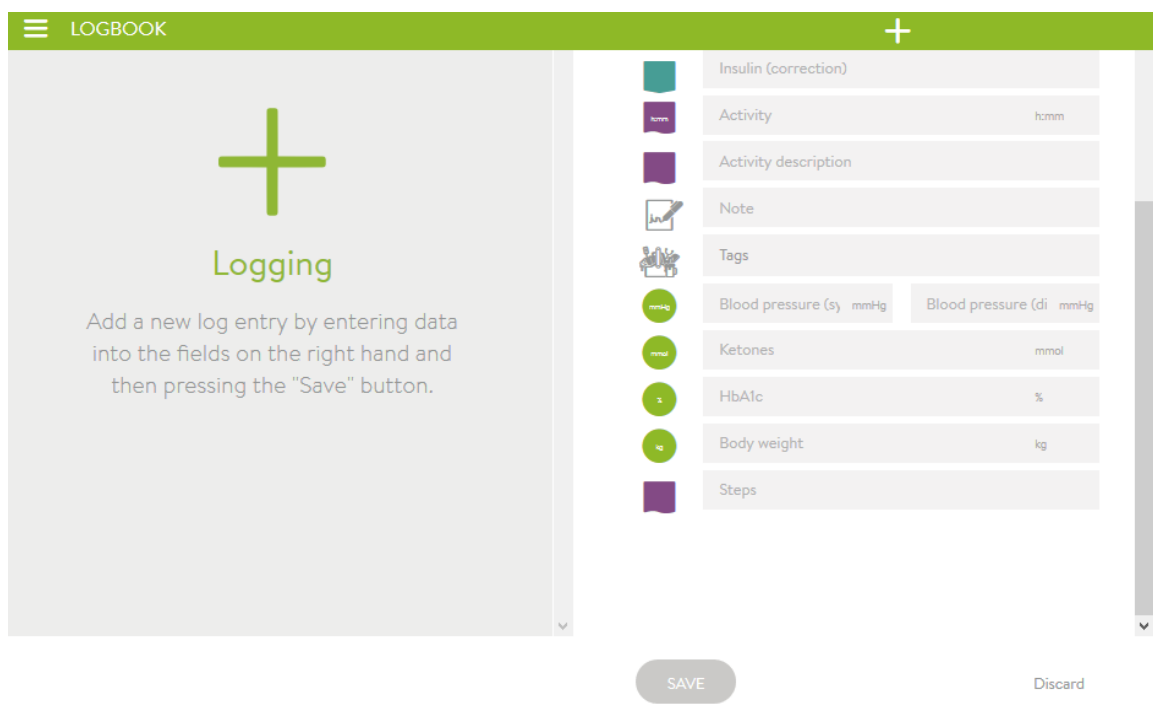


Figure 5: The mySugr Logbook Data Entering (2)

Figure 4 and Figure 5 show different functions available for the daily data entries of the users. This is referred to as the ‘logging of data’. To make or edit their daily entries, the users click on the symbol plus (+); they can also use a search option (a magnifying glass icon) to search for past entries. The search option is a feature available exclusively on the mobile phone of the users and not on the web.

The users can either change or add their location, the date and the time of their entries. They have options to take pictures and set different alarm times (15mins, 30mins, 1h, 2h etc.) to remind them to measure their blood sugar levels²⁶. They enter their blood glucose, the amount of carbohydrates in the food; describe the type of food eaten (whether they are eating vegetables, whole grains, sweets and snacks etc.), add their insulin dosage either for the actual food eaten or for the insulin injected for the correction of their blood glucose levels. The users can also enter the times when they exercise (physical activity or sport) and describe the

²⁶ The functions of ‘taking pictures’ and setting the ‘alarm time’ are only available to the users of mySugr Pro and also available only on the mobile phone of users and not on the web platform.

type of exercise or activity made. They can add their weight, their blood pressure, the percentage of their HbA1c²⁷, the amount of ketones²⁸ and also add any personal notes.

Users obtain points as they put in details about their blood sugar levels checks, insulin injections and physical activity. The more details logged the more points earned, though the app does not give any kind of judgment if the daily total points earned²⁹ are low or target is not reached. After making the entries, the users save their data by pressing the ‘save’ button in order to repeat the same process the next day in the idea of improving and managing their condition. The overall data produced by the users of the mySugr logbook app is stored in the company’s databases running on AWS (Amazon Web Services). The obtained data from Europe and the United States are kept separate due to the policy differences regarding data privacy. Also, the data as well as the communication (emails, feedback etc.) between users and the mySugr company is encrypted.

The Tags

The notion of the tags is about the daily life experiences of diabetes patients. These tags represent and describe various situations, scenarios and specific context like moods or emotions, which are important for the user to record in order to view what happened in the time that has passed. For example, the user can describe with these small icons (see figure 6) his or her actual emotional state, whether happy, sick, in pain, stress, angry, excited, tired etc. The user can also add some notes to describe in more detail his or her current situation.

²⁷ HbA1c is also referred to as haemoglobin A1C or simply A1C. The term HbA1c refers to glycated haemoglobin, which develops when haemoglobin, a protein within red blood cells carries oxygen throughout the body and joins with glucose in the blood to become 'glycated'. The measurement of HbA1c enables doctors to get an overall picture of what the average blood sugar levels have been over a period of either weeks or months.

²⁸ Ketones are substances that are made when the body breaks down fat for energy; ketones can be tested by using blood or urine tests and is recommended for all people with diabetes.

²⁹ Detail explanation regarding the daily total points as well as how users may reach their daily total points is available in the “earning of points” below

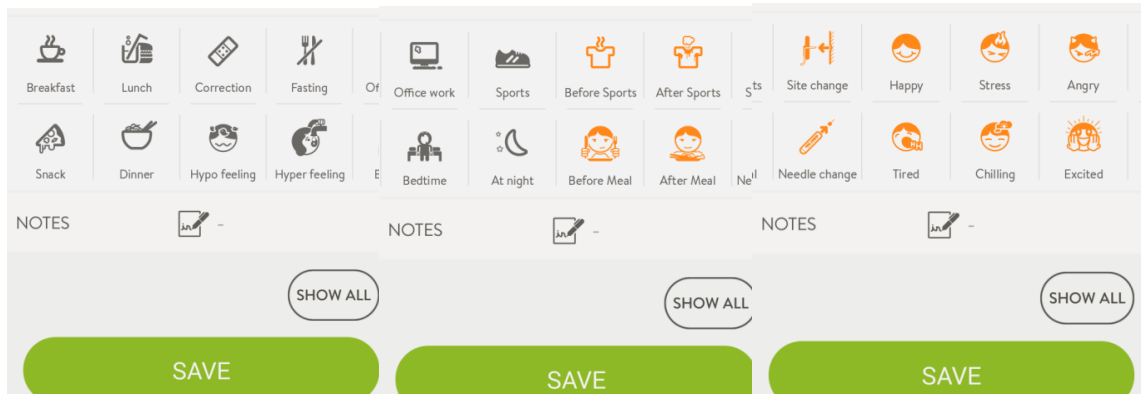


Figure 6: The mySugr Logbook Tags

Figure 6 shows several small icons (breakfast, lunch, correction etc.), which are referred to as the ‘tags’. These tags help the user to remember his or her daily experiences in the form of a story telling, they help the users to better understand the relationship between specific situations or the moods occurred during the day and the effects on their blood sugar levels. There are for instance more than 40 tags available for the users of the logbook Pro with only 12 tags available on the basic logbook app as shown on Figure 6. For example, when the user creates a new entry, he or she can select a tag or more tags to describe the context or the story of that particular entry as shown on Figure 7.

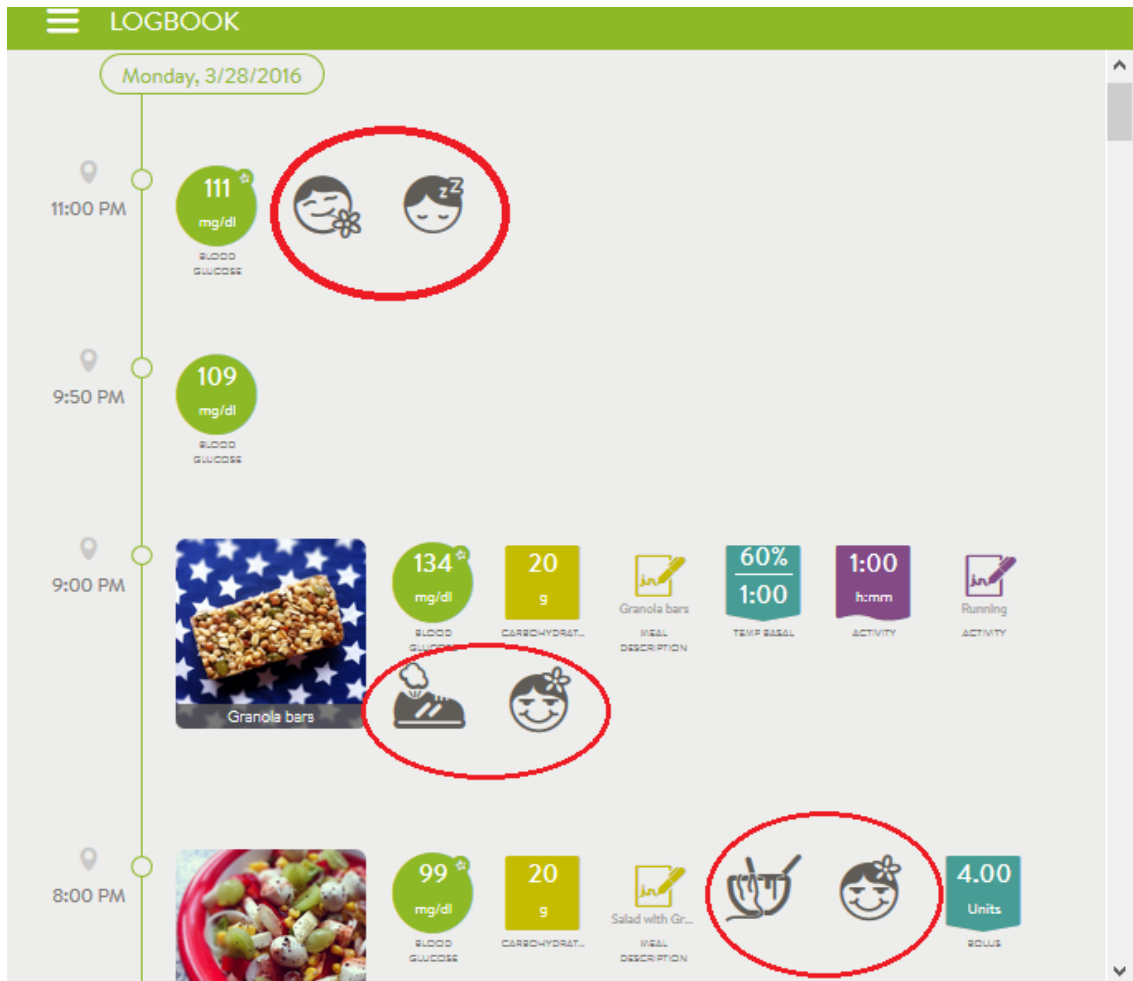


Figure 7: An Example of a user data entered into the mySugr Logbook app

Figure 7 is an actual example of how the logging of users' data looks like on the web or on the mobile phone of users. This figure shows the logging data of user X³⁰ on Monday the 28th of March 2016. At 8:00 PM he or she tagged the icon which in the app indicates 'dinner' (the icon of a 'dirty' bowl); the user also tagged his or her current mood as 'happy' (using the icon with the smiley face). At 9:00 PM, the user tagged the 'happy icon' and the icon with the shoe which means that he or she had exercised; the user also noted the type of sport which reads 'running' on the last row in note. At 11:00 PM, the user tagged the icon which denotes 'chilling' or 'relaxing' (the icon with the face with the flower in the mouth) and also the icon

³⁰ The data displayed on Figure 5 are data which are up to date and obtained from the demo account of the company. This account has a user name, however for privacy reasons and to protect the name of the user; I used the alphabetic letter X to refer to the user.

that indicates 'tired' (icon with the sleeping symbols). Figure 7 also shows that the blood glucose level of the user which is in green changed its values according to the data the user logged in the app on that particular day (99 mg/dl at 8:00 PM, 134 mg/dl at 9:00 PM, 109 mg/dl at 9:50 PM and 111 mg/dl at 11:00 PM).

When the user clicks on these small icons to tag their entries, there are three things happening simultaneously, the user gets points for each clicked icons, the colour of the icon clicked changes to green and the icon clicked also reacts by changing from its original status to another status. For example from a 'clean bowl with food' to a 'dirty, messy bowl'(see for example on Figure 6, the icon 'Dinner' and compare it with the icon 'Dinner' on Figure 7, the icon of dinner didn't change to green because the image on Figure 7 is taken from the web and not on the mobile phone). The user can also tap and hold the available tags he or she uses as often as they like and move them to his or her desire order or position. These tags also help the doctors as well as the care givers of the user an effective and efficient explanation of the diabetes data obtained.

The Earning of Points

The users get points for each action taken with regard to their daily self-care and self-management of the disease. The goal is to have at least 50 points at the end of each day in order to beat the diabetes monster which is circled in red Figure 8.

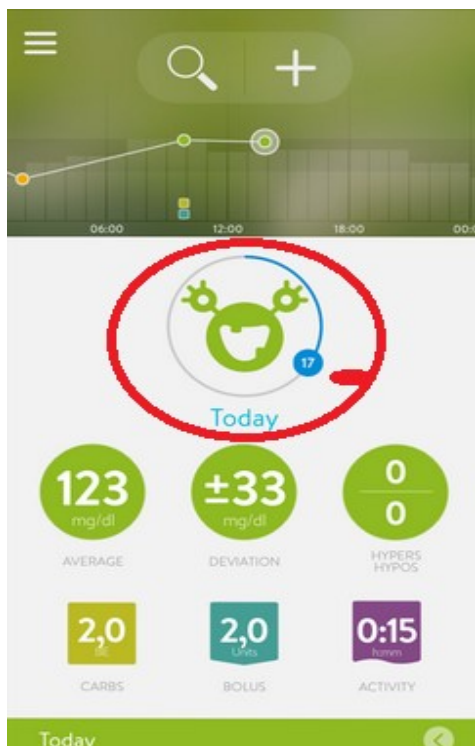


Figure 8: The Diabetes Monster and the daily earning of points

Once the users start earning the points, the monster becomes friendly and stays green or becomes unfriendly and changes its colours to red or orange. Users do not receive points for their ‘good’ or target range blood glucose or ‘bad’ blood glucose. The points are given, for example, whenever users check their blood glucose, take their insulin injections or pills, tick their tags, participate in the challenges or enter detailed descriptions of any actions taken regarding their condition. In general users earn one point per tag; two points are given when they check regularly their blood glucose levels, their carbohydrates, set their location and also for their insulin therapy. Three points are given to entries such as the detailed description of meals (vegetable, healthy snacks, whole grain etc.), activities (running, biking, walking etc.), notes etc.



Figure 9: The last 90 days total earning of points

Figure 9 shows for example the total points earned by a user after logging his or her entries after five days (see numbers which are circle in red).

The Challenges

The main concepts of the challenges are divided into two goals. The first goal is to encourage individual users to engage in various actions such as physical activities, such as sports, to optimize the levels of the blood sugar. The challenges are about specific assignments which are oriented towards achieving specific goals. The second goal is about engaging users in participating in these challenges in order to raise money for non-profit organisations that provide services or educational assistance programs to diabetes patients. Each challenge has the objective to motivate the user, lasting sometimes for only few hours, others lasting for several days to a week.

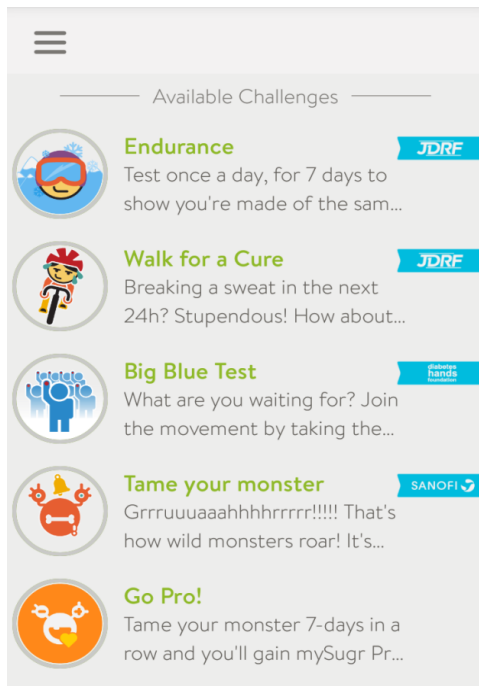


Figure 10: The mySugr Logbook Available Challenges

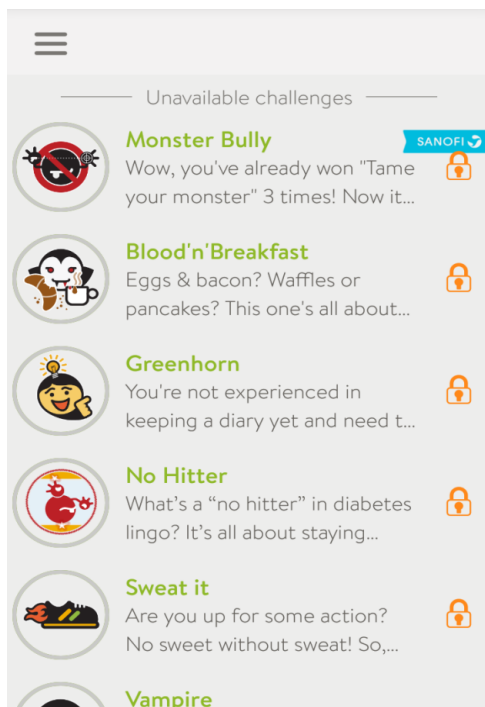


Figure 11: The mySugr Logbook Unavailable Challenges

Figure 10 and 11 show various challenges designed for the daily use and continuous motivation of the users of the logbook app. These challenges as displayed on both Figure 10 and Figure 11 are only available on the user's mobile phone and not through computer browsers. Figure 10 shows challenges available to the users of the mySugr logbook which is free and

Figure 11 shows challenges which are locked (orange lock); these challenges are available to the users of the logbook Pro which is the paid version with advanced features.

