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# Identifying success factors in mHealth for diabetes self-manage- ment

**A mixed methods study based on the updated De-  
Lone and McLean information systems success model**

Master thesis 15 HEC, course INFM10 in Information Systems

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# **Identifying success factors in mHealth for diabetes self-management: A mixed methods study based on the updated DeLone and McLean information systems success model**

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**PUBLISHER:** Department of Informatics, Lund School of Economics and Management,  
Lund University

**PRESENTED:** June, 2022

**DOCUMENT TYPE:** Master Thesis

**FORMAL EXAMINER:** Osama Mansour, PhD

**NUMBER OF PAGES:** 225

**KEY WORDS:** diabetes management, mHealth, updated DeLone and McLean information systems success model, mixed methods, information system

**ABSTRACT (MAX. 200 WORDS):**

Diabetes if not managed properly may have severe health implications. Mobile applications that support its management have been developed, however, little research has examined their success. The aim of this mixed methods study is to identify success factors of such applications from the users` perspective. The research process was guided by a conceptual framework based on the updated DeLone and McLean information systems success model. Interviews were conducted on users of a specific application as the main data source, which was combined with a survey that reached users of various apps, following Farmer`s triangulation protocol. Our outcomes indicate that although the users` attitude toward the examined application was generally positive, they expressed their desire for more functions and better overall output. Additionally, our study suggests that the ability to track the results and key metrics over time have given users the possibility to better control their disease and made their life more convenient. This also constitutes the strongest incentive for using the app. Finally, the cost implications of using such applications seems to affect user satisfaction levels.

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## List of abbreviations

- BMI Body Mass Index
- CEE Central Eastern Europe
- CET Central European Time
- DSM Diabetes Self-Management
- ECIS European Conference on Information Systems
- eHealth electronic Health
- EHR Electronic Health Records
- ENHTA European Network for Health Technology Assessment
- EU European Union
- GDPR General Data Protection Regulation
- Health-tech Health technologies
- HIPAA Health Insurance Portability and Accountability Act
- HIV Human Immunodeficiency Virus
- ICIS International Conference on Information Systems
- IS Information Systems
- IT Information Technology
- KPI Key Performance Indicator
- MDD Medical Device Directive
- mHealth mobile Health
- MSK Musculoskeletal conditions
- TAM Technology Acceptance Model
- US United States
- WHO World Health Organization

# 1 Introduction

In the introduction, the background of the study is presented. Then, the problem is identified, as well as the purpose of the research. Finally, the research question is defined, along with some delimitations that are involved.

## 1.1 Background

Diabetes, otherwise known as diabetes mellitus, is a group of metabolic diseases which result from defects in insulin action, insulin secretion, or even both (American Diabetes Association, 2014). Their common characteristic is hyperglycaemia and if not managed properly may cause severe damage on various organs, such as the eyes, kidneys, or heart (American Diabetes Association, 2014). Noncommunicable diseases such as cancer and diabetes are responsible for 74% of deaths globally (WHO, 2022) and according to two studies done by Danaei et al. (2011) and Saeedi et al. (2019), just under half a billion people live with diabetes. With the rising number of people that live with this chronic disease (Danaei et al., 2011; Saeedi et al., 2019) it has become vital to find ways to improve diabetic care so as to mitigate its health and economic burden (Atkinson, Eisenbarth & Michels, 2014). Studies have clearly demonstrated that self-monitoring of blood glucose levels improves long-term health conditions, regardless of the type of diabetes (Barnard, Young & Waugh, 2010; Karter et al., 2001; Towfigh et al., 2008).

This is the area where the contribution of the Information Systems (IS) field is noticeable. Information systems for managing chronic disease symptoms have emerged as recently as 2010 and are experiencing rapid growth (Agarwal et al., 2021). Studies within the field have displayed this growth in electronic health (eHealth) that aids diabetics with the management of their disease, with mobile technologies being in the forefront (Costa et al., 2009; Lyles et al., 2011; Schnall et al., 2016). Mobile health applications or otherwise known as mHealth apps have impacted the digitalization of healthcare services, mainly due to the ubiquity of mobile phones (Ali, Chew & Yap, 2016; Bhavnani, Narula & Sengupta, 2016; Birkhoff & Moriarty, 2020; Gimpel et al., 2021; Messner et al., 2019; Stoyanov et al., 2015; Xu & Liu, 2015). The term mHealth is defined by the WHO (World Health Organization) as the “spread of mobile technologies as well as advancements in their innovative application to address health priorities” (WHO, 2011, p.2).

Even though mobile applications that assist with chronic disease management relatively new (Agarwal et al., 2021; Cafazzo & Seto, 2016), their utilization promises great benefits in self-management of diabetes, including user empowerment and better health conditions (Huang et al., 2015; Lyles et al., 2011; Wickramasinghe, 2019; Zapata et al., 2015). When referring to the self-management of diabetes through mHealth applications typically the features include the self-monitoring of blood glucose, blood pressure, body weight, diet, activity, as well as insulin and medication intake (Chomutare et al., 2011).