For example, the first challenge **‘Endurance’** says:

*“Test once a day, for 7 days to show you’re made of the same stuff [sic] as Chris Southwell! He is taking on 7 of the most demanding endurance events on 7 continents, to prove that having diabetes or a chronic illness should not stop us from living our lives to the full!
By playing this challenge, you support the JDRF in their search for the cure! Learn more on the mySugr blog.”³¹*

This particular challenge encourages users to test their blood sugar level at least once per day during seven days (for a week). The key is to keep users’ focused on their condition and help them care more effectively about their diabetes therapy. When users of the mySugr logbook app participate in this particular challenge and actually measure their blood glucose levels during the seven days, they are supporting the Juvenile Diabetes Research Foundation (JDRF) in their research mission and goals. The mySugr company therefore pays for the support by donating to the organisation. The mission of JDRF is to find a cure for diabetes type1 (T1D) through the support of research and by also helping those with diabetes type1 to have and live healthier lives.³²

The Logbook Analysis

The logbook analysis is another feature of the app which displays each entry made by users on a daily basis as well as the last seven days and last 30 days (See Figure 12). The more the users record or log in their data (entries) in the app, the more data they save in the app which results in more data to analyse leading to a better understanding of the data.

³¹ Taken from the mySugr logbook app, section goals

³² To learn more about their research, please visit their website www.jdrf.org.

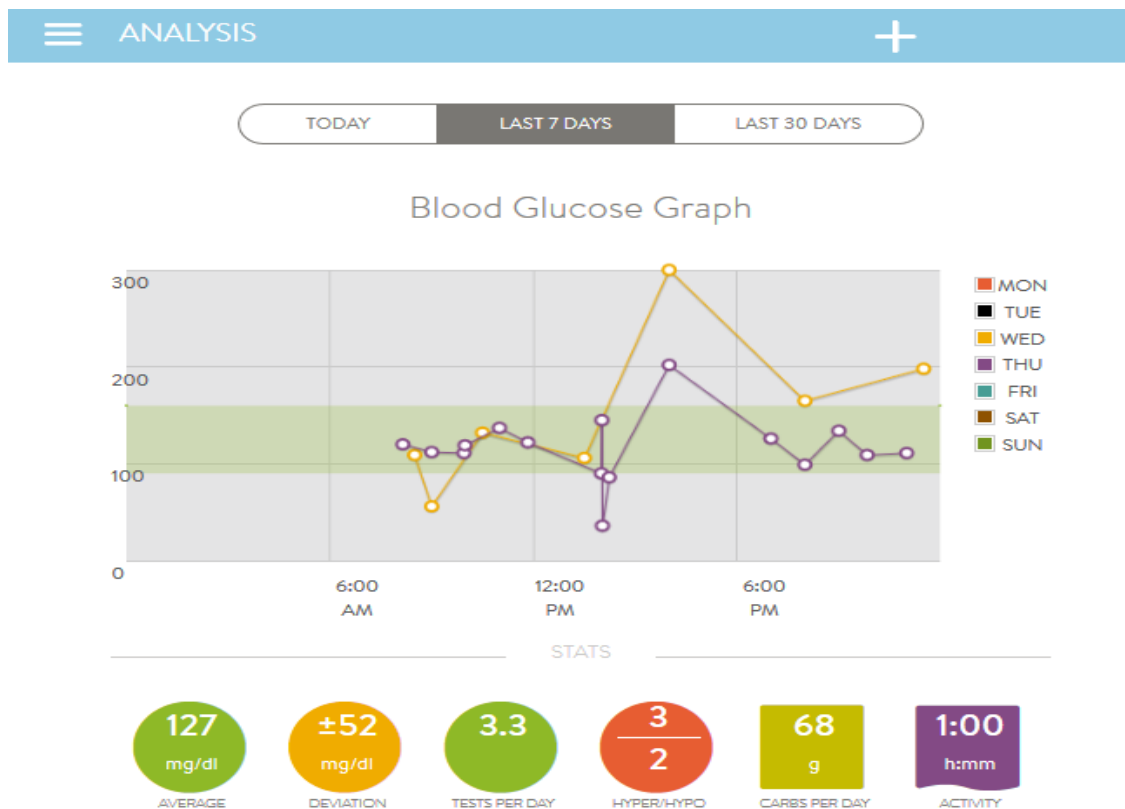


Figure 12: The mySugr Logbook Blood Glucose Analysis

Figure 12 shows the analysis of the users' blood glucose from the last seven days displayed as graphs. This particular data analysis shows that the user logged into the app on Wednesday (colour orange) and Thursday (colour purple) – see Figure 12 at the top right, the display of various colours which are assigned to each day of the week.

Below the 'blood glucose graph' the Figure 12 also shows "STATS" and displays below various functions (following the order): the blood glucose average³³ value of the user which is in green, the deviation³⁴ which is in orange, the number of blood glucose tests per day which is in green, the number of "hyper and hypo"³⁵ which is in red, the number of carbs³⁶ per day

³³ The blood glucose average is also referred to as 'BG average', it represents the average of the user's blood glucose during a day, a week or a month.

³⁴ The deviation refers to standard deviation and represents the average deviation of the user's blood glucose levels. The user activates this function after typing five blood sugar entries on three consecutive days. The deviation is then displayed daily on the screen of the user

³⁵ Hypers refers to hyperglycemia which means high blood glucose levels and Hypos refers to hypoglycemia which means low blood glucose levels

³⁶ Carbs refers to carbohydrates

which is in brown and the total amount of activity which is also refers to sport or exercise shown in purple.

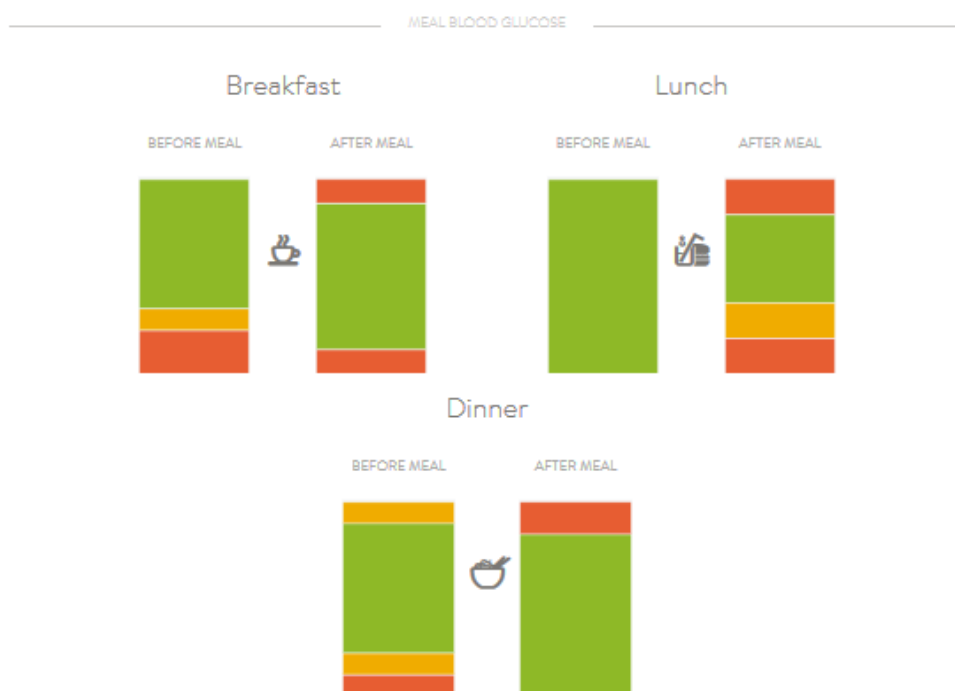


Figure 13: The mySugr Logbook “before and After Meal” Analysis

Keeping track of what diabetes patients eat for example or do in relation to their blood glucose level is the easiest way to self-care and self-manage the disease and improve the diabetes therapy. Figure 13 shows different analysis of the user’s blood glucose levels before and after each meal time. For instance, before breakfast the blood glucose level of the user shows green at the top, orange in the middle and red at the bottom; after breakfast the blood glucose level of the user shows red at the top, green in the middle and red at the bottom. There is also a difference between the sizes of each colour. Green for instance means that the user’s blood glucose is within its normal range, the colour orange means that the user’s blood glucose level is not in within the normal range and there is nothing to worry about; however the colour red means that the user’s blood sugar is either too low or too high. Figure 13 is a seven days “meal” analysis of the user’s, we can observe that in that particular week the user’s blood glucose levels before breakfast were within the normal range (the colour green at the top followed by orange and red) and sometimes not. After the users’ breakfast we can also observe that the user’s blood glucose levels were not within the normal range and some-

times within the normal range. When we look at Figure 13, we can understand how the user’s blood glucose changes depending on the time the user took his or her meal and sometimes the type of meal of food eaten can affect his or her blood glucose.

The features of the data analysis allow the users to see a visual representation of their average blood glucose levels, the average amount of blood glucose tests taken, the average of their intake carbohydrates and the average of their physical activities. The user needs to simply ‘swipe’ his or her mobile screen to either to the left or to the right to see his or her averages for each day, the last seven days, the last two weeks (14 days), the last 30 days and even 90 days all displayed as graphs and statistics (see figure 14).



Figure 14: An Example of the mySugr Logbook last 30 Days Analysis

The Logbook Reports

The Logbook report represents the user's personalized review or a 'quick' summary of the overall diabetes management of the user for the past seven days as well as the last 30 days (see Figure 15)

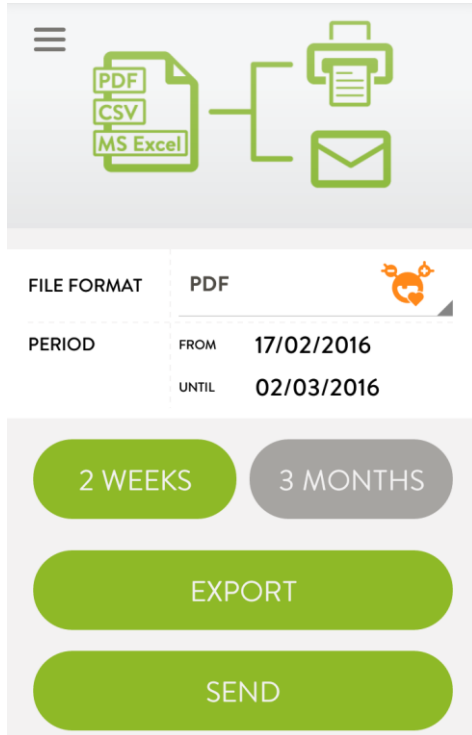


Figure 15: The mySugr Logbook Reports

The Logbook report allows users to look at how many days they met their target goals as well as their total average of blood glucose levels in regards to their self-care and self-management of their diabetes monster. The most interesting function of the report is that users can export as well as print and email their reports in three different formats: PDF (Portable Document Format), CSV (Comma-Separated Values) and Microsoft Excel file which are convenient to hand in to their doctor or care givers during their routine visits (see Figure 16).

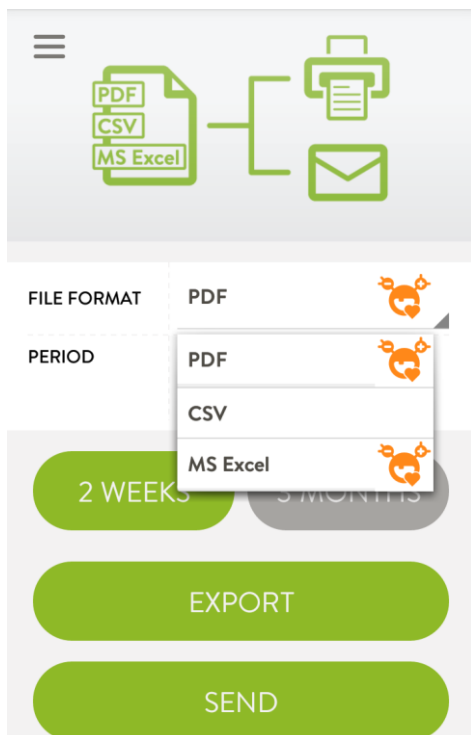


Figure 16: The mySugr Logbook displaying all its File Format

The users can see a breakdown of their data and compare it to their previous week's data; they can see whether their therapy has improved their condition, or if they need to take a closer look and take any actions regarding their treatment. The users can also see the overall total of their physical activity time for the week. In this report format there is also a 'fun platform' with a winner stand displayed as a sneak peek, where users can see the position of their diabetes monster as an 'Olympic winner' of which at the first place the user and the user's monster holds the gold medal, at the second place the user's monster holds the silver medal and third place with the bronze medal. The user can also compete and compare their result with other users as well as the mySugr team. The users are also able to look at how many days they met their target goals, how many total points they received for each entries as shown in Figure 17.

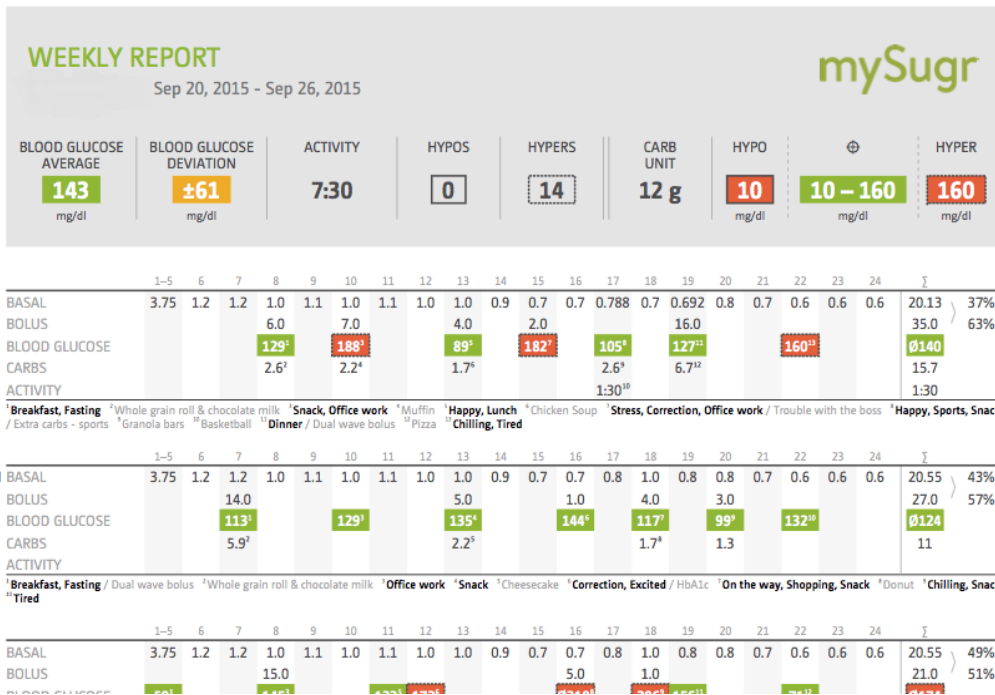


Figure 17: An Example of the mySugr Logbook “Weekly Reports”

6. THE RESEARCH METHODOLOGY

The research was intended to primarily gain a deeper insight into diabetes patients' use of a mobile health app known as "mySugr Logbook" and secondly understand the role of these mobile health apps in the self-care and self-management of diabetes. Qualitative interviews were therefore chosen as the prime method of data collection to acquire profound accounts of the actual practices of diabetics' use of mobile health apps. Conducting a research study in which interviews are chosen as the prime method of data collection requires thoughtful preparation as well as clear established strategies particularly in accessing the field. I was aware of some of the difficulties I would face accessing this field in particular both in terms of conducting interviews and further fieldwork. For instance, I had to think about how to acquire the contact of the research participants to interview, how to explain the aim of the interview as well as the purpose of the research. I also had to consider where to conduct the interviews, what type of questions to ask during the interview and many other variables. Therefore, I established some steps to approach the field and guide the process of the data collection which in the end helped me stay focus on the goal and purpose of the research.

I planned for the first step, to contact "mySugr GmbH" which is the name of the company which developed the mobile health app called "mySugr Logbook" as well as offering many other mobile health app services to diabetes patients in Europe, the United States and other countries around the world. I believed that it was important to begin the study by understanding the concepts of the company – on how they developed the ideas of mobile health apps for diabetes patients, what was their motivation regarding the development and future of the app and what the app represents – before setting the various appointments to interview the research participants. This first step in my opinion would allow me to meet at least one team member of the company in person where I will present the aim and objective of the research study as well as acquire detailed information regarding their mobile health app services. Additionally, this first step would also facilitate the process of acquiring the contact of potential research participants to interview. In the second step I planned to conduct interviews with diverse research participants in order to acquire answers to the research question. I also planned to take notes as well as audio-record each interview in which I planned to provide informed consent forms to be signed by both the research participant and the researcher before the start of the interviews. The third step was to analyse the data obtained from the inter-

views. I planned to use grounded theory for the data analysis which would consist of comparing the data obtained with each other as well as providing analytical explanation and interpreting the data obtained during the fieldwork. The fourth and final step was to reflect on the research study, open further discussions which might lead to other research studies and provide a conclusion to the study (see diagram 1).