## 1.2 Problem

The overall praxis of information systems and technology in healthcare also called health-tech draws increasing attention from different stakeholders which parallelly enhances investments and development in that sector (Black et al., 2011; Campanella et al., 2021). To dignify the market, Statista (2020) indicates that the global mHealth valuation might increase to 332.7 billion US dollars as of 2025 in comparison to 71.6 billion US dollars in 2020. Additionally, during the 2020 COVID-19 outbreak, an increase of 65% related to medical apps downloads was observed worldwide (Statista, 2020). That trend may accelerate the adoption of mobile health-tech solutions which affects each field independently of further pandemic development. The focus of the academic community has also increased towards mHealth (Agarwal et al., 2021; Chen et al., 2020; Debon et al., 2019; Ershad Sarabi et al., 2016; Fakh El Khoury et al., 2019; Lee et al., 2018; Mirza, Norris & Stockdale, 2008; Scott et al., 2020; Triantafyllidis et al., 2019; Wang et al., 2014; Wilhide III, Peeples & Anthony Kouyaté, 2016; Zahra, Hussain & Mohd, 2016). Two leading conferences in the IS field, ECIS and ICIS, highlight the significance of papers dealing with mHealth solutions and their impact (ECIS, 2022; ICIS, 2022).

However, despite the importance of mHealth in improving health services of diabetics (Huang et al., 2015; Lyles et al., 2011; Wickramasinghe, 2019; Zapata et al., 2015) and the increase in studies performed by researchers such as Agarwal et al. (2021), Triantafyllidis et al. (2019), and Tabor et al. (2021) who comprehensively approached the analysis of mobile health applications, a majority of those apps still need to be evaluated (Chen et al., 2020; Debon et al., 2019; Ershad Sarabi et al., 2016; Fakh El Khoury et al., 2019; Jimenez, Lum & Car, 2019). Thus, there is no clear definition of their success factors, while at the same time the positive outcomes of using the apps are more difficult to be guaranteed (Agarwal et al., 2021; Lee et al., 2018; Scott et al., 2020; Wilhide III, Peeples & Anthony Kouyaté, 2016; Zahra, Hussain & Mohd, 2016). The non-established quality (Chen et al., 2020; Debon et al., 2019; Ershad Sarabi et al., 2016; Fakh El Khoury et al., 2019; Jimenez, Lum & Car, 2019) in conjunction with the abundance of available applications in the market (Benjumea et al., 2020; Larson, 2018) makes it also challenging for users to find appropriate and trustworthy applications to manage their diabetes (Gimpel et al., 2021; Jimenez, Lum & Car, 2019; van Haasteren, Vayena & Powell, 2020).

The aforementioned facts constitute the foundation of a research problem that is emerging along with the intensive technological occupation in chronic disease management support. This generates the need to understand what defines a successful mHealth application that supports diabetes self-management to find nuances that may be overlooked (Lee, Choi, Lee & Jiang, 2018). Examining the success factors of such applications also has practical implications. For instance, the evaluation can constitute the guideline for improvements in future versions. Existing studies showed that success factors and tangible outcomes of mHealth solutions in chronic disease management are under the careful eye of researchers Triantafyllidis et al. (2019), Hamine et al. (2015) and Lee et al. (2018) who conducted systematic reviews. According to Ahn and Kang (2018), this is a highly comprehensive method to analyze and present data gathered from already conducted similar studies within the research topic.

Triantafyllidis et al. (2019) and Hamine et al. (2015) identified both positive and neutral findings which give overall mixed outcomes of feasible results while applying mobile health applications. All researchers agreed that there is a necessity for further examination of alternative ways of therapy such as mobile apps that are prominently used as complementary solutions along with standard care (Triantafyllidis et al., 2019). However, both aforementioned studies

focused on multiple chronic diseases and applications instead of one which might have a significant impact on the accrued results. On the other hand, Tabor et al. (2021) investigated a patient-centered approach and focused solely on the BOOST Thyroid App used for managing underactive thyroid symptoms, concluding with the overall beneficial impact of the technology. Similar advantages were brought by Hamine et al. (2015) and Miller, Cafazzo and Seto (2016).

The variety of presented research approaches with overall ambiguous conclusions may comprise a foundation for profound research. Additionally, the surging relevance, lack of related research, as well as practical implications involved in addressing the success of such applications makes this subject area particularly worth exploring (Bartunek, Rynes & Ireland, 2006). Therefore, further and in-depth research has to be conducted in order to assess the success factors and guide the development of mHealth based on empirical data and meaningful analysis of existing tools. If such research will be continued for different applications available on the market it may generate beneficial outcomes for users. However, without the predominant guidelines for mHealth evaluation, it might be more difficult to obtain tangible results.

### 1.3 Purpose

The research presented in this paper aims to assess the success factors of mHealth applications that are designed for diabetes self-management by encompassing users' perceptions to understand them in a more holistic way. Since neither well-grounded standards nor widely used guidelines that ensure how to properly define success factors of such applications have been developed yet (Scott et al., 2020; Zahra, Hussain & Mohd, 2016), the study was performed utilizing a conceptual framework that was based on the updated information systems success model by DeLone and McLean (2003). A mixed-methods approach was followed. The study strived to enrich the understanding of the success factors of one particularly chosen application through collected, analyzed, and interpreted interview data which was complemented with survey results. The focus was put on the interviews and the two methods were combined following the triangulation protocol proposed by Farmer et al. (2006). The research outcomes may be later utilized in the process of enhancing the existing capabilities of such applications, which was also mentioned in existing research performed in the sphere of mHealth (Agarwal et al., 2021; Tabor et al., 2021). We also recognize the potential for the findings to act as guidance for the development process of future applications. This could lead to increased benefits in the self-management of diabetes, including user empowerment and better health conditions (Huang et al., 2015; Lyles et al., 2011; Wickramasinghe, 2019; Zapata et al., 2015).

### 1.4 Research question

The research was devoted to understanding people who are users of mHealth applications for diabetes self-management in order to discover the success factors of such apps through a mixed-methods study.

As the focus is directed on the previously defined stakeholders, the following question was identified:

- What are the success factors of the mHealth application for diabetes self-management from the users' perspective?

## 1.5 Delimitations

Due to time and resource constraints, the research was not focused on the whole market or full coverage of available solutions for diabetes self-management in the context of mHealth applications. Instead, a mixed-methods approach was applied to evaluate one specific app by interviews and then make the outcomes more generalizable by conducting a survey among mHealth for diabetes management users. Because of this, our outcomes depended on the communication with both the interview and survey participants. Thus, the replicability of our study would be difficult, since taking the same approach could yield different results if we had other participants. The replicability, as well as generalizability of our study is further impacted by the geographical homogeneity of our participants (i.e., European continent). All interview participants were located in the United Kingdom, while the majority of survey participants were located in Poland and Greece. Furthermore, the final amount of collected data could also have an influence on the generalizability of the research, considering that the interviews had 5 participants, while the survey had a total of 25. Additionally, due to the full anonymity of our survey, the potential of having respondents who did not fit into the targeted group could have occurred. Thus, we consider the replicability and generalizability of our study to be limited without further research.

The focus of our research was also not on examining the technical side of mHealth apps. Instead, it was put on the users' perspectives and how they interpret value. Thus, even though we developed a conceptual framework to guide our study based on the updated DeLone and McLean information systems success model, the dimension of system quality was not examined. The dimension of service quality was also not taken into account, since it was deemed to be out of our research scope. Furthermore, considering the complexity, the research was narrowed to comprehend only participants who are users of the apps. This particular research did not consider other perspectives, such as medical professionals. That might comprise the ground for further research.

Finally, having had an opportunity to talk to the founder of the examined application we asked some more detailed questions about the company from its executive member. However, because the scope of the study was to focus solely on the users of the apps these findings were only presented without further engaging with them.

## 2 Theoretical background

The literature and theory research were conducted to frame the study in the existing academic findings regarding the IS in healthcare ecosystem. The general approach toward eHealth is presented in chapter 2.1 where some of the crucial benefits, challenges, and success factors were introduced as a foundation for a further in-depth examination of mHealth that can be found in chapter 2.2. Narrowing down the perspective, chapter 2.3 describes the purpose of mHealth for patients suffering from chronic diseases. Then the actual mHealth for diabetes self-management is presented as the theoretical frame in chapter 2.4. Afterwards, in chapter 2.5, the focus is put on the updated DeLone and McLean information systems success model. Thereafter, chapter 2.6 explores IS literature where the model has been applied in the mHealth context. In the final chapter of the theoretical background, a conceptual framework for evaluating success factors in mHealth for diabetes self-management is constructed based on the theory and context of our study. This conceptual framework is used to guide our study and design the interview guide, as well as the survey.