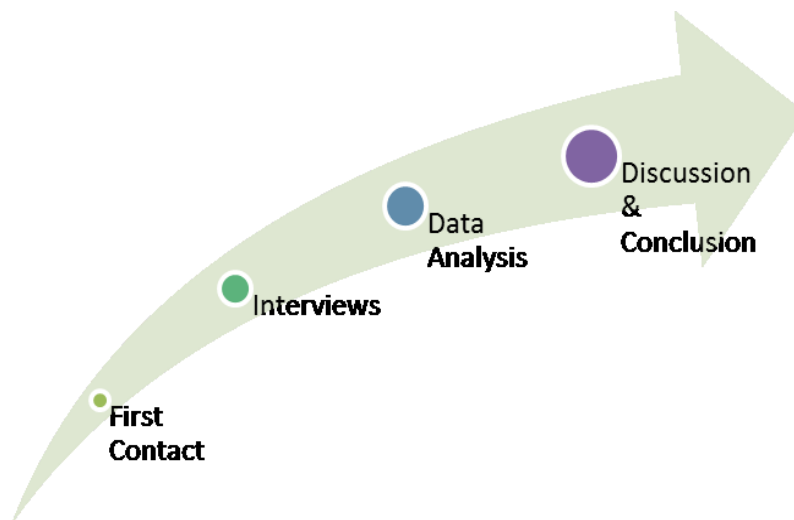


Diagram 1: Steps to Data Collection

6.1. On Qualitative Interviews

I assumed that qualitative interviews would best suit the aim of the research – to explore and understand the views, the experiences, as well as the beliefs and motivations of diabetics use of “mySugr Logbook” app. Though this method is the most common method conducted in social science research for data gathering, it was not used for these reasons but rather because the method seeks to explore and describe specific phenomena which often leads to acquiring more detailed explanations. By choosing this method, I wanted to understand the role of mobile health apps in the daily self-care and self-management of people living with a chronic disease specifically diabetes. I also wanted to compare how the life of a diabetes patient looks like in reality (in vivo) *without* the use of “mySugr Logbook” app and how life is *with* the use of the app and observe the diverse changes. For these reasons, I decided that listening and asking questions directly to the people involved in such practices would be the right tool to expand the understanding of diabetics’ use of mobile health apps; as the diabetes patients participating in the interviews would describe and interpret with their daily practices

in considerable detail. I was convinced that the method of qualitative interviews as the prime method of data collection was most suitable to highlight where missing knowledge about diabetes patients use of mobile health apps in dealing with the condition would be.

I reviewed several literatures in which research participants reflected on the process of taking part in interviews and also literatures where various scholars used qualitative interviews as their method of gathering data. I was also convinced that the method is appropriate to acquire detailed insights about this particular practice which required the description of individual participants. For example, a study conducted by Wolgemuth et al. (2015), researchers from the United States show that when participants take part in interviews, they talk openly about their difficult experiences and seem to have a trusting relationship with the interviewer (Wolgemuth et al., 2015). This study also demonstrated that interviewing participants result in building a trusting relationship which allows the participants to contribute to sensitive topics and to feel comfortable while discussing delicate as well as private aspects of their personal lives. Another study used qualitative interviews to analyse the relationship between ‘scientific expert’ and ‘lay people’ regarding the risks involved in the use of pesticide in Denmark. The researchers conducted sixteen (16) interviews regarding the perception of risk as well as the regulation and attitudes towards the use of pesticide in agriculture and homes; they specifically conducted two focus group interviews³⁷, eight interviews with “pesticide experts” and eight with “lay people”. The study showed that *“most lay-people and most experts in Denmark [...] possess the necessary resources, in the form of reflexive identities, to engage in mutually beneficial dialogues on risk issues”* (Blok, Jensen, & Kaltoft, 2008:205). Qualitative interviews allowed these researchers to describe the different patterns involved between ‘scientific experts’ and ‘lay people’ regarding the risk of using pesticide in agriculture and homes in Denmark. This study for example, demonstrated that, in order to understand people’s opinions or views on various topics, researchers need to ask questions and actively listen to acquire additional or “new” knowledge.

I also compared qualitative interviews methods to focus groups and ethnography methods used in social science research to gather data. I was strongly convinced that the chosen qualitative interview method would be the way to approach this research especially for exploring

³⁷ These two focus group interviews consisted of one group involving six “lay people” and the second group involving three “lay people” and three “pesticide experts”.

such a sensitive topic related to people's own personal health conditions. For example, I believe using the method of focus groups in gathering data in this research would not provide the in-depth understanding of diabetes patients use of mobile health apps I was aiming at. The method of focus groups in social science studies is used to critically analyse issues regarding the context of public understanding of science; it is used to access meanings and norms of people gathered in larger or smaller groups. The method reveals "*what participants think and why they think as they do*" (Liatto-katundu & Bratton, 1994:537). According to Jennifer Cyr (2016), who assessed the use of focus groups method and examined articles published in social science journals, data gathered from the method of focus groups enabled various scholars to "resolve concerns regarding measurement validity", "*appraised multiple opinions or viewpoints*" and "*produce findings that raised new research questions*" (Cyr, 2016:250). Scholars in the department of Science and Technology Studies often used focus groups in their research and for example published various articles on "the cultural construction of the publics" (Felt & Fochler, 2010), on how "topic discussed during focus groups meetings shapes the political positions of the participants"(Felt et.al, 2008) and also how "*the participants think about their own engagement in focus groups settings*" (Felt & Fochler, 2008). For example in a comparative analysis of twelve (12) focus groups, three professors – Ulrike Felt, Maximilian Fochler and Peter Winkler – investigated how focus group participants also referred to as "lay people" understand, perceive and position themselves as individual and as collective regarding the topic of "biomedical technologies" such as organ transplantations and genetic testing. The study showed how participants in three different countries – Austria, France and the Netherlands – addressed the topic of "biomedical technologies" differently. They observed that "inscribing" these (organ transplantation and genetic testing) technologies means, for example, in Austria to abide by the established policies that otherwise prohibit the technologies. In France, these technologies are perceived as "good tools" which need the support of individual citizens. In the Netherland, these technologies are regarded as instrumental in solving specific problems (Felt, Fochler, & Winkler, 2010). They concluded that the ways the focus group participants addressed their views as well as positions to these two technologies "*have been constructed over time and are distilled from multiple encounters and experiences with the technology*" (Felt, Fochler, & Winkler, 2010:21). The three professors gained multiple perspectives in studying participants in focus groups, however, I believe the use of quali-

tative interviewed would have identified detailed perceptions as well as attitudes towards these biomedical technologies.

After reviewing the literatures and comparing the chosen method to other methods such as focus groups and ethnography methods, I decided to therefore use qualitative interviews to gather the data because this method generates in-depth understanding of people's individual practices. Also, this research is not a quantitative research which tends to distinguish the quantity or number of people using mobile health apps, but rather a qualitative research aimed at understanding how diabetes patients use and give meaning to the use of "mySugr Logbook" app in their daily self-care and self-management of their condition. There are several types of interviews which scholars can conduct - structured interviews or unstructured interviews, formal interviews or informal interviews as well as semi-structured interviews. Therefore, I decided to conduct semi-structured interviews to allow each participant ample time and opportunity to speak in detail about their personal experiences; allowing them the freedom to express their views using their own terms; describing their various opinions regarding their health related issues in a more intimate and personal setting while recalling their past experiences without the use of the app and their current experiences with the app. Semi-structured interviews allow researchers to structure their interview questions by providing a clear set of guideline questions as well as asking any questions that may develop naturally during the interview to develop a better understanding of the topic of interest. I chose to conduct six semi-structured interviews with diabetes patients regardless of their gender, age, profession, marital status and their type of diabetes, focusing during my fieldwork, to interview people living with diabetes and using the "mySugr Logbook" app in their daily self-care and self-management of the disease. I believed that six research participants would provide different experiences as well as reliable and comparable data which would in turn provide answers to the research question.

Although the method of interviewing was the primary source of data that would be used in answering the overall research question, I decided to combine the interviews with some 'shadowing' during the fieldwork. Shadowing is a technique used in various types of fieldwork and according to anthropologist Harry Wolcott (2002) shadowing means "acting like a detective" in order to understand a particular activity. It is an approach "*to learn what is going on, rather than what should be going on, as resulting from documents and even interviews*" (Czarniawska, 2007:33). During the interviews, I wanted to listen to *how* the research

participants use the “mySugr Logbook” app; however, by ‘shadowing’ I wanted to observe *what* the research participants did exactly with the app on their phone; which I believe would lead to understand the practices of the app with more concrete details. As such, shadowing diabetes patients permitted the comparison of not only the intended practices “inscribed” in the app by the developers to their intended users; shadowing presented the actual practices accomplished on daily basis by the users on their own.

Also it was argued, that practices are not only enabling people to get things done in the world as Bourdieu (1977) and Giddens (1979) inspired, Davide Nicolini explained that practices rather “*can never be captured by a single method or reproduced through one single style of writing*” *because of its multifaceted and complex nature*” (Nicolini, 2009:196). Combining qualitative interviews with shadowing, I believe would lead to observe as well as capture how people in practice use mobile health app, showing as such whether the users of the mySugr logbook app followed the scripts inscribed by the designers or inscribed their own scripts into the app. Also, practices are considered to be the building blocks of social life and it was also argued that realities are also enacted in practices (Law, 2011). Practices involving the diabetes patients and the use of the mobile apps should in this context be understood as “*a routinized way in which bodies are moved, objects are handled, subjects are treated, things are described and the world is understood*” (Reckwitz, 2002:250). In another words, I will pay attention and observe during each interviews the body language, as well as gesture and anything related to how the research participant handle themselves and discuss about the topic.

6.2. Approaching the Field

Although, I planned to conduct six semi-structured interviews, I conducted only four interviews during the fieldwork. The research participants were diabetes patients all living with the type 1 even though I was approach by two categories of diabetes patients. The first category, I will refer to as “non-users of the mySugr app” and the second category “users of mySugr app”. The research participants are women and men living and working either in Austria (Vienna) or Germany (Berlin and Munich).

Approaching the field as well as collecting the data in order to understand diabetes patients use of “mySugr Logbook” app and the role of the app in the self-care and self-management of the disease was a learning process for me as researcher. I describe the plans

and actions taken before conducting the interviews and explained with much details how I met each research participant. I therefore invite you to experience the journey of doing research in the field of Science Technology Society (STS) as you read.

6.2.1. The First Contact

The research focus on a mobile health app officially registered under the name of mySugr GmbH³⁸. I first acquired general information about the company services on their webpage and subscribed to their monthly newsletters. I contacted the company by writing an email to the support team for further assistance and the person who replied to my email happened to be one of the co-founders of the company. After exchanging several emails, an appointment was scheduled to allow each person to present himself in an official way. In the course of the meeting, I had a brief presentation of the app which was called back then ‘mySugr Companion’ and I also explained the purpose as well as objectives of the research study. After that meeting, the company agreed to assist me in establishing contacts with the research participants to discuss their daily experiences with the app, but unfortunately the resulting process was very slow and delayed the fieldwork.

However, I persisted in contacting my interlocutor and at last received a reply through an email in which I was introduced to another person, call Dr. Hagen who happened to be a physician and had been in collaboration with the company for more than three years. I was of course much more relieved that there was still further contact with the company, but at the same time I was not pleased with the ‘new contact’, since my focus was rather on the users of the app and not on the physician. I used this opportunity to talk with Dr. Hagen and through him, I received the contact of another physician, call Dr. Schütz-Fuhrman who happened to be in constant and direct collaboration with diabetes patients using different kinds of technologies in the management of the disease. Dr. Schütz-Fuhrman introduced me to another physician Dr. Irsigler. Who happened to be a pioneer and contributed to the ‘*new approaches in the treatment of diabetes*’ literature in Austria. At last, my interlocutor at the company who is one of the co-founder of mySugr GmbH created a newsletter which was shared to 30 users of

³⁸ GmbH (Gesellschaft mit beschränkter Haftung). The acronym GmbH is, in general, written after the name of the company and means that the company has acquired the legal rights to stand as a company with ‘limited liability’ to offer their products or services to consumers.

the app living in Vienna. This newsletter allowed the users of the app to voluntarily enter their names as well as their email address to participate in this research study. The co-founder allowed me to access the newsletter list of which three people subscribed to the list, I sent an email to each individual and received the reply of only two people. The third person has not reply to my email as of today.

The purpose of this first step in the data collection was to acquire the contact details of six people to participate in the research interview. The approach turned out to be a difficult process as well as a challenging experience. I initially planned to obtain the contact details of the research participants through the assistance of the company; expecting this to be done in a short period of time without facing any problems. During this challenging period I learned, for example, that I could have obtained field contacts by first establishing contacts with the doctors or physicians responsible for diabetes patients' care in Austria. These experiences in the process of data collection allowed me to establish new contact not only with the mySugr team members but with medical doctors actively working in the field of diabetes care. Despite the obstacles, the first step established for the data collection was nevertheless successful; I received very informative explanation of diabetes self-care and self-management in the Austrian context.

6.2.2. Expert Interview

As mentioned above, the first step established for the data collection allowed me to interview expert doctors which helped me to contextualise the research study. I learned valuable lessons from each expert doctor. In the following paragraphs, I explained what I learnt from each interview.

Dr. Wolfgang Hagen is a physician at the 'Krankenhaus Hietzing', a hospital located in the 13th district of Vienna, also known as one of the biggest hospitals in Austria. Dr. Hagen is one of the doctors in the '3. Medizinische Abteilung KH Hietzing' (name in German) and works in the medical department of metabolic diseases and nephrology. Mr. Dehong, one of the co-founders of the "mySugr GmbH introduced me via email in which he explained my interest in understanding the views of both doctors and patients on the topic of mobile health apps. We exchanged emails and decided to meet and discuss on the topic of diabetes patients and the use of mobile health apps in Austria.

During the interview, I asked questions regarding the historical development of Diabetes in Austria as well as how diabetes patients deal with the condition. I also asked about his role in the lives of diabetes patients and the current research studies on diabetes patients' use of mobile health apps. After our meeting my understanding and views regarding the Diabetes Mellitus in general was enlarged from my previous little knowledge. I learned that the first insulin therapy was introduced between 1930 and 1940 in Austria which was back then not very successful, however past research studies which focused on type diabetes lead to the development of different types of insulin. I also learnt that more research studies in the area of diabetes patients and the use of health technologies are needed in Austria as Dr. Hagen explained that it is difficult to trace the historical development of the disease in the Austrian context.

This interview helped me to review the questions I planned to ask the research participants especially regarding their diabetes therapy. Although, Dr. Hagen could not provide me with the participants I needed for the interview, he shared knowledge about the disease which helped me to engage more on the research study. Fortunately, he introduced me to one of his colleagues in the department of diabetes care in Austria.

Dr. Ingrid Schütz-Fuhrman is a medical physician also at the 'Krankenhaus Hietzing' hospital. She is a member of the Medical Association of Vienna, a specialist in the area of 'Endocrinology and Metabolic Diseases and Nephrology'. She is also in the chairman of the Austrian Diabetes Association call Österreichische Diabetes Gesellschaft (ÖDG). I received her email address during my meeting with Dr. Hagen, he also introduced me to her and asked me to write to her and told me that she is responsible for the Diabetes outpatient clinic at the hospital. After exchanging several emails, she asked me to come to the hospital where she gave me an overview on the diagnoses of diabetes mellitus and showed me the different technologies used at the hospital for diabetes patient.

At the hospital, I learned more about the use of insulin pump technologies in the care of diabetes patients with the type1 diabetes. I learned for instance that insulin pumps administrate small amount of insulin to diabetes patients more than six times in a day. I also learned that while diabetes patients used the insulin pumps, there is a continuous glucose monitoring devices which shares information via specific health software between the patient and the doctor. Additionally, I learnt that Dr. Schütz-Fuhrman is one of the medical advisors of the

mySugr GmbH assisting the team of the company in educating other diabetes patients regarding the use of insulin pumps as well as the mySugr logbook app.

I requested for the assistance of Dr. Schütz-Fuhrman in asking her patients to participate in the research interviews. She also introduced me to one of her professors and colleague as I asked also questions regarding the historical development of diabetes in Austria.

Univ.-Prof. Dr. med. Karl Irsigler is a university professor in the medical fields of endocrinology and metabolic diseases, internal medicine, intensive care medicine and Nephrology. He is currently a retired doctor; however offers his services at the Döbling Private Hospital especially for diabetes, obesity and kidney patients. I was introduced to him by Dr. Ingrid via email in which he replied and scheduled an appointment date for a meeting at the Döbling office centre.

I further learnt through the immense knowledge of Dr. Irsigler about how the ‘Metabolic Department of the Vienna-Lainz City Hospital with the L. Boltzmann Institute for Metabolic Disease and Nutrition’ was founded in 1930 by the Geheimrat Prof. Carl von Noorden. In 1980, Dr. Irsigler was the director of the department. I found out that the department for ‘Metabolic Disease and Nutrition’ is not the current ‘Krankenhaus Hietzing’. I was also informed that before 1975, self-urine tests were not reliable tools to diagnose diabetes and that patient especially with type 1 diabetes used to come for their medical control once every three months. I also learnt that the department for Metabolic Disease founded its first study group for diabetes and pregnancy in 1977; where the department also purchased in 1978; an artificial endocrine pancreas called “Biostator” and started a diabetes screening programme.

After the meeting, Dr. Irsigler gave me the name and the contact details of one of his colleagues who worked with him on several projects and is a hypertension patient expert. I decided not to meet with this particular doctor, because I realised that the first contact began to expand and might never stop if I continue meeting new physicians; I might also lose the focus of the first contact and might not collect any data on my particular focus, the users.

However, the interviews with these expert doctors helped me to acquire more knowledge on the disease as well as diabetes patients in the Austrian context. I also revised my guideline questions for the interviews with the research participants and established my very first contact with a participant to interview and obtained detailed contacts of the other research participants and conducted the semi-structured interviews as planned.

6.3. The Interviews

	Research Participants	Gender	mySugr Logbook app	Insulin Technology
1	Kofi	Male	Non-user	Insulin Pump
2	Thom	Male	User	Pen-based insulin
3	Stella	Female	User	Insulin Pump (Omni Pod)
4	Perrine	Female	User	Flexible Insulin Therapy

Table 1: Details of research participants interviewed during the fieldwork

Table 1 shows the number of research participants interviewed during the fieldwork. The names used in the table are all pseudonyms. The table also shows the gender of the research participant as well as whether they are a user of the “mySugr Logbook” app or not. The participants are all patient with type 1 diabetes and in general, people living with type 1 diabetes need insulin injections either because the pancreas does not produce any insulin or not enough insulin in their bodies or they cannot properly use the insulin produced. There are different ways to inject insulin as shown in table 1.

While setting the appointment date for the various interviews, each participant received via email a *participant information sheet*³⁹ in order to understand the purpose of the research study as well as understand the interview procedure and prepare accordingly. On the day of the interview each participants signed an *informed consent sheet*⁴⁰ before starting the interview. One of the participants (Thom) could not sign the informed consent sheet because the interview was conducted through Skype, nevertheless he gave consent verbally.

During each interview I was granted the permission to audio-record the interview, to take notes as well as some pictures. After the session(s), I transcribed each interviews, assigned names to each participant as well as to the data obtained and saved the information on my hard drive in a folder secured with a password.

³⁹ See Annex Documents

⁴⁰ See Annex Documents

6.3.1. Interviewing the Research Participants

As mentioned above, the names of each participant are pseudonyms (see table 1) given by the researcher for confidentiality. In the following paragraphs, I will describe how contacts were established between the researcher and each participant and explain how the interviews were conducted.

The first person, I named Kofi. He received my email address from Dr. Schütz- Fuhrman who thoughtfully introduced my research interest and my call for diabetes patients to interview. We shared several emails in which he received the '*participant information sheet*', and we scheduled an appointment day and agreed on the place and time for the interview. The interview with Kofi went very smoothly, he was very nice and his English was also good.

This first interview helped my research in many ways. It provided responses that cultivated my understanding of diabetic's life with the daily use of technologies other than mobile health apps in particular the insulin pump. I gained also more knowledge regarding diabetes type 1 and how patients deal with their conditions. As I conducted that first interview, I obtained a better understanding about how to conduct qualitative interviews. Though the interview provided considerable amounts of informative data, aspects of interviewing such as being patient were realised after listening to the audio recorded data where I identified a number of mistakes that I made during the interview. I learnt for instance to listen more to the participant detailed explanations and to talk less during the process, I also understood that silence was okay and to be patient on particular questions as time is required to think about and answer certain questions. This first interview was really important to me since I waited so long (more than 5 months) to interview participants. I had for the first time the opportunity to talk with a diabetes patient which helped me to perceive the "broader picture" of diabetes patients daily routine lives with the use of mobile health technologies, however not mobile health apps. The initial data collected helped me to reorganize the interview guideline questions prepared specifically for the users of mySugr app. I was hence forth prepared to meet other participant to conduct the rest of the interviews.

The second person that contacted me was again through the help of Dr. Schütz- Fuhrman; I unfortunately could not meet with that particular person to conduct the interview as we faced a language problem: she sent me emails written in German. She introduced herself and asked several questions regarding the research study as well as the procedure of the interview. Although my level of German is low, I replied in German and answered all her questions and

explained to her that the interview will be conducted in English; she honestly told me that she will participate in the interview only if it was in German. I could not conduct the interview in German, because on one hand I don't speak and understand German perfectly to conduct an interview, and on the other hand the Master of Art in Science-Technology-Society (STS) is an English language programme, therefore the research thesis was also to be written in English.

The third person I named Thom. He voluntarily registered to the newsletter created by one of the co-founders of the mySugr company. I sent him an email in which I showed him my gratitude for accepting to participate in the research. I also inquired when he would be available in order to schedule a day for the interview. He responded that he lived in Berlin and not in Vienna; we therefore agreed and conducted the interview via Skype⁴¹ which is convenient tool to conduct video interviews as I experienced. This particular interview was my second experience in interviewing a diabetes patient; however it was my very first interview with a user of the "mySugr Logbook" app. This interview, similar to the first one, was also very important to me as I was approaching the goal of the research. The interview deepened my knowledge as I understood from the participant views how the app plays various roles in the self-care and self-management of diabetes. However, because the interview was conducted using Skype, I was unable to 'shadow' his practices with the mobile phone; I could not observe how he made his entries or even observe what features of the app he used.

The fourth person I named Stella made contact similar to Thom by registering to the mySugr newsletter created for the purpose of the research. We shared several emails and after receiving the '*participant information sheet*', she suggested a day, a place and a time for the interview. We had a very long and detailed conversation; where I was able to see in detail how the mySugr logbook looks on the mobile phone and also how entries were made in the app. She was very friendly and patient in her explanations, providing many details of her experiences with the disease as well as the use of the app. I saw the different features of the app and acquired answers to my longing questions. This was my third interview and the second person interviewed who was a user of the mySugr logbook app.

The fifth person who contacted me received my email from a friend who told her about my interest in the lives of diabetics. She sent me an email in which she briefly introduced

⁴¹ Skype is a social media tool allowing video calls with family and friends

herself and also scheduled a day and a time to conduct the interview. I replied and asked her whether she uses the mySugr app of which she answered no. I was a little bit disappointed and at the same time could not cancel the meeting; I therefore sent her the ‘*participant information sheet*’. When we met on the appointed day, she asked in German whether we could speak in German instead of English. I assured her that her emails were understandable and readable therefore she does not have to worry about her English, she then explained that her husband helped her to write these emails. I did not conduct the interview.

Perrine is the sixth person on the list of field contact, however on table 1 she is the fourth person I interviewed. I received her contact from a school colleague who personally has some acquaintance with her. After sharing several emails an appointment day was scheduled for the interview, she also received a research participant information sheet. This last interview was challenging; first we didn’t agree on the exact venue for the interview as done previously with the other participants. Therefore, we lost some time looking for a quiet place for the interview, as most of the cafés in Vienna play music which are neither loud nor quiet. It was difficult to find a quiet place, the café in which we decided to conduct the interview could not lower the volume of the music and that affected the audio recording of the interview.

6.3.2. Interviewing “mySugr GmbH”

During the first step of data collection (see diagram 1), I initially planned to first contact mySugr GmbH to acquire more knowledge about their services especially the “mySugr Logbook” app. Even though, I aimed at acquiring the contact details of potential research participants (or users) to interview, I also aimed at conducting an interview with at least one team member of the company in order to understand various concept(s) behind the development of the mySugr app. It was after conducting my fourth interviews with one of the research participants that I conducted the interview with one team member of the mySugr company who happened to be one of the co-founders of the company, Frederik Debong. He has also been my interlocutor since I established my first contact with the company’s support team.

I needed to meet one of the team members of the company for significant reason of I acquiring more details about the company as well as how the idea of the mySugr Logbook app developed. I also wanted to understand their concept of mobile health apps for diabetes patients as well as their relations with the users of the app and many others questions. Therefore, I prepared guidelines for my interview in which I asked questions regarding detailed

account of both the company and the “mySugr Logbook” app. I asked questions regarding the business model of the company as well as how they formed the team of the company. I also asked questions regarding the various features of the app as well as the meaning of terms such as “diabetes monsters”, “the challenges”, “the tags”, etc. I further inquired about the cost of the apps as well as how they intended to implement their mobile health app services.

Fredrik Debong is one of the Co-founders responsible for the Community Relation Lead (CRL) of mySugr GmbH, a company located in the seventh district of Vienna. I wrote an email to the mySugr support team and received a reply from him, which is how we established our first contact, after sending and receiving several emails we decided to meet and talk. The first time I met with Frederik was at the ‘Quantified-self Vienna’ meetup where he made a presentation about the app, I presented the research purpose and ideas as well as my interest in studying the company’s mobile health app and its users as the case study. We met again a second time where I conducted an interview and received detailed information concerning the company and its different products and services.

The interview with Mr. Debong lasted about two hours. The interview went very smoothly and discussions with him proved to be a positive learning experience, it was interesting as well as instructive. He took the necessary time to explain with much detail the concept behind the services of the company. I learned about how they formed the mySugr team and how many people work for the company as well as how the idea of the mySugr logbook app emerged and the meaning of each feature of the app. I was also informed more about the various business model of the company as well as how many people downloaded the app since its development. After the interview, I transcribed the data obtained and analysed in detail the mySugr logbook app using the data obtained from the interview and the data available on the webpage of the company.

I also installed the mySugr logbook app on my mobile smartphone to closely observe and analyse the features of the app. I did not type in my personal information or any required data and did not use the app as a user since I am not a diabetic myself and as such I was not conversant with the terminologies used in the app. I however have the app installed on my phone to help me understand and remember what the research participants had previously explained or showed me on their mobile phones during each of interviews.

6.4. Approaching the Data

The interviews lasted between sixty to ninety minutes and were audio-recorded where none of the research participants showed any negative concerns regarding the recording of the conversation. I verified before conducting each interview that the recording tape worked properly throughout the process of the interview and after each interview, I assigned to the interviews the name of the participants; I also played the tape to ensure that the conversations were clear and comprehensive. I also checked my written notes and added any particular observations made during the interviews.

After each interviews, I transcribed the data obtained, sometimes on the actual day in which I conducted the interview or the next day, however I made sure to transcribe the data obtained as soon as possible. I used one particular free software call *transcribe*⁴² which allowed me to integrate the audio recorded interviews to the player and a space to write the text at the same time. This software also allowed me to adjust the speed in which I wanted the recorder to play as allowing me to type text as I hear. However, the process of transcribing each interview took a huge amount of time and turned out to be a very long procedure. For instance, it was sometimes very difficult to clearly understand the words pronounced by some participants and I needed to playback the recordings several times.

The interviews were transcribed as it was conducted on the exact appointed date, without correcting any terminology, pronunciation of words or grammatical errors of the research participants. I also decided to send the sample of the transcripts to each participant for verification since I wanted to give to each participant the opportunity to change or correct what they said during the interviews, as such to make sure that their ideas and words were not misrepresented or misinterpreted.

After transcribing the interviews, I obtained many segments of data including four transcripts as well as field notes, some pictures and the audio recordings. I needed to analyse this data as well as select the distinct data to help in answering the research question. Therefore, I decided to approach the data by using grounded theory.

⁴² Transcribe is an online software that assist people in their transcribing task; for more detail see www.transcribe.wreally.com

6.4.1. *On Grounded Theory*

I believed that grounded theory would help in articulating the meaning ascribed to the data obtained. Grounded theory is a research method frequently known and mostly used for analysing qualitative data and fit to the segments of data I collected during my fieldwork. According to Charmaz (2006), this method allows the researcher to be involved in the analysis of the data collected by observing as well as explaining the ‘world’ of the research participant as the research participant sees the ‘world’ (Charmaz, 2006:187). The role of the researcher therefore is to remain an outside ‘expert’, who observes and explains the views, the thoughts as well as the values of the research participant. Charmaz articulated grounded theory as a *constructivist approach* which emphasises on the meanings people attribute to a particular topic.

Grounded theory is a learning practice which has different stages or guidelines to help in analysing and giving meaning to the data collected. For instance, *coding* the data obtained is one step which consists of comparing sets of data to other similar sets of data and grouping these sets into similar categories. Another step is *memo writing* which develops when assigning concepts to the categories obtained. Once the categories are conceptualised and studied a theory is thence developed.

This study was concerned with how diabetes patients use mobile health apps (especially mySugr logbook) in their everyday lives experiences. Therefore, I chose three sets of data instead of the four sets of data collected from the research participants. My task was to present the collected data in ways that give meanings to the issues of diabetics’ use of mobile health apps. Coding allowed me to outline various concepts and develop coherent explanation about how diabetics use mySugr logbook app in their daily lives.

7. ANALYSING THE DATA

The goal of this research is to understand how people living with diabetes use mobile health apps, precisely the mySugr logbook, in their daily lives. The procedure used in the collection of the data was an interesting experience for me as a researcher. I learned valuable lessons during the process and obtained ‘rich qualitative’ data concerning diabetes patients’ use of mobile health apps in the self-care and self-management of their condition. Choosing qualitative interviews as the research method was indeed convenient in gaining the research participants life experiences as well as their personal perspectives regarding mobile health apps such as the mySugr logbook. The data obtained revealed that each research participants’ has a unique and interesting case to analyse individually. I therefore grouped the data obtained in two different categories based upon the accounts given by the research participants. The first category I referred to as ‘diabetics: non-users of mySugr app’ and the second category as ‘diabetics: users of mySugr app.

7.1. The Case Studies

People with diabetes have blood glucose levels that are so high that the pancreas produces little or no insulin, which is the case for type1 diabetes, or the insulin the pancreas produces does not work properly, which is the case for type2 diabetes. Every cell in the body needs energy in order to live and the body gets its energy by converting the food ingested into fats and sugar called glucose. This glucose travels in the bloodstream as a component of normal blood to the body cells; the individual cells then remove some of the glucose from the blood to use as energy for their activities. The substance that allows the cells to take glucose from the blood is a protein called insulin which is produced by the pancreas. Without insulin the cells cannot get the glucose they need and the cells ‘starve’ while the glucose builds up in the bloodstream and the glucose level in the blood rises. When the blood glucose level gets very high, the body removes the glucose and calories through urine. As a result, patients may have one or more of the following signs: feeling thirsty, urinating more often than usual, feeling very hungry, losing weight without trying or wanting to, feeling more tired than usual.

The treatment of diabetes patients in general starts once the doctor confirms the presence and the type of diabetes. According to the stories of the research participants, the daily diabe-

tes therapy begins at the hospital with several activities. The patient receives all necessary information about the disease, the possible medical therapies available for the condition as well as instructions on choices that promote a healthy lifestyle. The diabetic patient learns for instance, about when and how to measure his or her blood glucose levels, the amount of carbohydrates in the meals, how to inject insulin and all other necessary routines. When the patient checks the blood glucose and sees that the glucose levels are not in the normal range, which is in general between 90-160 mg/dl, the patient needs to decide what to do to get the blood glucose back within the target range. The decision and action of the patient in that situation consist of either managing the disease with pills, as in the case of type2 diabetes, or managing the condition with self-injecting insulin, as in the case of type1 diabetes. The action taken by the diabetic patient when feeling a low level of blood sugar (Hypoglycaemia) or a high level of blood sugar (Hyperglycaemia) is what I refer as 'diabetes therapy'. In the context of this particular study, whenever I mention diabetes therapy it refers to the action taken by either the patient or the medical caregiver in order to control the disease, because the nature of diabetes in addition to its complications forces the patient to have a constant awareness of the level of glucose in the blood, therefore making a continuous monitoring of the blood glucose a necessity. Moreover, type1 diabetes patient requires self-care and self-management of the disease consisting of taking insulin, which is a hormone that the body, specifically the pancreas, produces to help convert the food eaten into energy. Insulin helps the blood sugar (glucose) to get into the body's cells and to build muscle. There are not only different types of insulin to meet each individual diabetes patient's needs, but also different ways to inject insulin as observed during the data analysis of the research participants.

In the presentation of the data obtained, I first give a general presentation of the research participant as single case studies, emphasising on how diabetes patient's self-care and self-management 'diabetes therapy' are different from each other. I also included excerpts from the interview as examples to illustrate on similar or different views on diabetes therapy. These excerpts are from the interview transcripts and are presented as the research participants explained and answered to the questions on the appointed date of the interview. As explained earlier, when I transcribed the interviews, the grammatical errors as well as incomplete sentences and unclear words pronounced by the participants were not corrected nor changed. I therefore included in the excerpts signs and symbols to describe and emphasised on specific actions taken by the research participants during the interview.

Meaning of signs and symbols in the interview excerpts:

... Saying 'hum' 'hum' or searching for particular words

--- Being silent or saying nothing

(.) Unfinished finish sentences

[...] Something was said before

7.1.1. Diabetics: non-users of mySugr app

The non-user of the mySugr app is the case of Kofi, a 37 years old professional in the automotive industry in Vienna. He was diagnosed in 1994 with Type1 Diabetes when he was 16. It was his mother who noticed the symptoms in the beginning and took him to see the doctor. After being diagnosed he was trained on how the whole human metabolism works and how a certain amount of proteins could affect his glucose level. He was also trained in guessing how much glucose certain foods contained and started his diabetes therapy.

His first diabetes treatment consisted of injecting himself with insulin twice during the day. He therefore had a precise time during the day in which he had to eat a specified quantity of food. This treatment was very limited and according to him, it was not the best treatment. He changed his treatment some years after to the diabetes therapy call 'FIT' also known as the Flexible Insulin Therapy⁴³. This therapy was better than his first therapy and it also upset him that the doctor didn't propose this particular therapy to him earlier in his treatment, although the FIT had been already in use.

After the first doctor handling him retired, he met another doctor (Dr. Schutz) who convinced him that the insulin pump was actually the best therapy available for his condition. It took him some time to decide on this new therapy, since he didn't want to wear an electronic device 24 hours long – all day. He however searched on Google to find out more about the insulin pump in order to make his decision. After trying the pump for the first time, he was comfortable with it and confirmed that the therapy is indeed the best treatment for diabetes

⁴³ Detail description of the Flexible Insulin Therapy is discussed in the section below.

patients and he is not willing to change to another therapy. He also gets new insulin pump every four years and as of the time of the interview he was on his third insulin pump. The insulin pump is a small device which is about the size of a (mini) cell phone that is either worn externally and can be discreetly clipped to a belt, slipped into a pocket, or hidden under the patient's clothes. It delivers precise doses of insulin to closely match the body continuously needs. He explained that the body cells (of diabetics) need insulin 24/7 for its normal functions; he therefore has the insulin pump on him 24 hours a day and has configured the pump to give him a very tiny amount of insulin (micro-litre) on a regular basis. Every couple of minutes the pump makes a very tiny noise and gives him a tiny amount of insulin and he is sure that in another one hour he will get the amount of insulin as he has configured.

In addition to the use of his insulin pump, he added the use of a glucose sensor which helped him reduce his rate of hypoglycaemia. The glucose sensor is a device that tracks and measures the body glucose levels all day and night. He explained that whenever he measures his blood glucose levels and observes a high glucose value it could be the result of insufficient insulin in his blood or because of too much insulin, which - if untreated - leads to a hypoglycaemia, which in turn leads to the release of glucose from muscle or liver cells. This especially challenging during the night, as a hypoglycaemia might go unnoticed; it is difficult to explain what happened the night before and this is where the sensor is convenient. The use of the sensor helped with his sleeping habits as he admitted having severe sleeping problems over fears of hypoglycaemia at night, he could now rely on the sensor when asleep to wake him up to take action if needed. He had gotten the newest model of the insulin pump and noticed that the company added a new feature called smart guard, the previous model only turned off the insulin under a certain threshold⁴⁴ with the glucose sensor levels, but the newest model turns off before the threshold occurs.