### 2.1 eHealth

Implementing Information Systems (IS) in healthcare led to a variety of enhancements in the sphere of routine tasks, treatment support, diagnosis, distant knowledge exchange, and many more areas (Hesse & Shneiderman, 2007). It allowed to generally improve the outcomes of medical professionals' activities yet also raised a question concerning IS benefits for individuals who are directly or indirectly influenced by the changes that are still ongoing within the medical industry (Hesse & Shneiderman, 2007). The overall concept of bringing technology to support healthcare is called eHealth (Hesse & Shneiderman, 2007). According to Oh et al. (2005), the term eHealth is found to be concentrated on the systems and services first and then followed by the interest in the actual medical professionals and patients. This interpretation is supporting the close relation of eHealth and IS. Information systems are being widely involved in providing the right capabilities to maintain the delivery of appropriate support, rather than act as a substitute to the stakeholders involved in medical operations (Oh et al., 2005). However, considering the user-first design approach, the developers are becoming increasingly aware of the requirements that have to be fulfilled while the need for further improvements is still noticeable. Hence, design toward doctor-centrism and patient-centrism with paying attention to evidence-based medicine becomes a key factor while developing any kind of system involved in diagnosis or treatment support (Hesse & Shneiderman, 2007).

Supportive mechanisms that minimize errors, and protection from omissions of any kind of aspects involved in the medical path from the initial diagnosis to the treatment supervision are some of the motivators for stakeholders to properly implement information systems (Hesse & Shneiderman, 2007). Overall, this brings another perspective of eHealth that is concentrated on the business aspects (Oh et al., 2005). One of the aims providers of electronic medical services and systems have is to generate profit, which is becoming possible by generating noticeable value that follows the implementation of eHealth (Oh et al., 2005). Additionally, the ongoing research and improvement of the assessment methods allow to present more measurable outcomes than before and identify potential flaws. Nevertheless, with the wide spectrum of applications, there is still an ongoing need for better guidelines and ways to allow new attempts to



evaluate IS performance in healthcare (Black et al., 2011; Oh et al., 2005). Moreover, apart from having the right evaluation methods for success factors, efficiency or effectiveness, and guidelines in place, it is important to further decrease the number of technologies that are implemented without generating a positive impact on healthcare practices (van Gemert-Pijnen et al., 2011). To better understand the chances given and challenges brought by eHealth, academic researchers conducted a prominent number of studies. Several of them were researched for the purpose of theoretically framing the IS present in healthcare. Early detection and prevention were identified to be the benefits of implementing eHealth (Ahern, Kreslake & Phalen, 2006; Hesse & Shneiderman, 2007; Kreps & Neuhauser, 2010). However, apart from actual systems development and integration, there is a need for the behavioral change that should be engaged in information systems and lead to improvements to the patient's disease management (Ahern, Kreslake & Phalen, 2006; Hesse & Shneiderman, 2007; Kreps & Neuhauser, 2010). Gaining trust and momentum is required to get the full advantage of the contribution of technology to the health sector (Kreps & Neuhauser, 2010). The effort to achieve it is justified because gains from eHealth adoption can directly influence the way self-monitoring, treatment adherence, or health surveillance is performed while applying electronic services (Cwiklicki et al., 2020). Adaptation and ease of use are other factors in eHealth that are determinants of the system's success (Kreps & Neuhauser, 2010). Therefore, the importance of factors such as IS skills of patients and medical professionals, their education, health condition, and consideration of the overall technology awareness are remaining vital to enhance the capabilities that eHealth brings to the market (Cwiklicki et al., 2020). Hence, there is a need for a bridge between tech-savvy designers and developers and less acquainted end-users who are looking for the best possible value of the system while the top-notch innovative form factor, for them, is placed in the latter category of priorities (Kreps & Neuhauser, 2010). Moreover, the limited capacity of the medical sector that was brought by Ahern, Kreslake, and Phalen (2006) constitutes one of the driving factors for implementing IS in healthcare. Therefore, eHealth is one of the means to tackle the ongoing need for supporting the counseling and monitoring processes so that the consistency of operations is maintained (Ahern, Kreslake & Phalen, 2006). Having the possibility to gather and analyze a greater amount of data by applying eHealth solutions is a foundation for more precise and tailored medical recommendations or interventions (Ahern, Kreslake & Phalen, 2006).

IS in healthcare can also work in favor of the clinical trials and research advancements conducted as a way to generate data sets that give more highlights and further milestones of early diagnosing and treating predominantly hardly curable diseases (Ahern, 2007; Kreps & Neuhauser, 2010). Additionally, the potential of eHealth is being noticed in the educational sector as a way to digitize crucial medical operations and thereafter design the simulations that can constitute a learning tool for students and doctors who are already working independently with real-world cases (Ahern, Kreslake & Phalen, 2006). Despite the bigger contribution of resources that are required at the start of the implementation of eHealth services, the long-term figures show that the investment regains by offering lower delivery costs while fully functioning (Ahern, Kreslake & Phalen, 2006). However, the funding struggle exists and is one of the challenges in expanding the infrastructure even further (Ahern, Kreslake & Phalen, 2006). Another challenge is concerned with the interoperability of different systems and tools that would allow the analysis and transfer of information between a variety of available means that support healthcare (Kreps & Neuhauser, 2010). The main objective of creating an interconnected infrastructure lies in assuring that crucial data is always available at the place and time when it is necessary to avoid omissions and have the details to decide about the next treatment or diagnosis paths (Kreps & Neuhauser, 2010). Interdisciplinary cooperation between different