Kofi is not using the mySugr mobile health app, because he personally never heard of the app until I mentioned it while exchanging emails. He however checked the app on Google and after reading about it added that he will not use the app, because the insulin pump and the sensor allowed him to also indicate whatever he does regarding his blood sugar levels, which he types into his device; for example he described it in the excerpt bellow:

⁴⁴ Threshold in this context refers to the target range of blood sugar level.

I am now doing sport for one and half hours, and then the hospital they have a software...which will show really...wonderful graphics of.....what happen...they... will show you...the curve from the sensor...they will show you exactly...when you ate...how much...how much insulin....you injected for it... they will give you statistics... of for example...how did your blood glucose react in the hours following a meal.....and you can see...when ... when you had...I don't know...when you were doing sport or all the markers you set, graphically...(Kofi, 2015)

He also explained that after discussing with his doctor about how to keep the records of his diabetes therapy, the conclusion was reached that the logbooks he kept were no longer needed since the insulin pump automatically records and saves all the necessary data, he therefore saw no need to re-enter them into a logbook or in to a mobile health app.

7.1.2. Diabetics: users of mySugr app

For the data analysis I focused on this particular category - ‘diabetics: users of the mySugr app’. I studied three people living with diabetes using the mySugr app in the management of their condition. They shared their personal stories regarding their diagnoses of the disease as well as their experiences of the use of the app during the semi-structured interviews. The data obtained from the interviews are treated as single cases in order to understand how their diabetes therapy are similar and/or different from each other as well as regarding their self-care and self-management of the disease and their experiences of the use of the mySugr app.

Pen base insulin

The first user is the case study of Thom, a 38 year-old freelance developer and IT professional who lives in Berlin, Germany. He was diagnosed with type1 diabetes in 2012 when he went to see the doctor for his general check-up, the analysis from his blood tests showed that he had diabetes. He recalled having several symptoms suggesting he had diabetes but did not connect them to the disease, although he had common knowledge about diabetes. He then studied more about how to take care of himself by being mindful of what he was consuming and how it was affecting his body and his overall health. The condition has changed his attitude towards nutrition; it has enabled him to rearrange his diet habits around the management of the disease.

Thom explained that the diabetes therapy he uses is known as the ‘pen base insulin’, he also described what he has to do with this type of insulin therapy to stay healthy.

I have like the pen...pen...pen base insulin therapy [...] is like you have insulin pens, they look like that [he shows me a bag in which he brings out something that looks like a pen] so it looks like this... and then you have to like...before each meal...the...or...the main meals...you have to like measure... your...the glucose...the blood glucose levels and then...according to what you eat you like you inject yourself insulin...and that pretty much of it [sic]. (Thom, 2015)

The insulin pen looks like a fountain pen but is a little thicker in size. It has a disposable needle at one end with a cartridge that holds the insulin and also has a button that is used to select the insulin dose. Some pens are disposable and thrown away once the insulin is gone, while others are more ‘environmentally-friendly’ with disposable glass cartridges that are replaced when they are empty. Thom admitted feeling strangely “creepy” [sic] the first time he had to inject himself, but affirmed that the needles are really small (just 1.8cm long and about 0.25 mm thick), and he learned to inject fatty areas of his body and avoid muscles as this could cause pain. Knowing that the condition was a life-long condition, he had to adjust himself to the new regime on how much insulin he needed, what kinds of food he could eat and also how to observe the impact of various actions on his body. For example, he realized very quickly that increased heat and stress levels affected his blood sugar levels and learned the exact measures to take into regard with his insulin intake and how to adjust to the situation accordingly. While researching the disease, he discovered the mySugr Logbook app and had the app installed on his iPhone and also on his iPad to have his data always available: if one was not available the other would still have all his data accessible.

Insulin Pump

The second case study is about Stella, a 40-years-old pianist living in Vienna, Austria who is also a music teacher at the University of Munich in Germany. She was diagnosed with type1 diabetes in 2001 when she was 26 and explained feeling thirsty all the time during the summer and lost weight and was actually happy to be losing weight. She recalled having all the symptoms but did not attribute them to diabetes, because during that period, she was in Switzerland for a summer class and did not have the time to see the doctor. Nevertheless, when she returned she went to see a doctor who told her that she had too much sugar in her urine and was given some pills to take for a week, the doctor also advised her on a list of

foods to avoid and to come back for another check-up. After taking the pills as prescribed, she still felt sick and returned to the doctor who told her that the pills didn't work and sent her to the hospital. She believes she should have been sent much earlier to the hospital since her blood sugar level was 400mg\dl high and pills at that stage was not the best treatment for her condition. She also believes that the stress that accompanied the time leading up to the writing of her diploma exam and the beginning of her teaching job contributed to her condition (diabetes), because she had her diploma exam in January 2001 and received her teaching position in April of the same year.

At the hospital, several blood tests and medical examinations revealed the presence of type 1 diabetes, she was admitted for two weeks and received serums (infusions) to bring down her blood sugar level, and then started her diabetes therapy. In the beginning, she received the insulin pens for her injections and was also told about the insulin pump, but she was not comfortable with the idea of wearing a device on her body all day long and opted instead for the injections and learned how to administer it herself. She decided later, however to have the insulin pump which is known as 'Omni Pod' and consists of two devices: a pod and a personal diabetes manager which is a wireless communication device.

... it is like a pump, but is like a patch, you.....you sticks [sic] it to the ...to someplace...maybe here or maybe here [showing places where to stick it and the place where she has hers] andits full with insulin, the insulin you feel it, ja because there is a small canoe inside[sic]... is just like the pump but without this....you know the device that is attached to you...and you change it every three days....is very convenient for me... you can stay in the water for like one hour, you can swim and it does not ja....if you want you can put some more tape but it never happen to me until now that it dissolves...its ok...ja...so it's good for me...is very practical because ja...ja... you don't have to carry the injections, ... you don't have to be careful about it's hot or you know [sic]... so this is very practical for me....so this is the Omni pod [showing me her arm] (Stella, 2015)

Stella finds this particular insulin pump convenient as it allows her to not carry any injections anymore and she need not worry about the amount of insulin to have for her trips. She explained, for example, that it was a problem for her when she was traveling to Greece and many other countries, always having to find a pharmacy where she could buy insulin shots to sustain her blood sugar level. Besides her pump she also has a sugar sensor which gives her a reading about her blood glucose levels every five to ten minutes. The device also has an alarm to warn her when her glucose levels are too low or too high, which is very helpful as it

gives her the necessary time to react in preventing hypoglycaemia. In the beginning when she was diagnosed with the disease, it was a shock to her; she remembered how this condition had hit her “out of the blue” [sic] and therefore knew that she had to deal with it. She has used the mySugr Logbook app since the development of the app and has it installed on her iPhone.

Flexible Insulin Therapy

The third case study is about Perrine, a 27-year-old student from Germany, studying art history and living in Vienna who was diagnosed in January 2012 with type 1 diabetes. She discovered her predicament during winter when she was very thirsty and felt tired all the time. She thought it was because of the dry air caused by the weather. She went to her gynaecologist who checked her urine and saw the presence of sugar in her urine. He tested her blood sugar level and it stood at 480mg/dl, apparently her doctor has some other patients with diabetes. He immediately called the ambulance to send her to the hospital, but when the paramedics arrived, they assured her that there was nothing to be worried about, but her gynaecologist insisted that she could fall into a coma at any time. She became at that time very nervous and that caused her blood sugar level to rise extremely high and was sent anyway to the hospital. She explained having a very difficult experience at that particular hospital, there were no beds left and she was left with no other option than to sleep in the corridor; she was also told she had type 2 diabetes and was given some pills; and since she was not pleased with the care at that hospital, she signed a discharge form that allowed her to go home. She later asked at the WienerGebietskrankenkasse for more detailed information, which she received and was sent to another hospital.

At the second hospital, she was checked thoroughly and received the confirmation about the presence of type 1 diabetes. She was relieved and pleased with the professionalism with which she was handled, she was given insulin in very small doses to check her body's reaction till the needed amount was determined. She was also given a quick training course on how to manage her condition, the insulin injections and the required dosages, what was generally acceptable and what was not. She was also taken through several exercises where images of several foods were shown to her and she was to guess on how much carbohydrates each contained and what vegetables to eat them with. She is on an insulin treatment known as Flexible Insulin Therapy (FIT).

...so before every meal...I'm supposed to do it three hours after every meal, but... because with me the case is that the insulin takes longer to work so I have to wait actually three hours before I can correct it so that mostly then when I eat again anyway (laughing) ...because I have to eat and do the correction and one injection [...]it's called the flexible insulin therapy...it means at certain times you have to check the insulin just depending on what you do [...] well, you have the assessing insulin and I have to inject in the morning at 9Am and at night at 11PM... and that is just for (.), so this would keep the glucose levels down if I don't eat anything so that's when sometimes you have to eat nothing for a whole day so they can check if this is right and the other one is for when I eat something... that is the bolus insulin (.) and that one you inject when you eat something, so the bolus insulin works more after but not that long and the other one works like about 12 hours (Perrine, 2015)

The Flexible Insulin Therapy (FIT) allows the patient to adjust the timing and amount of insulin to meet his/her needs, as Perrine explained. FIT consists of a fast or rapid acting insulin called 'bolus insulin' and a long acting insulin called 'intensive insulin'. The intensive insulin keeps the glucose levels down around 12 hours when, for example, Perrine does not eat anything and she has to inject it twice a day (at 9am and at 11pm). When she eats something she injects the bolus insulin at the exact time she eats in order to reflect the grams of carbs that she has actually eaten. She has tried the mySugr Logbook app for about three months, has it installed on her smartphone and since then used the Pro version for two years.

7.2. Becoming a user of 'mySugr' app

The establishment of the market apps store namely Google and Apple in early 2009 has grown the market apps economy to become one of the largest and most dynamic market sectors in the world. For instance, in 2015 more than three billion downloads of mobile health apps have been estimated for Google Play Store and Apple App Store, the two main online app stores (Research2Guidance, 2014). A survey of smartphone users in the USA found that the average number of hours that adults spent per month on using apps exceeded 30 hours, and that these people used an average of 26 apps each⁴⁵. From these facts, the online app store has been and remains a 'busy' place for users to download their apps. Nevertheless, be-

⁴⁵ (Nielsen., Smartphones: So Many Apps, So Much Time.)

fore exploring how people use these modern mobile health apps, I believe that it is important to first analyse and understand how people *encounter* mobile health apps before downloading it from the online app store for their daily use. In short, my interest is in how people ‘become users’ of technology. For that reason, during the interview, the research participants (Thom, Perrine and Stella) were asked about how they discovered or heard about the mySugr Logbook app before integrating it into their daily lives and regular use. The analysis indicated that – referring to the research participants in this particular case study – some diabetes patient, Thom, Stella and Perrine, searched for the mySugr mobile health app to accomplish specific tasks and also use the app to fulfil their various needs. The mySugr logbook helps in the accomplishment of their daily diabetes therapy tasks and routines.

Search engines such as Google, social media (available as printed or online), as well as healthcare providers are examples of circumstances in which the research participants – Thom, Stella and Perrine – discovered the mySugr logbook. These elements have been observed as the non-human and human actors to explore the relationship between how people living with chronic disease use mobile health apps. I observed that the context in which people searched, learned and discovered a particular mobile health app played an important role in their decision to use the app or not.

7.2.1. Search Engines

The internet has become the primary source to which people turn to first when they need information on specific – scientific, medical, educational, etc. – topics (Horrigan, 2006). Nowadays, questions crossing one’s mind can be entered directly into Google for an immediate multiple answers. Authors such as Ken Hillis, Michael Petit, Kylie Jarrett referred this attitude to ‘the culture of search’ which is the activity of constantly searching for every fragment of information on the internet (Hilis, Petit, & Jarrett, 2013). One of the research participants - Thom, had also a similar experience as he relied on the internet as a primary source for his needs, turning to the services of Google search to find appropriate mobile health apps to help him with his daily blood glucose diary.

I’m...I’m using it since the beginning [sic]...since I don’t want to use like a paper...like a diary and the pen...and I did some research and I... I find [sic] the logbook pretty early ... and I haven’t use a pen and paper... book ... ever since...so ... I’m pretty happy with that [...] I look at Google and I just ...search by phone apps,

since I use an iPhone then I searched what kind of apps can you use and there... I think I found this one pretty quick ... I look at some other ones I think there are one from Skype founders or so... I...I forgotten [sic] but...I think one thing that kept me at this app was that I can export it in the PDF the ...there is something I need for my doctor... so it nice not only to have it for me but also to some like medical professional like...that... this piece of paper you can give them then they can have a look (Thom, 2015)

Thom in this account explained why he uses the mySugr logbook, he first justifies himself, that he is not willing to manually write his therapy details such as blood glucose as well as insulin injected with a pen on a paper, nevertheless he credits the app for allowing him to print his diabetes therapy details as data in a PDF format which is a paper containing written detail of his diabetes data of which he needs to give to his doctor. The account of Thom shows that search engines such as Google search and the advent of the iPhone are ways most people might search for answers concerning their health and also on 'becoming users of mobile health apps. Thom's account helped in understanding how diabetes patient in the same case as Thom makes decisions about the use of mobile health apps in their daily self-care and self-management of the disease.

Search engines such as Google represent a non-human actor which plays an important role in how most diabetics decide on the use of mobile health app.

7.2.2. Mobile Health App Testing

Apps are generally developed to solve specific problems or to offer services according to people's needs. I observed that many of these apps are available on the online app stores, where people can choose their apps from different categories such as lifestyle, fitness and health, sports etc., according to their specific needs. When these apps are developed, they are tested in lab environments before they are put out in the public domain. Commercial business organizations developing new products or offering new services also have their products or services tested. Product or service testing is a very dynamic marketing strategy used by many business organizations to ensure that their clients understand the product or service developed on their behalf before market distribution. The actual testing is part of the development process of these products and services. The mySugr company at its early development stage enrolled diabetes patients as volunteers in a testing group, allowing the participants to send

feedback as day-to-day messages or through regular meetings. Stella, the second research participant, was part of the mySugr testing group and talked about her experiences.

Well...I guess... I don't know exactly, but I guess... you must ask [referring me to one of the mySugr team], because, I was one of the (...).It's like that...I read something in the newspaper about this app being created in Vienna by this [sic]very young people so I guess is [sic]like 5 years I have the app, or it was in the television? I don't know, they started the call for people that will be interested to... to ...test it...and I was in the test group...in the beginning...so I wrote ...I thought ok it would be nice, because.....maybe it helps and ja...so from the beginning on...and I have it on my mobile phone...this one ... iPhone [Showing me her phone] ...because in the beginning, they didn't, it was not official, I mean we had to sign something you know.. and we were testing it and he was sending every week or every two weeks a new version, we could say what is good, what is not good, what is not working and then I don't know when they got it official... but I think in 2012...And now I bought it...because something didn't function, I had another phone and I don't know and I didn't want to both-er them, so I said now is Ok, it's 12... 20 Euro something like ... is ok ... I think I pay every year with this, I think, I am not so sure, but ja I think it this one ... (Stella, 2015).

Stella narrated how she heard about the app for the first time, pointing at the newspaper as her source of medical information and not the search engine, Google, as observed in the case of Thom. This first shows that newspapers might also be a source in which people get their medical information. Stella described her experience as being part of 'the tester group', which consisted of first signing a consent form to be part of the group, receiving updated versions of the app and sending feedback to the developers. Two interesting observations were made from Stella's account: the first regarding the type of relationship that was built between the people who participated in the tester group and the mySugr team. I observed that being part of the tester group, created a **trusting relationship** between the users and the developers of the app. Stella also mentioned receiving prompt reply from the support team whenever she writes feedback about some other issues. For instance, she didn't want to call them to fix her problem when she changed her phone when she discovered that the app didn't function properly. This particular strategy used by the mySugr company has helped the team to carefully evaluate 'prospective' user's questions and difficulties. It also solved users' technical problems and helped to integrate new features to obtain the current outcome of the mySugr logbook app. The second observation is about the process which led Stella to 'become a user' of the mySugr logbook. Different circumstances might turn people living with diabetes to

become users of mobile health app. Thom for instance, did not experience the ‘users-developers’ relationship as Stella did, nevertheless still became a user of the app through his search on Google.

Newspapers similar to Google search represent the second non-human actor, which played a role in the process of how some diabetics might decide to become users and use mySugr logbook.

7.2.3. Medical Advisor

The development of mySugr logbook concept about “*making the life of diabetes patients easier*” focuses primarily on diabetics daily practices of self-care and self-management of the disease. However, the account of one of the research participants revealed that doctors or care givers are also involved in the process of managing the disease. Perrine mentioned similar description and explained further how she became a user of mySugr logbook through her doctor.

...well my doctor at the hospital, told me about the app, he is [sic] professor and I think he is also a member of the Austrian Diabetes Association ... I think, and that's how I just heard it. I think he has some contacts with [giving me the name of one of the co-founders of the app] or something and he has just heard about the app and told me,... and because it's also easier for him ...before I had to always have to write it down on sheets of paper and I was carrying huge sheets of paper with me... First I had the sheets and then I had a little book... where you could also...like I had to calculate the average of what I'm eating [I will try to send you that paper] so for instance, he had a voucher that I could use it I think for three months for free and of course it was much more comfortable (laughing) than the other one and ... so then I just bought it [...], so now I use this... (Perrine, 2015)

Perrine learned about the app from her doctor. This account shows that mobile health apps are mediums which create a ‘*doctor-patient relationship*’, this relation between the patient and the doctor also plays a role in how diabetics’ decide on the use of mobile health apps. As a result, the team of mySugr has expanded their relationship not only to the users, but also to their respective doctors. The mySugr company has ten medical advisors coming from the USA, France, Austria, Germany and Japan; they are all members of their board meetings. I observed that the doctor-patient relationship between Perrine and her doctor helped her in the process of becoming a prospect user of mySugr logbook.

Thom and Stella individually mentioned that their daily use of mySugr logbook app is more of an assistance to their respective doctors in analysing their condition. Perrine described how uncomfortable it was for her to carry her blood glucose diary all day long. A similar problem has been observed in Thom's account regarding the writing down of details, such as blood glucose and insulin intake, on sheets of paper. Perrine's account shows reasons why people with chronic diseases might use mobile health apps in their condition.

I learned from the three case studies that human (diabetes patients, medical doctors) and non-human (search engines, mySugr logbook) actors play important roles in the process of understanding how diabetics use mySugr logbook in their daily self-care and self-management of the disease, but also on how people made their decision to become users of a particular mobile health app. Diabetics, as observed in the case of the research participants, might become users of mobile health apps depending on the context in which they first encounter the mobile health app. The context in which mySugr logbook app was presented to the research participant fostered their decision making about becoming users of mobile health apps. Madelaine Akrich (1992) stated that "*in general an individual becomes a citizen only when he or she enters into a relationship with the state*" (Akrich, 1992:215). After analysing the context in which the research participants encounter the mySugr logbook, I am adding to the statement of Akrich that an individual becomes a user – in the context of mobile health apps - only when he or she encounters the app or enters into a relationship with the technology.

7.3. Using 'mySugr' mobile health app

After analysing the three research participants' case studies, I discovered that although mobile health apps are designed to solve a generally defined problem and "participate in building heterogeneous networks", what happens with the apps once in the public domain is all in all different from the user's ways of use. I asked the research participants (Thom, Perrine and Stella) to describe how they individually use the app on a daily basis. I first discovered that the research participants faced some difficulties in describing 'how they use mySugr logbook'. They instead described how they view the app, what the app represents and means to them and explained the features of the app they actually prefer to use.

7.3.1. Used features

The mySugr logbook has two different versions of the mobile health app - the free functional logbook and the logbook Pro which is subject to a fee. The difference between the two versions of mySugr logbook is the additional functions available in the pro version of the app. The research participants – Thom, Perrine and Stella – explained having the “Logbook Pro” installed on their respective devices, which means that they have all the available features of the app and have the possibility to use the app as long as they wish without any limitation. They can for instance, take pictures of their various meals when they log in details about their food and have access to all the available tags as well as the challenges. They can detail the actions and activities taken with the available tags and also import their blood sugar levels data directly in the app without typing the value again in the app. In short, the research participants have full access to the ‘all-inclusive’ features of the mySugr logbook app. They have no limitation regarding the use of the app and their self-care and self-management of the disease. When I asked Thom about how he uses the mySugr app, he presented some details about the features of the app he actually uses and other features he had disabled.

...in the app you can track like how much you eat for the meal...and how much ...is your glucose level.... and how much insulin you will inject yourself and ---then you also have various kinds of stuffs where you can target with it is with breakfast or lunch or some...something about your mood or if you are sick and this kind of stuff...but I have to say....don't really use it for the special moods stuffs...I really just use it to track like breakfast lunch and dinner...[...] I'm mostly using it ... to ... read ... like measure your glucose levels, your blood glucose levels...that is what I really mostly use and then you have a lot of other options but I'm most of the time have them disable... (Thom, 2015)

Thom uses, for instance, the app to ‘*track what he eats, input his blood glucose level and insulin*’. He then continued by giving a sort of advice which gives the impression it might be a warning regarding the features of the app to not use, ‘*the app for the special moods*’ and features of the app to use instead. He explained that he personally uses the app ‘*to track his breakfast, lunch and dinner and to see the averages of his blood glucose levels*’. He however gave details about the features available on the mySugr app and also explained that he tried out most of the features of the app. For instance he used to take pictures of his food, but stopped because in his understanding that is a better option for people frequently on Instagram and not for his self-care and self-management of the disease.

Thom in this account demonstrated his awareness and knowledge about the available features of mySugr logbook app and showed me features he uses and others that he did not use. Thom also explained he was using the app mainly to see his weekly as well as his monthly blood glucose averages which help him to understand how his blood sugar reacts before and after he has taken his meals. These averages shown on his weekly report also help him to better measure his insulin dosage and self-care for his condition. I observed similarities in the analysis of both Perrine and Stella. Perrine also explained, similar to Thom, using the app to ‘only’ type in her glucose levels and to see the averages of her blood sugar levels.

...well in the beginning... I did a lot of the challenges and some other stuffs because I thought this really help to motivate myself...but now I just actually use it to just type in my glucose levels [...] so in the beginning when it was new it was really funny and it helps me to get to know the app, but now I’m not in to that challenges... I don’t use it that much... (Perrine, 2015)

She also explained how she first typed in her personal data as she first downloaded the app, she was asked to choose her type of diabetes, her diabetes therapy as well as her blood glucose target range. She explained using the challenges as well as other features of the app to understand and know the app better, moreover uses the app to observe how her blood glucose levels react to the daily insulin dosage she takes.

Stella also explained that there are features of the app she actually uses and others she does not use. She also demonstrated not using some features by showing me the total points she acquired for the past week on her phone screen.

... so the logging is about... see you have here plus (showing me the sign of the plus on her iPhone) and now if I have this... sensor thing [sic] (removing the sensor from a purse) and I can see, what is my sugar right now... and it’s can read 183 Ok!?! So I’m doing (she typed in the phone) this and I can say Blutdruck(German word) 183 ok so... and then its gives you this curves here (showing me the curves on the screen of the phone) where you can see all your [sic]or here you can see the ...the development and then if, maybe I say ok 183 it’s a little bit too much, I’m correcting it with maybe one unit of insulin (showing 1 with her thumb), so I type it ... yeah ... and later you can see was it good if its function or not, maybe was it too much and you got (.) which I’m not doing now because I think its falling so you know... ja and I (.) what else. I mean you can... you can put what you eat, what you drink...and here you can see all of the... symbols (showing me the symbols of the tags, a bowl, a smiley face, a spoon and a fork, snacks and drinks etc.) that is easy to breakfast or lunch and then you have the [sic] all kind of conditions you can be in, if you are stress, you are traveling, so

everything its makes an impact on the sugar...and the more you... have information about it, the better you can control... (Stella, 2015)

Stella's account showed that she uses essential features of the logbook as well as the available tags to self-care for her condition. She mentioned using the 'search option' available on the user's mobile phone to search for her past entries. For example, she explained by drinking cappuccino often, she always searched in the app the amount of carbohydrates she needs as the quantity changes according to café or restaurant. She also explained using the search options to learn about how past actions affected her blood sugar levels. These features are important for her self-care and self-management of the disease.

I discovered that, when it comes to the use of the mySugr logbook app, the users in my case study find it difficult to show and describe exactly how they use the app, they instead explained about the features they prefer to use, which are convenient and fit their individual needs. The account of each research participant helped to understand not only how diabetics use mySugr logbook in their self-care and self-management of the disease, but also helped to understand what 'kind of users' the mySugr app shaped with the company's notion of script as described by Madeleine Akrich (1992) and also helped to observe and question what users actually do with the app, regarding features they actually use the most and the features they do not use.

7.3.2. Non-used features

I discovered that the research participants talked about the use of similar features, therefore, I also asked the research participants about the use of the other available features of the mySugr app, such as the unlimited challenges. I discovered that they do not use this particular feature of the app.

... I think that I did it at the beginning ... there you can have like most challenges ... and then ... I think ... you can earn like professional time or points that you can use the app ... I think if you have the content you can use it on multiple devices [...] I think for the beginning it the (.) ... if you start with it ...or if you have difficulties like ... I mean those challenges range around that you (.)... I think measures a certain number of times and in ... in a specific time frame and I think it's a good thing if you are I will say lazy and don't measure too often ... I mean I totally can understand if you are younger and then is ... this can be really a pain not like physically in a ... in a ... in an effort way to ... to ... constant check on this ... because you want to do it ... it

is a hassle to carry around always those like ... measuring devices and all those kinds of stuffs and you just think about when you eat ... I think for younger people or so if you are lazier[sic] then those challenges... can be a good thing to ... have like ... gamification thing in to like insert in device to do it mark ... I think that is a good thing...and I think they also have the children app ... I think for children that probably a good thing because they ... for them is much harder to have this ... or do this ... on a regular basis... (Thom, 2015)

Thom explained that he does not use and participate in the challenges anymore, although he knows about these challenges. He explained that doing the challenges are not easy tasks, since the user has to carry the diabetes measurement devices all the time and this is one of the reasons why he does not participate in these challenges. He also believed that this particular feature of the app is convenient for younger users of the app and also for users who he referred to as 'lazy', who need to be reminded to check their blood glucose levels. Stella also explained that she does not use the challenges and other game services offered by the app, she again showed me the screen on her phone where I saw that her total points are zero and also that the challenges are still locked and have never been opened.

...no I'm not into the challenges... not at all no (shaking her head to the right and to the left and laughing) ... no, no with the points I mean I see this points I don't puff (she made the sound as if she was exhausted) I no it's (... I mean like here you see (showing me the phone) I have zero point today (laughing) ... n, no, no, but it doesn't, no its not mine ... like with the games and stuffs like that, no, no, no, (laughing) and ja exactly it's possible to disable them ... I enter what I think is more important, like ja, what I eat, what I injected ... (Stella, 2015).

... There are different types of challenges, sometimes there are about [sic]that you have to ... try to stay below some ... average for a day or longer or is it that you type something in certain amount of time within a certain period ... and they have like funny names to do with ... the monsters ... the one where you have to measure your glucose levels I think seven times a day at least and some name with vampires (she started smiling) ... so in the beginning when it was new it was really funny (she started laughing) and it helps me to get to know the app, but now I'm not in to that... I don't use it that much... (Perrine, 2015)

Perrine explained what the challenges are about and what the user has to do. Her account shows that she is aware of what the challenges are and used it previously. However, this feature of the app plays no specific or important role in the use of the other features of the app as well as her self-care and self-management of the disease.

The research participants – Stella, Thom and Perrine – have similar views and ways of using the app regarding their participation in the challenges. They are all not taking part in the challenges for the same reason: they do not find the use or importance of it in the self-care and self-management of the disease. The key observation is that in these cases diabetes patients might use mobile health apps according to their preferences and needs. They acquired necessary knowledge about what the functions of the app are and decide to use what is relevant to their condition. Another observation is that the research participants have the option to choose how they want to use the app. For that reason I came up with the idea of *users' as customizer* which I defined as users choosing and modifying mobile health apps features according to their personal preferences or needs.

7.3.3. *The “Weekly Reports”*

I acquired better understanding and detailed meanings of the notion of *‘the weekly report’*, which is one of the features offered by the mySugr logbook app. The report symbolizes a personalized analysis or assessment of the overall diabetes management of the user for the last seven days, the past two weeks and the last three months. The mySugr logbook has interesting ways of rewarding the users who enter more detailed data into the app than others. The app analyses all data entered by the user, organises the data by week and provides a summary, a report, which gives an overview of the users’ diabetes management for each week. This particular feature of the app helps users to compare their data to different past weeks.⁴⁶

... in case you don't make any entry for the next days, it does not affect your past data, you see for example I haven't type anything in here so it's just blank (showing me her phone), but it will still give you from the last 14days ... so now because I was on holidays and I was very lazy I haven't type anything for the last week but ... you could also go back and type what you did ... and of course it's more accurate if you type in immediately but I just don't ... but in the beginning I did made a lot of entries for instance when I check my blood glucose level... but because like I have two jobs and university and sometimes in between I just eat very fast, so now I mostly do it once a day, because I think, I can remember exactly what I ate or the day before and normally I do it in the afternoon when I'm at work and I have the time ... then I type in from the last days ... (Perrine, 2015)

⁴⁶ Further details of what report is about was discussed in the analysis of the mySugr logbook app

Perrine explained that whenever the user decides to not log any data in the app for a particular day, the past data does not change. This means that the user can type in his or her data whenever he or she decides. The user can of course fake all his or her logged data, however in an interview, one of the co-founder of the mySugr company explained that they developed the app in such ways to allow the users to be responsible for their own actions regarding their self-care and self-management of the disease. Perrine also acknowledged that it is ‘accurate to log in the data immediately in the app’ when taking actions towards the disease, however the cases are different according to the occupations or the type of work the users may have. Perrine for instance explained that due to her two jobs as well as her study at the university, she only logs into the app once a day. Stella explained that she logs a lot of data sometimes and other times not so much, due to the fact that she travels a lot and also forgets sometimes. Thom explained that he logs in his data whenever he checks his blood glucose levels, which in general is before each meal, therefore three times a day. However he added that the ideal amount of time to log in data should be around six or more times, whenever the user measures his or her blood sugar levels.

I observed that the services of the reports offered by the mySugr app are an important component of the app. This weekly reports affect the user’s self-care management of the disease. For instance, when the users record their daily diabetes routines, such as blood glucose levels, insulin dosage injected etc., and detail their tasks with the help of the tags, they obtain at the end of each week the overview of their overall diabetes management for that particular week. However, whether the users of the logbook app participate in the challenges or do not participate in any challenges, the weekly reports and the analysis are not affected. This explains why my research participants do not participate in these challenges, since they can anyway obtained the weekly overview of their diabetes management. These observations helped me understand that the users in this case study do take into account most of the features available on the mySugr app and others do not.

... well here you see the...what is the English word for VIAT?, here you see your glucose levels and then the next one (showing me the values on her phone) ... yes so that will be my glucose level at 8 AM on Saturday the 22 and then I have breakfast...I eat 3 bread units and I injected 6 for the insulin, so yeah that is what you can see then ...normally up here you will see your average ...how much it went up and down from the average how much you ate...on the day or on the week and how much bread units and how much you injected for it...also you can have here if you do any sports or

something that can brings[sic]down the glucose levels ...yeah and then here is the monster up there and depending on how your blood sugar levels are its smiles or frown... (Perrine, 2015)

Perrine explained here, that she uses the features of the logbook (tags, insulin injected as well as the averages of the blood glucose levels) to the management of the disease. For instance, she connects the changing colours as well as the reactive moods of her diabetes monster to her averages of blood sugar, displayed as graphs on the screen of her phone. Thom and Stella explained that they use and like the app for the fact that they can see their blood sugar averages and also that they can export and import their weekly reports to their respective doctor. However they did not mention anything regarding their diabetes monsters.

... I mean, I use it [referring to the app]... it's also personally but when I go to the doctor office they want to have like the last 2 or 3 weeks of data and ... then I just ask... there is an option on the app where you can export like a PDF version and that is what I'm also using ...so I export the PDF version and just print it out and put it on the doctor desk [sic] front desk they just scan it and then the doctor can have a look and see how you are doing [sic] fine or not...(Thom, 2015)

Thom explained that his doctor requires the data to see his progress regarding his diabetes therapy, which is another reason he uses the app to export his data as a PDF format. This account shows that the feature of the weekly report is important to Thom. Perrine also mentioned using the app to avoid carrying the 'huge papers' on which she needed to write and calculate her blood glucose averages, she also mentioned that using the app is not for her advantage alone but makes her visits to the doctor 'shorter' and it is 'easier' for the doctor to see her progress when it comes to the calculation of her HbA1c⁴⁷, which help the doctor view her condition on a weekly or monthly scale.

⁴⁷ HbA1c is also referred to as hemoglobin A1C or simply A1C. The term HbA1c refers to glycated hemoglobin, which develops when hemoglobin, a protein within red blood cells carries oxygen throughout the body and joins with glucose in the blood to become 'glycated'. The measurement of HbA1c enables doctors to get an overall picture of what the average blood sugar levels have been over a period of either weeks or months.

7.4. User's Views and Concerns

The use of mobile health apps and other medical related devices used in the intention of lay people has drawn the attention of medical advisors and practitioners as well as many scholars in the field of medical and public health. However, there is little research on lay people's concerns and how they perceive their use of mobile health apps. I therefore asked the research participants about their views and concerns' regarding their overall use of the mySugr logbook app.

I think ... yeah I made one payment and I am using the professional account or something like that, I mean ... I'm still a bit ... unsure how ... the guys made their money? With those [sic]...with the one payment idea ... but (.) And I will also ... I will clearly pay like a monthly amounts [sic] ... in a small amount to use it because I use it every day, multiple times and its makes my life with this condition ... pretty good so ... although ... is like ... I will say an existential part of how I deal with that... (Thom, 2015)

Thom showed some concerns regarding the payment system established by the company; he wanted to understand the reason of making only 'one payment' to use the logbook Pro on a daily basis. He explained that paying a monthly fee for the daily use of the app will not affect him, since the app plays an important role in the overall management of his condition. He could therefore not understand the reason why the company established a 'one payment' system for such an app. Stella explained paying between € 12 and € 20 for using the logbook Pro, I realised that she was not sure of the payment system. Perrine on the other hand explained paying € 17 for using the logbook Pro and added that she made a 'one-time payment'. However, Perrine and Stella did not show or mention their concerns regarding the payment system of the company. All of them seemed comfortable with the cost of the mySugr logbook Pro.

I discovered that since the company is actually at its early development stage, they are constantly developing the payment system of the app. However, while I interviewed the mySugr company, one of the co-founders explained that the company experienced several changes regarding the payment system of the app. For instance, in 2012, the users of the mySugr logbook Pro which was known and referred back then as "Companion Pro" gained access to the app through what the company called a "one-time in-app purchase" which means that the users pay only once to use the app as long as they wanted to. In the late 2014, the company decided that the mySugr logbook Pro is now subject to a fee of € 3 per month or

€30 per year and includes extended features which allow users to control their daily diabetes management. The users also have the possibility to use the logbook Pro according to their needs and pay only for these needs.

7.4.1. On Data Privacy

The mySugr company provided information regarding their terms and privacy policy as well as the terms and conditions of use of the app. The company provided for instance, a user's logbook manual which is available on the websites platform and on the mobile phone of the users. The users can also write to the support team or to the help centre of the company whenever they face any issues including technical issues regarding the use of the app. The company explained how they adhere to regulatory bodies such as the European Medicines Agency (EMA) in the European Union and the Food and Drug Administration (FDA) in the United States regarding the issue of data privacy. The company explained that their products as well as their services are certified with these regulatory bodies. The company added that the user's data is stored on their Amazon sourced servers databases. The company also stated that users' personal information is anonymised when used for scientific purposes and pledged to 'never transfer the personal health-related data of its users and to be responsible for the user's data security.