specialists and a multi-layered approach is crucial to allow for the holistic approach in the development of eHealth, which in fact, tries to interconnect various branches (Pagliari, 2007; Ahern, 2007). Stakeholders outside of the IT (Information Technology) world should be aware of the software lifecycle to better understand interdependencies between programmers and the actual system deliverables (Pagliari, 2007). Factors that enhance eHealth success were identified by existing research and are favoring the systems that above all provide interactive communication, generate understandable and transparent output, and maintain adaptability with interoperability between different environments (Kreps & Neuhauser, 2010). Electronic health records, symptom checkers that help to identify occurrences, decision support systems, web portals, and tools supporting the communication between professionals and patients are other reasons which enlarge the dependency of healthcare on IS (Black et al., 2011; Kreps & Neuhauser, 2010).

To bring some crucial aspects of eHealth to CEE (Central Eastern Europe) Cwiklicki et al. (2020) conducted research about the conditions that must be fulfilled in order to achieve the successful implementation of eHealth at the national level. The researchers found out that workability is a deciding factor, while efficiency is important (Cwiklicki et al., 2020). However, it is not always required for the system to succeed (Cwiklicki et al., 2020). The formalized framework is applied more often than the one developed in a less regulated environment and legal form (Cwiklicki et al., 2020). Therefore, the legal aspect of the whole ecosystem is highlighted as a significant contributing factor determining the success of IS presence in healthcare (Cwiklicki et al., 2020; Hesse & Shneiderman, 2007; Kreps & Neuhauser, 2010).

## 2.2 mHealth

The increasing contribution of mobile devices in our lives enhanced the development and expansion of mobile applications in the area of health. mHealth was proved to be working in two studies mentioned by Kreps and Neuhauser (2010) where the researchers emphasized the limited capacity of in-person healthcare. That limitation can be supported by applying technology in the pre-diagnosis, treatment adherence, and support in between the clinical appointments (Kreps & Neuhauser, 2010). In some cases, such as stress-related issues, the technology was found to perform comparably well as a more casual treatment approach (Kreps & Neuhauser, 2010). This brings the motivation behind further research and development of mHealth solutions within the market (Cameron, Ramaprasad & Syn, 2017). To make it clearer Cameron, Ramaprasad, and Syn (2017) defined mHealth as the distant and personalized approach in healthcare that is able to bring tailored and targeted attitudes in diagnosis and treatment. The distant and high bandwidth connectivity provides medical professionals and patients with a capability that has never been seen before. In this particular case, the authors are focused more on the software and hardware aspects. On the other hand, Nacinovich (2011) defines mHealth as a subsection of eHealth which might be the actual and natural progression of the older concept that is brought into a mobile form factor in the setting of mHealth by allowing anywhere in the world communication with the health institutions. It starts to work as an extension of the stationary, in-person treatment which becomes obsolete as the life pace and customs are evolving (Nacinovich, 2011). Considering Nacinovich's (2011) approach, mHealth focuses more on the information and services themselves rather than the pure technology behind it. Nevertheless, the one fits all definition of mHealth is hard to be determined because of the high-paced and complex ecosystem with lots of interdependencies (Cameron, Ramaprasad & Syn, 2017). This is due to the constant evolution of systems and increasing demand. The field keeps expanding



as the global mHealth market is forecasted to grow by \$332.7 billion in 2025 from \$71.6 billion in 2020 (Statista, 2018). Therefore, mHealth developers and designers are constantly gaining increasingly more possibilities to bring their creativity to real life (Cameron, Ramaprasad & Syn, 2017). The recent and wide 5G technology implementation brought new perspectives for high-performance mHealth sensors to be implemented on a wider scale (Cameron, Ramaprasad & Syn, 2017).

mHealth has become the way to improve the medical interventions in the public sector of healthcare professionals as well (Brown et al., 2013). The fact that the growing participation of technology has brought the attention of public committees is a significant step for the overall market to be able to cover treatment for people who are not benefiting from the private sector where most innovations usually take place (Brown et al., 2013). Current applications of mobile technologies in healthcare can range from habitual change support and supervision to helping with more advanced diseases such as heart-related issues (Brown et al., 2013). However, the growing presence of mHealth has not led to an increased number of registered clinical trials taking place in the medical sector (Brown et al., 2013). It might be a sign for regulators and policymakers to prepare more guidelines and requirements for the mobile health applications to be released and approved to use by the patients (Brown et al., 2013). Currently ruling MDD, which stands for Medical Device Directive, introduced by the European Union, might be too obsolete to fit in the existing progress of the market (European Commission, 2017). Nevertheless, considering the ongoing adherence of the applications in the market and the noticeable appreciation of patients it might indicate that to a certain extent, the solutions produced seem to fulfill the needs of the end stakeholders (Brown et al., 2013). Yet, further regulations, guidelines, and more in-depth tests are necessary to provide ongoing improvements and elimination of insufficiently performing and confusing applications (Brown et al., 2013). The need for more policies in the industry of mHealth can be motivated by the researchers' findings. They indicate that some apps which require constant data input were prone to malfunctioning and causing delays with potential errors occurring while performing designated operations (Brown et al., 2013).