The mySugr company showed growing concerns about user's data privacy and after reviewing the terms and privacy policy of the company, I understood the reason why it took the co-founder so long to provide the contact details of the users to participate in the research interviews. However, as I mentioned earlier there is also little research on lay people's concerns and views regarding data privacy. I therefore asked the research participants about their views regarding the data they log in the logbook app on a daily basis and their concerns on how their data is stored and secured.

ja this is a big question because you know ... as I told you, I am a little bit sceptical about all of this... too much information in the net and Facebook and everybody is sharing their personal things ...this is not (...)...but somehow because I know Fredrik (referring to one of the co-founders of the company) and because I know how the work and I...somehow I have the trust that ... I mean you never know but I know they certainly wouldn't share this data, but I mean ... probably if it was another app ... and you just download then you never know who this is ... probably I will be more sceptical but I was from the beginning on ... I mean I know this data is ...is in good hands

and I don't have a bad feeling about this one ja ... I mean ja of course ... I never ask how or where they store the data no but...yeah....well no ask no but I know from Fredrik they have it on the server there and ... probably the use it but its anonym ja for... for research or for I don't know ... , which ok with me you know because I think if it can help its fine, but of course it wouldn't be. I mean you know diabetes is ...how can I say, I mean many people say I don't want other people to know that they have it ja and in the beginning it was for me very... yes strange to take out the pens and to put the injections and then I thought ok if somebody ... broke his legs everybody can see it and ... is like that and I mean is like that ... (Stella, 2015)

Stella explained that she disliked the idea of a social network and the sharing of personal data online. She added that she was not on Facebook. However, since she knows the team members of the company (especially Fredrik), she developed trust in them and believed that they will not share her data. She added, that since she was in the 'app testing group' she is assured that her data is safe with the company and even if they decided to share the data it will be for research purposes which is a 'good cause' to help find a cure for the disease.

Stella's account shows on one hand that she is not aware of how and where her data is stored, although the company made that information available in the user's manual. On the other hand she raised concerns about data privacy when she discussed whether it was just 'another app' she downloaded. If it was not for the fact that she personally knows about the mySugr company and its team members, she would have paid more attention to the privacy and security of her data.

yeah, I did, because also... one mobile phone of mine was stolen and I really thought oh my God now they have all my data but then I thought in the other hand ... people who don't have diabetes they can't really use this for anything I guess --- and ... otherwise I mean I sent it per mail to my doctor --- and my mother is very worried ... oh are you sure that you want to do that? but as I said, I think no one can really can use it for anything and when you have the problem, they also, I mean the people from mySugr I think they can see but...I had some problems with my log in, that is because I'm always log in on the phone and when I lost it because it was stolen and I got a new one and then I had to put in my log in and I have forgotten it and they use a wrong one and send me another profile and I thought all my data was lost but then she told me no, that I had used my wrong email address...and they are really good, like if you write them it doesn't take them long to answer you and she was really ... helping me a lot, oh can I do anything else for you...yeah...so I think my data are safe with them [...] ...when I was there and I had the job interview, (she named one of the co-founder) told me that because they are medical, they have to, apply to so many

rules and whatever then I think it is really secure, I don't think they will sell the data...[...] I really think about my data but as I said in this case (shaking her head to say no) I think they don't ... (Perrine, 2015)

Perrine explained that losing her phone enabled her to raise more concerns on her data privacy. She described how she was anxious about having her data in the hand of 'a stranger', but was comforted that the 'stranger' having her phone may not have any idea of what her data is about since the 'stranger' may not be a diabetes patient. She explained that the mySugr company has access to view the data, since they helped her to access her account when she received a new phone. She also believed that her data is safe with them, because they are a certified medical company.

Perrine's account also shows that the mySugr company provided much transparency about users' data privacy. One of the policies applied by the mySugr company when recruiting people to work in their team is that the applicant must have diabetes knowledge or is a diabetes patient; however this depends on the type of job they offer. Perrine also explained that her experience during her job interview assured her that the company does not sell the data to a third party; her data are therefore safe within the company.

7.4.2. On the role of the app in the self-care management of diabetes

When I asked Thom about how he uses the mySugr app, he first explained that the users are to measure their blood glucose levels before having their main meals and according to the quantity they decide to eat, they inject themselves insulin and record the data in the app. This description points out to his daily diabetes therapy, which means that the individual diabetes therapy of the research participants, in which Thom uses a pen base insulin, Stella her Omni Pod (insulin pump) and Perrine the Flexible Insulin Therapy (FIT), is *independent* from their use of the mySugr logbook app. Perrine also mentioned that before taking her meals she measures her blood sugar levels, then logs in the value, the amount of food as well as the insulin injected in the app. I therefore asked the research participants about the role of the app in the actual management of their condition.

... well I'm using the app because I have to write down ... I don't know the word in English ... but I have to write all down and see because for diabetes most of the therapy is done by yourself so to say so your doctor can only give you advice but in the end its you who does the therapy[...]so the apps makes it maybe more visible for you because if you have all the right glucose levels and you know when you have to

change, but...yeah so that's how I think it helps, but other than that Its really rather independent it doesn't, for the doctor it doesn't matter that March-February I wrote down on the app so it's just more comfortable to do it with the app, because you don't have to carry around paper with you or carry around pen all the time...if you type in something wrong you can just erase it, the other one was really small everything ... And also because the app shows you the statistics I think and the graphs so its gets more visible for you and that make it more easier but on the other hand also you can like...ignore it like that...(Perrine, 2015)

Perrine explained that she is using the app to avoid carrying her diabetes diary book and using pen and papers to write. Keeping a record of diabetes therapy in a diary is necessary for diabetes patients; the recorded data helps the doctor or their medical advisor to interpret their condition in order to better manage the disease. She described that the app makes the task of writing her diabetes data 'more comfortable'; she does not need to carry the papers and pens anymore, but instead type the data in the app. She also does not need to worry about the space to write or erase her mistakes. The role of the app is to first make Perrine's daily diabetes routines 'more comfortable' and to make her overall data 'more visible' by providing her statistics as well as graphs; however the app does not play a role in her actual self-care and self-management of the disease.

The doctor is not using this (showing me her phone) but the doctor can read this one (showing me the sensor) and this one (showing me her Omni Pod on her arm) and is basically... because he has a cable and he can see ja...and its basically because probably the same, but I can help him if he says OK on this day why did you [sic]...why didn't you take so much insulin and I can look here (showing me her phone) maybe I wrote ok I was exercising which there (pointing at her sensor) you cannot and then you know ... here (showing me her phone)it gives you more details ...(Stella, 2015)

Stella explained that she helps her doctor to better understand her recorded data, especially when something is not clear to his understanding. Although the doctor has access to her data through the sensor and the insulin pump devices, he does not know about the exact actions she takes regarding her blood sugar management. As Perrine explained earlier in her account, whether the diabetes patient decides to use the app or not, he or she has the responsibility to individually self-care for his or her diabetes condition. The role of the doctor is to advise the patient on actions to take in order to improve his or her condition. The app therefore, plays the role of 'the personal assistant', helping Stella to remember various actions,

regarding her self-care and self-management of the disease. I came to the conclusion that not only Stella is involved in the use of the app, but so is her doctor.

... you have clearly a better overview how ... how ... how your ... average levels are and I think you totally see when something is going out of line ... then you see like the progr(.) ... how the progress changes over time and if you ---what I said earlier...I think the the average ... the averages that you see over all your data is... really interesting ... since when you have only... the ... the just imagine when after the paper thing then it pretty complicated to have like an average to see how ... how all is going on all your data ... (Thom, 2015)

Thom explained having a ‘better overview’ of his overall diabetes therapy (the blood sugar and insulin records) whenever he uses the logbook app. Seeing the various averages of his blood sugar levels also allows him to discipline his habits of keeping his diabetes logbook update. He also added that when he used to record his data on the paper logbook, it was difficult to see the averages of his blood sugar levels. The app plays the role of calculating and managing his averages, creating ‘discipline’ as well as ‘optimizing’ his diabetes therapy.

... I mean, I use it [referring to the app]... it's also personally but when I go to the doctor office they want to have like the last 2 or 3 weeks of data and ... then I just ask... there is an option on the app where you can export like a PDF version and that is what I'm also using ...so I export the PDF version and just print it out and put it on the doctor desk [sic] front desk they just scan it and then the doctor can have a look and see how you are doing [sic] fine or not...(Thom, 2015)

Thom, in his account of how he became a user of mySugr logbook, explained searching for an app that will allow him to avoid writing his data manually with a pen and paper. However, in this particular account, he explained that the doctor requires the data to see his progress regarding his diabetes therapy, which is the reason he needs to export his data as a PDF format. Perrine, also in her account of how she encountered mySugr logbook, mentioned using the app to avoid carrying the ‘huge papers’ on which she needed to write and calculate her blood glucose averages, she also mentioned that using the app is not for her advantage alone but for the doctor’s as well, so he can see her progress when it comes to the calculation

of her HbA1c⁴⁸, which helps the doctor to view her condition on a weekly or monthly scale. Thom and Perrine shared the idea of using the app not only for themselves, but also for their respective doctors who need to have a look at their data for a clear representation of their diabetes management.

The first point I would like to make with these examples is about the '*patient-doctor relations*' the research participants all seemed to use the app to care for themselves but also use the app on the behalf of their doctors. The second point is about the '*mixed relations*' between patient, doctor and technology in this case the app. Even though diabetes patients use mobile health apps to self-care for their condition and provide the logbook reports to their doctors, the app functioned as the medium that linked together the patient and the doctor, to have a close look into the management of the disease. The three research participants (Thom, Stella and Perrine), their respective doctors and the mobile health app) are all part of what John Law referred to the '*networks of heterogeneous materials*', which means that the construction of '*social networks*' or social relations is not only the interaction of human beings to other human beings (as observed in the case of the research users and their doctors), but the interaction of human beings with other '*materials*', which might be machines, texts, mobile health app etc. If the diabetics were not using the mySugr logbook, the patient-doctor relationship will exist nevertheless in order to have the 'social order' other materials such as the paper logbook, the pen, the huge papers and even the disease will participate in the social relation of the patient and the doctor relationship.

The networks of heterogeneous materials indeed comprise human and non-human actors that need to be similarly analysed (Law, 1992). Deborah Lupton (2013) stated that "*Digital health technologies are described as promoting communication between healthcare providers and patients, encouraging lay people to engage in preventive health activities and improving patient adherence to treatment protocols and their self-management of chronic diseases*" (Lupton, 2013:257). The mySugr logbook app plays the role of the '*mediator*', participating in the '*social relation*' of the users and the doctors. The app also plays multiple roles

⁴⁸ HbA1c is also referred to as hemoglobin A1C or simply A1C. The term HbA1c refers to glycated hemoglobin, which develops when hemoglobin, a protein within red blood cells carries oxygen throughout the body and joins with glucose in the blood to become 'glycated'. The measurement of HbA1c enables doctors to get an overall picture of what the average blood sugar levels have been over a period of either weeks or months.

as *personal assistant, calculator, analyser, manager of blood glucose averages, discipliner, educator* as well as *optimizer* of user's diabetes therapy. The mySugr logbook is promoting the 'communication' between the users and their respective doctors as well as their self-care management of the disease.

7.4.3. On the changes in the self-care management of diabetes

During routine visits, doctors require the daily data of their diabetes patients in order to review whether, for example, the patients need adjustments in their insulin doses. I learned that people living with diabetes need regular health check-ups by visiting their doctors every three to six months for various tests and exams. The research participants explained that before the use of the mySugr app, they used to write their diabetes management data on paper logbooks and carry pens and papers all the time without understanding the context of their written data. The use of mySugr logbook seemed to provide clear context (location, notes, pictures of food, the tags, etc.) with the recorded data. I therefore asked about how the use of the app changed their daily self-care management of the disease.

Well ... it helps ... it helps ... to ... be more ... conscious and to be more ... to do more, I mean when you see ok I have a highs, like very high and you see it re-e-e-d (laughing and showing me the signs on the phone) you don't feel so good, you try to I mean it's ... it has an impact on you because you ... of course you know that too if you don't write it down you know it somehow, but when you see it, black on white you know then you think ok, it cannot be like that because it since 5 days is so high you have to do something and this is I think the most important ...ja more conscious on my health I will say , ja ja ja I have to check myself, exactly ja and this of course helps, but I think also this disease helped me to go in this direction because before I was not ... not at all conscious about ...my health and if I can say that there is something good about this diabetes is this, because I learned to be careful with myself and to see, to you (.) of course you always feel it but you don't give it always meaning, ok it will go away, especially when you are young and now I take it serious and I think ok ...I have somewhere there is a limit and I have to be careful and now I try to make more you know to relax a little bit more or also with sport, I never did something like sport before and now I know it very important for the sugar ja I Mean also when you do some sport so when I go running for half an hour and then I can put it inside and I'm really proud you know because (laughing) so you know it's good ja (laughing)...(Stella, 2015)

I find Stella's opinion very interesting as she explained how the use of the app changed various aspect of her life. She described how the use of the app created awareness regarding her overall self-care management of the disease. She became more conscious regarding the ranges of her blood sugar levels. For instance, when the app displays her blood sugar levels in red she is aware that she is not in the normal target range (90 - 160 mg/dl) and therefore takes actions regarding the situation by injecting insulin or doing sport. She explained that the use of the app made her look at the graphs and the statistics more often, as well as the averages of her data to take the necessary actions regarding her condition. She also described how she learned more about the disease and how the condition enabled her to change various aspect of her daily life. For instance, she changed her eating habits, learned to relax more often and play sports. She added how happy she feels to type in the app after running which helps to keep her blood sugar levels in the normal range.

well...actually most changes I think that is like the changes have to do with what I talk to with my doctor and nothing with the app actually, it's just that its different, that the doctor has more a better overview of what I do and... It calculates more things ... so like before ... meetings with the doctor were much longer because he had to calculate himself if I didn't do it and now he just sees it and I can send it to him the day before we meet so he already has time to check it and ... It goes faster there ... but otherwise nothing that comes from the app that change the therapy so the therapy is kind of independent of the app... That's what I will say ... (Perrine, 2015)

Perrine explained that the use of the app changed her routine visits, especially the time she spends at the doctor's office. She described how convenient it is to send her data to the doctor the day before her doctor's appointment and how convenient it is for the doctor to see her blood glucose averages calculated already by the app. She described how before the use of the app, her meetings with the doctor used to take longer, since the doctor has to calculate her blood glucose averages recorded on the paper logbook. She also explained how it was difficult for her to remember the exact context in which she recorded her data and the doctor needed the details of her data to better understand and interpret her condition. The app changed her routine visits with her doctor; however, she added that the use of the app did not change her daily therapy regarding her self-care management of the disease.

... I think is like...it helps you bit to ...to focus more ... on what your...on your...what you were eating and you live more conscious...since you have to have look in what you eating and what your ingredients are and what does the ingredients do to your

body so you bit more conscious on your eating habits ...and...ja...I think ... in my age now with a bit more settled and when I was younger then is a pretty easy thing to live with... So I don't have really... some...like --- problems with...with...with the disease... really... I mean you have--the ... start...you have to do like with put in insulin and all the stuff...but when you have like---like a regular schedule of time is pretty similar every day and ...then its I think really manageable to live with that...[...] I mean (re-ferring to his changes) I did bit more exercising and.....eat bit more healthy...drink less soda and those kind of stuffs that --- and then yeah...be more actif [sic] ... (Thom, 2015)

Thom explained that the condition enabled him to become ‘more focused and conscious’ regarding his overall health. For instance, he changed his eating habits by paying attention to the ingredients he consumes. Thom described that the age at which a patient is diagnosed with diabetes plays an important role in the self-care management of the disease. He compared his age to someone younger and added that keeping ‘regular’ daily routines in caring for the condition becomes a habit; which leads to a healthy lifestyle and helps you live with the disease.

...no, no I didn't even know that there are 2 types of it you know...I didn't know, as they told me in the hospital...you have diabetes and you have it for now...you have it for ever... like I mean for your life, there are two important things you must know that...its...if you have children there is a very low possibility that they have it like 5% and if you....in your life expectation is the same as healthy people....and that was at that point that I learn ah ok ja...I mean you know ... with the with the....sometimes you know ok...I did something wrong that's why I got it, ...(Stella, 2015)

Stella recalled that her grandmother had type2 diabetes, however, explained that she had no knowledge regarding the different types of diabetes. The detailed information she received at the hospital, helped her to better understand her condition. She was relieved to learn that she is not guilty for her condition and learned about what to expect in relation to the disease and how it affects her plans of having children and learned also about how to deal with the disease.

When Perrine was first diagnosed, she also felt guilty about her condition and thought her consumption of sugar was excessive and led to her condition.

The diabetes patients I interviewed considered their condition from different perspectives which changed their ways of dealing with their condition. Although the disease is not to wish for, it has brought a few positive effects, at least in the life of the research participants. They,

for instance, learned to understand how their body systems react to the insulin they inject, how their blood sugar levels respond to certain food they consume as well as to sport and stress. They became responsible for their self-care management of the disease, taking necessary actions in eating the right ingredients, injecting the needed insulin dosages and observing the analysis of their blood glucose averages. The use of mySugr logbook app and their daily diabetes therapy enabled them to change their mind set regarding the disease and to develop skills such as diabetes knowledge, discipline, problem solving, independence, perseverance, time management etc. When the research participants used the app, they obtained immediate, useful and meaningful data with their printout reports for the doctors. The app keeps track of important information, addresses the issues of data management and helps with the discipline as well as the emotional aspects of the user's diabetes therapy.

7.4.4. On Users' New Terminology

Using tags, logging, diabetes logbook, mySugr, diabetes monster, challenges, weekly reports, averages, blood glucose or blood sugar, daily diabetes management and many others are terms used by the research participants during the research interviews. I discovered that when the research participants explained how they use the mySugr logbook app, they often used words such as 'track', 'tag', 'entries, challenges and so on. These particular words in my understanding are only familiar to users or people who have acquired some knowledge regarding the mySugr logbook app. I learned for instance, about their meanings and used these terms as well in the writing of the study. Unfortunately, I did not ask the views of the research participants regarding these terminologies. I discovered these terms while analysing the data of each research participant. As you read, I invite you to observe the words used by the research participants and think about how the concepts of mySugr logbook app generated a powerful process of learning about the diabetes and its buzzwords.

*I mean sometimes **I'm logging** a lot and sometimes not, because its depends on if I'm travelling or I just forget or something...[...] so the **logging** is about, see you have here plus [...] **I can see**, what is my sugar right now [...] I'm doing this and **I can say** (typing) Blutdruck 183 [...] it gives you **these curves** here[...] **I'm correcting** it with maybe 1 unit of insulin, so **I type** it yeah... [...] I mean you can... you **can put** what you eat, what you drink...and here you **can see all of the... symbols** that is easy to breakfast or lunch and then **you have the all kind of conditions you can be in**, if you are stress, you are traveling, so everything [...] One time **I put 2 units** and I see oh it*

*was less, it was not enough so next time I can Go back and see, and you have here **the search function** which you can see [...] cappuccino ok and its gives you all the times you have a cappuccino (showing me the results of her search) and then you can see what did I do?, how much you know, this is helpful... (Stella, 2015)*

Stella began to explain about how she uses the app by using the word ‘logging’, I interrupted to ask about the meaning of ‘logging’ as she assumed that I knew what logging means. She continued to explain using the same word but, this time showing me the screen of her phone with the display of the app functions what the word (logging) means. She continuously explained the use of the app by employing words (in bold) that were new to my understanding.

*... in the app you **can track** like how much you eat for the meal [...] you **can target** with it is with breakfast or lunch ...something about your mood or if you are sick [...]I think it also **inject** your location [...] and also it **tracks** the time [...]I mean the main features of the apps is [sic] that they **can track** like ... glucose levels...before my meals [...]it is not about the one point that **you track** is more about your progress [...]the interface from the app is pretty simple, you **can track** also like your [...]you **can have like most challenges**...and then ...I think ... you **can earn** like professional time or points [...I don't think its un-useful [sic]but it is not for me and **I am not tracking** those[...]you have clearly a better overview how [...]your **average levels** are [...] ...you **can export** like a PDF version[...] **I export** the PDF version and just print it out[...]I'm eating something then **I can just click it up**... so much stuff...when, (Thom, 2015)*

The words in bold were used by Thom to explain how he uses the mySugr app. I discovered that he possibly learned these terms from the Frequent Ask Questions (FAQS) of the logbook app, which are accessible at the support section of the app. The logbook FAQs allows users to better understand the functions of the app as well as the icons, the colours, and the symbols available. The company uses these terms to describe the steps to use for particular features of the app. One of the co-founders of the mySugr apps explained that the feedback as well as comments and questions of the users help the team to develop these FAQs as well as the user's manual book.

8. CONCLUSION

Engaging in this research study has been a very fascinating as well as a passionate learning experience. The data obtained from each research participant has been enthralling cases to investigate the use of mobile health apps in the context of diabetes patients. I learned valuable lessons from these three case studies.

The first lesson is regarding how people living with chronic disease become mobile health apps users. I discovered that there are different reasons and contexts as well as stories embedded in how a person becomes a mobile health app user. In this research studies, the diabetes patients I interviewed became users of the mySugr logbook app through *search engines* such as google, through the *medical advisor* and through *media advertisement* and in participating in *a testing app group*. Their shared stories and experiences show that people using mobile health apps become users of this app for diverse reasons and as Deborah Lupton (2014) explained in one of her articles that people engaging in self-tracking practices “*take an approach that is more specifically goal-oriented, seeking as they do to reflect on and make meaning out of the information they choose to collect and to discern patterns that will work to improve features such as their health, physical fitness, emotional wellbeing, social relationships or work productivity*” (Lupton, 2016:2). The users of this research are not only diabetes patients and mobile health apps user, but also self-trackers who have their goals, their personal decision to take responsibility for their current health condition especially in performing their daily diabetes routines, with this playing an important role in choosing to use this particular app. They decided to become users of the mySugr app to avoid writing their diabetes therapy details on the paper logbook with pens as well as to avoid carrying these papers all day long. The use of the app in turn enabled each of them to better understand their health condition as the app provided weekly reports which assist them in reflecting on their diabetes therapy. Also, by becoming mySugr apps users, each research participants joined as well as belonged henceforth to the diabetes mySugr health apps community both in Europe as well as any other country where the company has its branch and that I refer to as belonging and living in digital health society.

The second lesson is regarding the user’s preference and choice of mySugr logbook features: the script choice. I learned that there are on one hand features such as blood glucose averages, the logbook weekly reports and analysis, which are important to users, and on the

other hand features such as the challenges for instance, which are not important to the self-care management of the disease. The users I interviewed did not engage in the challenges as well as games provided by the developers of the mySugr logbook app. Although technological innovations contain *scripts* and the users in turn modify the inscribed *scripts* as Madeleine Akrich (1992) explained, I observed that these users had the possibility to *choose* the scripts that are appropriate or fit to their needs, as discussed earlier in the analysis of the data, the users were aware of what the challenges represent however did not engage in any of the challenges. The developers of mySugr logbook app have inscribed various *scripts* into the app and each feature I believe significant, however the developers did not *enforce* their scripts unto the users. Users have the possibility to choose features which are important to them and still obtained their diabetes therapy weekly reports as well as analysis. Belonging to a digital health society and using mobile health technologies might indicate that users also have the opportunity to choose the scripts of the designers, some might have features they might prefer to use and other features that they might not and still benefit from the outcome of the app.

The third lesson is that there are mixed relations between users and technologies. In this research study, the mixed relationships observed consisted of the users, the care givers (doctors) and various technologies (mobile health apps, sensor etc.). The relationship between the diabetes patients – users of the app – and their respective doctors does not include only humans, but also non-human actors as well; and as professor Mike Michael (2000) explained the social relations of humans are not shaped or formed only because people interact with other humans, but rather because people interact with non-human actors such as objects, papers, money, machines, etc. Approaching the research and bearing in mind that Actor network Theory demonstrated that the sociotechnical or material semiotic approach to user-technology relations involve humans as well as non-human actors. This user-technology relations as observed in this research added insight on the “*creative capacity of users to shape technological development in all phases of technological innovation*” (Oudshoorn & Pinch, 2003:16). I believe the data obtained from these cases helped in understanding how users of mobile health apps matter, especially in the field of Science Technology Studies.

The fourth lesson is regarding the concerns of the immense emergence of mobile health apps in the healthcare systems, which are not only the concerns of the developers, investors, medical advisors and scholars in various fields, but also the concerns of the users of these apps. The data obtained, revealed that the research participants paid significant attention to

the privacy of their data. They were concerned about how their personal information, as well as the data provided in the app, are used and stored by the company. They also revealed that their data is in safe hands and they (individually) trust the developers because of their personal experiences and acquaintances with one team member or another of the company. However, the extent to which their personal medical data is collected by the app remained open for further discussion. This led me to suggest that there is indeed a need for more research in the area of how mobile health apps are being approved on the market app store such as Apple app store and Google play store as well as how health apps or medical apps are being categorized on these market app stores. There is also a need for research on the ethical procedures that exist in the notified bodies such as the FDA in the USA or the notified body in European countries when regulating mobile health apps and taking their decisions regarding which apps belong to the health categorization or not.

The Fifth lesson is regarding the buzzwords generated by the mySugr logbook app and the immediate use of these buzzwords by the research participants. Their daily use and interaction with the mySugr logbook app influenced their ways of expressing themselves. The users I interviewed, employed words and vocabulary commonly used by people belonging to the diabetes health apps society and using the products and services of the mySugr logbook app. I believe it will be interesting to explore users who are also participating in the challenges offered by the mySugr logbook app to discover for example whether such users might use other terminologies or whether these challenges affect their self-care management of their condition. I discovered that these challenges are played only by about 15% of the users of the mySugr app. Exploring users participating in these challenges will add more knowledge on the concept of gamification as well as how mobile health apps users engage in self-tracking practices via health apps and game apps.

Finally, engaging in this research study allowed me to understand that the use of digital health technology consists of not only patients but non-patients as well. Also, focusing on patients users of mobile health apps has showed that some patient as observed in the Kofi 's case might not use mobile health apps in the self-care management of their health condition however still use other mobile health technologies. For that reason, I came up with the idea of *digital health society* to refer to individuals (patients or non-patients) as well as communities accessing the internet for medical or health information and using any health technologies to monitor, track and observe their health closely. This idea partially follows Debo-

rah Lupton's (2013) concept of the 'digitally engaged patient', which "*position lay people as ready and willing to actively engage in their own healthcare and promote their own health*" (Lupton, 2013:266). This concept encourages patients to take up the '*new digital media technologies*' which are mobile and wearable devices and engage in self-monitoring and self-care practices.

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Appendix – Annex Documents

In the process of the data collection, I developed three different documents to gain access to the research field: a research participant information sheet, an informed consent sheet and an interview guideline –I needed to inform the research participants about the research study, as well as the procedure of the interview. I spoke of, for example, what they can expect during the interview. I needed a document that would guide me to ask informative and relevant questions during the interview and I needed to also think about the ethical principles of conducting scientific research and respect the scientific research practices, since I was acquiring research participants' private health information.

Participant information sheet: This document was prepared in order to explain the purpose of the interview to the potential research participants. The document explained the format of the interview, indicating how long the interview will take and also requested permission to record the interview process. The document consisted of the title of the research study, the purpose of the research, the procedure of the interview and relevant contact information to answer any further questions that the participants might have. This document was an important approach in the research field. It ensured that the research participants had sufficient information to make informed decisions about whether to take part in the research or not.

This document was sent to each participant to read before scheduling the meetings for conducting the interview. It also allowed the participants to give *informed consent* after reading and understanding the document.

Informed consent: The informed consent is a document that repeats information – elaborated in the participant information sheet – to ensure that the key points of the research study are understood and allows the participant to agree or disagree in participating in the study with a signature. This document also consisted of the title of the study, as well as the summary of the research study. Sufficient spaces were provided for the signature, the name of the participant, as well as the name of the researcher and the date of receiving the consent.

Two copies of this document were signed by both the research participants and the researcher before conducting the interview. One copy was given to the research participant and the second copy was kept by the researcher – me.

Interview guideline: the interview guideline was developed according to the type of interview chosen (semi-structured). It is a document which follows a structure containing a list of

questions to ask the research participants during the interview. I initially developed two interview guidelines for this study. The first interview guideline was developed for the team of the mySugr app in order to have a detailed description of the company's services and products and the second interview guideline was developed for diabetes patients, who are the users of the app; however during the course of the data collection, I developed a third interview guideline for diabetes patients who are non-users of the app. The questions in the interview guideline were asked so as to acquire general information from the research participants their past and present experiences living with diabetes and the story of their use of the mobile health app in the self-care management of the disease.

The interview guidelines as well as the inform consent sheet and the participation information sheet were developed by the researcher (me). Guidance and assistance were provided by the research supervisor.

Appendix 1 – Participant information Sheets

TITLE OF THE STUDY

Diabetes Self-Management: Understanding the Impact of Technological Innovation in & on the Society

My name is_____. I am currently undertaking a piece of research for my master degree with the department of Science and Technology studies at the University of Vienna.

The purpose of the study is to understand how diabetes patients use health technology (e.g. mySugr logbook app) on a daily basis and how the practice changes the ways they deal with their condition. I am interested to listen and learn about your daily experiences as well as stories and views about the use of mobile health app and your self- care or self-management practices.

It is envisaged that findings from this study may assist diabetics all over the world to better support them in the future.

How will the study be conducted?

Participation in the research would involve you being interviewed by me. This interview would last around sixty or ninety minutes and would be audio-recorded. The interview would be held at a time and place convenient to you. I may contact you again a few weeks after the interview to request that you check my written notes of your interview to see if you agree with them. This should not take more than one hour and again you are free to decline this without any consequence.

Consent to participate

Your decision to participate is completely voluntary. You don't have to take part in this study and there will be no penalty to you if you decide not to take part. By completing and signing the attached consent form it is implied that you consent to take part in the study. You may however decide to withdraw from the study at any time.

Confidentiality

The information you give me in the interview will not be connected to your name or other identifying details. No one will have access to the (audio-recording and written notes) material obtained during the interview except me and my supervisor. Your recorded interviews and notes will be kept

in a locked and secure cabinet for a maximum period of ten years, after which time it will be destroyed. The findings of the study might be published in the department journals and education journals and presented at conferences. The published articles and conference presentations will not identify you as a participant.

Should you have any questions, please contact me at andreametonou@yahoo.fr; or if you would prefer, you may instead contact my research supervisor Prof. Dr. Maximilian Fochler at maximilian.fochler@univie.ac.at.

Should you have concerns about how the research study is being conducted and wish to speak to an independent Person please contact:

The Department of Science & Technology Studies

University of Vienna



Universitätsstraße 7

Staircase II/6th floor (NIG)

A-1010 Vienna

T: +43-1-4277-496

F: +43-1-4277-9496

Thank you very much for your interest in my research, your time is greatly appreciated.

Sincerely,

Principal researcher

Appendix 2 – Informed Consent Form

TITLE OF THE STUDY

Diabetes Self-management: Understanding the Impact of Technological Innovation in & on the Society

RESEARCH SUMMARY

The aim of this research study is to understand how you use health technology (e.g. mySugr logbook app) on a daily basis and how it changes your ways of dealing with diabetes.

By signing below, you are agreeing that: (1) you have read and understood the Participant Information Sheet, (2) questions about your participation in this study have been answered to your satisfaction and (3) you are fully taking part in this research study voluntarily (without coercion).

Participant's Name

Participant's signature

Date

Name of person obtaining consent

Signature of person obtaining consent

Abstract (English)

In our contemporary society, mobile apps have become extensively adopted by patients and non-patients as there are countless types of mobile apps that are classified in different categories on the Apple App Store and Google Play Store. This thesis examines the role of mobile health apps in everyday routine tasks of people living with chronic diseases. Mobile health apps in particular hold the promise of improving well-being, avoiding costly interventions, and broadening access to healthcare, especially in the care of people living with chronic diseases.

The role of a particular mobile health app referred to as “mySugr Logbook”, developed for assisting diabetes patients in their self-care and daily diabetes therapy has been investigated in this thesis. Literatures on the topic of health technologies and telecare technologies have been examined. Detailed focus has been on the dimensions of mobile health apps regarding how these apps are categorized in Appstores. Also the elements of gamification and the “*quantified-self*” practices have been examined. The literature section has been concluded with the notions of patients and medical knowledge.

The concept of “*heterogeneous networks*” and the concept of “*scripts*” developed from the field of Science Technology Society (STS) studies known as Actor Network Theory (ANT) have been used to think about the relations between human and non-human actors – between users and mobile health apps, between diabetes patients and “mySugr Logbook” app.

The motivation for this thesis has been grounded on two research questions. The first is *how diabetes patients use and integrate “mySugr logbook” app in their everyday routine tasks*. And the second is *which role the app plays in diabetes patients’ practices of self-care and self-treatment of the disease*. Qualitative (semi-structured) interviews have been conducted. The findings were enriching and provided answers to the research questions by describing how this health app has evolved and presenting the various features and functions of the app. How diabetes patients encountered the app and became health app users and how they integrated the app in their everyday diabetes therapy is explained. The results and the conclusions as well as future research are discussed in this thesis.

Abstract (German)

In der heutigen Gesellschaft werden mobile Applikationen intensiv von Patienten und Nichtpatienten angenommen, besonders weil es eine unzählige Anzahl von Applikationen gibt, welche unterschiedlichsten Kategorien im Apple App Store und im Google Play Store zugeordnet werden können. Diese Arbeit untersucht, welche Rolle mobile Gesundheitsapps im Alltag für jene Menschen spielen, die gelernt haben mit einer chronischen Krankheit zu leben. Mobile Gesundheitsapps halten ihr Versprechen, indem sie den Gesundheitszustand verbessern, kostenspielige Interventionen vermeiden und besonders die Achtsamkeit chronisch kranker Menschen auf ihren Gesundheitszustand lenken.

In dieser Arbeit wird die Rolle einer speziellen Gesundheitsapp untersucht. Sie heißt "mySugr Logbook" und wurde entwickelt, um Diabetikern/innen bei ihrer täglichen Therapie zu unterstützen. Hierzu wurde die vorhandene Literatur zu dem Thema Gesundheitstechnologie näher herangezogen, wo unter anderem über die ferngesteuerten Pflorgetechnologien berichtet wird, die einen Patienten / eine Patientin dazu befähigen (vor allem ältere Menschen), selbstständig ihr Leben in ihrer gewohnten Umgebung zu meistern.

Weiters wird der Fokus auf die Dimensionen von Gesundheitsapps gelegt, nach denen diese in Appstores kategorisiert werden. Zusätzlich werden die Elemente der Anwendung von Spielen und die personalisierte Selbstanwendung diskutiert.

Abgerundet wird der Literaturbereich mit der Betrachtung von Patienten und deren medizinischem Wissen. Es wird auch das Konzept von heterogenen Netzwerken sowie Anleitungen, welche in dem Bereich von STS entwickelt wurden (auch bekannt als Actor Network Theorie), vorgestellt, die Beziehung zwischen menschlichen und nichtmenschlichen Akteuren zu prüfen, d.h. zwischen Nutzern und mobilen Gesundheitsapps, speziell zwischen Diabetikern/innen und „mySugr Logbook“ App.

Diese Arbeit geht von zwei Fragestellungen aus. Zum einen stellt sich die Frage, ob Diabetiker/innen die App "mySugr Logbook" nutzen und wie sie diese in ihren Alltag integrieren. Die zweite Frage ist, welche Rolle die App im Umgang der Diabetes-Patienten mit ihrer Krankheit spielt. Hierfür wurden qualitative (halbstrukturierte) Interviews geführt. Die Ergebnisse sind aufschlussreich und liefern Antworten auf die gestellten wissenschaftlichen Fragen. Weiters wird dargestellt, wie Diabetiker/innen auf diese App aufmerksam und Benutzer eben dieser wurden und wie sie diese in ihren regulären Therapieablauf integrieren.

Darüber hinaus werden die Resultate, Schlussfolgerungen sowie Anregungen für zukünftige Forschung diskutiert.