One of the studies performed by Lux and Kempf (2021) focused on the factors that make the startups successful in the sphere of mHealth. Depending on the angle they identified factors ranging from the financial liquidity of the company itself to the customer-oriented approach and fulfilling the real needs of the targeted market which can be determined by the specific measurements called KPIs (Key Performance Indicators) (Lux & Kempf, 2021). The unique factor of the aforementioned study is the fact that despite describing specifically new coming mobile health applications, it also focuses on the grounds of business factors such as process structures, strategy, and knowledge of the market (Lux & Kempf, 2021). Mentioned criteria may seem to be obvious, yet they are often overlooked by the medical-oriented business founders and application designers (Lux & Kempf, 2021). Therefore, bringing this point is also vital for making the mHealth overall a successful branch on the market (Lux & Kempf, 2021).

The aspect of mobile health applications is noticing a rapid growth in developing countries like Bangladesh which was described in the study by Alam et al. (2020) as an effective opportunity for local private and public healthcare. However, as compared to the previous studies, the researchers also highlighted that a significant number of mHealth projects is subject to pratfall even though the market is absorptive (Alam et al., 2020). One of the ways to examine and further understand the reasons behind the successful and unsuccessful ventures was described as a "Theory of Acceptance and Use of Technology" (Alam et al., 2020). The aforementioned theory is vital in the area of assessing the responsiveness of the market for a particular solution

(Alam et al., 2020). Therefore, it should be a part of the obligatory evaluation introduced by the policymakers (Alam et al., 2020). More about the theories and different evaluation methods can be found in the later chapter of the following research. Nevertheless, the trial-and-error approach, despite being costly and prone to errors, is in some cases the only one that can make the progress in terms of the development of mobile applications for patients. The major factor that comes as of importance is to provide safety and controlled environment for patients who are using fresh to the market technology (Alam et al., 2020). One of the existing and well-known approaches to getting new users on board is extensive marketing activities (Alam et al., 2020). These activities have been proved to convert, however, there is a tight line between thriving and defeated outcomes of the paid initiatives (Alam et al., 2020). One of the ways to make the mHealth adaptation and popularization more surefire is to engage the marketing activities and evaluation frameworks parallelly, yet it requires know-how and efforts to execute it respectively (Alam et al., 2020).

To bring more relevant applications of mobile technology for patients Zhou et al. (2019) conducted another research focused on the factors regarding mHealth usability. To name a few purposes, the digital environment was found to be performing well in terms of the health data collection, change of behavior, or increased treatment and rehabilitation adherence (Zhou et al., 2019). The invisible wingman in the form factor of the device with the right software can become a noticeable change for the users who face different medical conditions (Zhou et al., 2019). The mentioned findings can constitute a motivation behind the mHealth branch to be constantly expanded, further regulated, and to become more relevant as the healthcare requires it to be (Zhou et al., 2019). Nevertheless, there is also a dark side of the market which causes the applications to be abandoned because of reasons such as an inappropriately designed user engagement process, too high costs after the trial period, or the insufficient benefits of using the mHealth compared to the effort required to use the solution (Zhou et al., 2019).

The flexibility that comes with mobile technologies is hardly comparable with anything else (Rajak & Shaw, 2019). Therefore, nowadays, portable devices with health-supported applications can reach destinations that cannot be normally covered by medical services (Rajak & Shaw, 2019). The whole phenomenon can be viewed as the extension arm for the clinics and general practitioners followed by different kinds of specialists (Rajak & Shaw, 2019). While having the range of coverage extended the supportive aspect of mHealth can be utilized in the diagnosis and treatment processes that require continuity and cannot be marked as resolved after the visit at the stationary clinic (Rajak & Shaw, 2019). However, to attain all the benefits and aid provided by the technology, the tight connection with the existing medical systems and procedures must be nurtured and constantly conditioned in order to make the remote and widely accessible extension of healthcare possible (Rajak & Shaw, 2019). Moreover, it is vital to match the patient with the right application (Rajak & Shaw, 2019). It could be motivated by the existence of different levels of advancement, complexity, and range of functions (Rajak & Shaw, 2019).

Another compound yet crucial aspect of the technological advancement in healthcare is its interoperability (WHO, 2016). Without maintaining proper communication between software that is already widely used and adopted, the newcomers to the market, such as mHealth apps, will face troubles with integration into professional device networks (WHO, 2016). It is inevitable that if one wants to succeed in the top-notch medical market, it is necessary to provide compatibility from the start after researching the real needs and systems used within the niche (WHO, 2016). Moreover, apart from the integration with widely used systems in healthcare, the connection with users' devices such as wearables, sensors, and any other measuring kits must be

assured (WHO, 2016). After combining endpoints, systems, and device integrations, there is a possibility to maintain patient monitoring and electronic health records unification (WHO, 2016). In simple words, mobile health is then able to provide a significant value for the patients and medical professionals altogether (WHO, 2016). Cooperation between entities will also empower the emergency services such as faint detection and calling emergencies automatically. Supporting medical decisions can be made possible by the data collected via all the integrated devices which are synced with the app. mHealth is useful where casual healthcare has trouble reaching, however, it does not stop there. Mobile health can help to manage medical conditions and unexpected situations when traveling around the world while having the app connected to telehealth services and measuring devices (WHO, 2016). On top of this, it is possible to raise awareness about different diseases and conditions through an interactive learning approach in the app (WHO, 2016). The crucial success factor is balancing the way to engage people in using it with the amount of actual knowledge provided (WHO, 2016).

The growing popularity of mHealth was observed in many sectors and one of the majors is the dietetics self-managing applications (Liefers et al., 2018). The phenomenon of such apps might be behind their positive motivational and theoretical input in the users' lives (Liefers et al., 2018). They can be used as an intermediary between the dietitian during the initial and then continuous phases of the lifestyle change and maintenance. The aforementioned use case is not secluded since there are different matters with similar mechanics behind them (Liefers et al., 2018). The repetitive factor where mHealth can contribute is the continuous supervision as well as data monitoring which depending on the context can work for instance as a motivator in documenting the change and can make the progress or regress more visible (Kumar et al., 2013; Liefers et al., 2018). Additionally, one of the interesting outcomes of the research performed by Liefers et al. (2018) was the fact that there is a direct correlation between the level of attractiveness of the app and the reputation of its developer.

Yet recognizability of the application producer might be elusive as the actual traits and their craft can be acknowledged as defining factors (Kumar et al., 2013). Therefore, the quality of systems should be recognized by the predefined guidelines and experts within the field who can determine whether aspects such as personalization of interventions, interventions on-demand, tailored interface, and data collected are in place in order to deliver indispensable components of service for the patient (Kumar et al., 2013). Another noteworthy aspect is correlated with the prevention and early detection of the diseases (Kumar et al., 2013). It is said that the prevention itself can contribute as a mitigating factor for major diseases which are becoming dangerous while uncured (Kumar et al., 2013). The perspective of mHealth becoming the major stake in prevention programs is rising year by year as more awareness and counteracting programs are being funded and launched (Kumar et al., 2013). On the other hand, there are more advanced measures being designed for the purpose of the unexpected events such as natural disasters which include portable imaging and multipurpose mobile diagnosing kits interconnected with the mobile app that can then transmit the data to establish stationary centers from where the life-saving treatment can be provided (Kumar et al., 2013). The delivered information must be served in real-time as the time sensitiveness regarding the data is often the case in health-related issues (Kumar et al., 2013).

## 2.3 mHealth in chronic disease management

Mobile health technologies, thanks to their characteristics, constitute great support in chronic disease management and control (Kreps & Neuhauser, 2010). mHealth is empowering patients by enhancing self-management, allowing for frequent, yet remote controls when feedback from the leading med professionals can be provided no matter where you are (Kreps & Neuhauser, 2010). Due to the engagement of mobile devices and apps, the increased motivation for self-recording the outcomes of the day-to-day treatment and medication adherence is being observed (Kreps & Neuhauser, 2010). The accumulated data can play a role as a determinant of the effectiveness of applied treatment and maintenance of chronic disease management according to the guidance provided by the leading medical specialists (Kreps & Neuhauser, 2010). Collected information becomes helpful to spot the sensitive points of the treatment and adjust accordingly (Kreps & Neuhauser, 2010; Kumar et al., 2013). The list of chronic diseases which can be supported via the contribution of mHealth is constantly expanding as more advanced technologies are being developed (Kumar et al., 2013). The ones that are well established around the mobile applications scene can be named asthma, chronic stress, diabetes, Hashimoto, cardiovascular diseases, different chronic lung diseases, rheumatoid arthritis, irritable bowel syndrome, and MSK (musculoskeletal conditions) (Hamine et al., 2015; Kumar et al., 2013).

Bradway et al. (2017) brought the example of the ENHTA (European Network for Health Technology Assessment), which is the leading organization supporting the development of the technology in healthcare within Europe. Drawn conclusions were indicating that due to the high-paced environment the regulatory frameworks are hard to design and then maintain (Bradway et al., 2017). Therefore, the field is facing the issue of lacking standardization (Bradway et al., 2017). Nevertheless, regulators and policymakers are still remaining the ones attempting to implement the mHealth guidelines and more defined terms to follow in the development of mobile software for patients suffering from chronic medical conditions (Bradway et al., 2017). Considering the aforementioned difficulties, it is sometimes hard to determine the status of mobile health applications in terms of reliability and trust levels (Bradway et al., 2017). Therefore, medical professionals who are trying to get the most out of the available tools often get into confusion while trying to recommend the most optimal solution for the particular patient (Bradway et al., 2017). Additionally, due to the increased freedom in the sphere of what can enter the market and be used by the real patients the risk of misinformation is noticeably increased as there are providers who do not verify and care for the quality of the information being provided in their tools (Bradway et al., 2017). It spawns the risk of the user being misguided and causes some adverse results to one's health and general living conditions (Bradway et al., 2017). The issue is subject to be constantly examined and the solutions to mitigate the misinformation should remain at the forefront of the priorities of regulators (Bradway et al., 2017). From the other perspective, a dynamically changing environment is pushing developers and companies to have agile processes which allow for quick modifications in place (Bradway et al., 2017). However, there are presumptions that are indicating the bright side of the mHealth for chronic disease management and support (Bradway et al., 2017). The multilevel purpose of mobile health technologies described in the previous chapter is also applicable to patients suffering from chronic diseases (Bradway et al., 2017). It means that benefits such as continuous supervision, distant advice, real-time parameter monitoring, and many more are likewise applicable in the case being described in this chapter (Bradway et al., 2017). Moreover, the implementation of mHealth is leading to lower costs of medical support and ongoing treatment of chronic diseases which is a desirable outcome in many branches considering the need for the plentiful capacity of the medical system (Bradway et al., 2017).



In the study about the evaluation and regulation of mHealth Nouri et al. (2018) have also mentioned the vast range of mobile health technologies in chronic diseases management. The possibility to engage patients in positive behavior change and build favorable daily practices that can transform the previous interoperate afflictions into manageable conditions are significantly positive contributors for patients (Nouri et al., 2018). Moreover, the development of new habits can constitute a favorable factor considering the mitigation of daily symptoms of the disease (Nouri et al., 2018). From the perspective of medical professionals, the constant access to health records or the support of research programs are other benefits and contributing factors that are working as the motives to prioritize the use of mobile applications in their daily practice (Nouri et al., 2018). Nevertheless, both medics and users have to pay attention to whether the app is evidence-based and who is behind the content creation for it (Nouri et al., 2018). Rising awareness in terms of users, in most cases also patients, being conscious about the validity and reliability of the information provided in the digital means such as mHealth apps (Nouri et al., 2018). Having regard to the intensity of how often new applications are being released it is rather an action that should be taken by the leading organizations interconnected between different countries, such as the aforementioned European-based association (Nouri et al., 2018). The adjunctive measure would be to increase the stake of mHealth apps in clinical trials to clinically prove or decline their effectiveness and impact on the treatment with measurable outcomes (Nouri et al., 2018). It might, however, increase the barriers of entry to new players on the market (Nouri et al., 2018). Therefore, this solution needs more guidelines and perhaps disassociation from the more general and lifestyle apps, not to exclude the value-adding solutions where the entities do not have enough resources to be involved into the professional examination of their app (Nouri et al., 2018). To name more risks and potential issues that might be involved, the app publisher should be concerned about the cybersecurity risks that are spread around the digital sphere. The aspects of privacy and data protection are even more relatable since the existence of tight regulations such as GDPR (General Data Protection Regulation) in the EU countries and HIPAA (Health Insurance Portability and Accountability Act) for medical appliances specifically (Benjumea et al., 2020; Nouri et al., 2018). Being aware of all the factors, interdependencies, as well as risks the following step should be to comply with the existing laws and guidelines (Nouri et al., 2018). In terms of more unregulated territories, the best existing guidelines should be applied while developing the application for health-related matters (Nouri et al., 2018).

Another aspect of mobile health technologies is the limitation that they are bringing (Peng et al., 2016). As users and patients want an all-in-one solution, it is usually difficult to deliver such a form factor (Peng et al., 2016). Therefore, the expectations gap can be observed in some cases when the needs and coveted functionalities are not there, or they perform in a different than imagined way (Peng et al., 2016). The technology is flexible, yet often requires users to be elastic accordingly (Peng et al., 2016). However, even when trying to adapt and cover the majority of users' requirements the discrepancy of expectations is becoming additionally dependent on the age group of users which can constitute one more development challenge where the variety of stakeholders is looking to be taken care of (Peng et al., 2016).

Looking from a different perspective, the mHealth applications' recognizability issue and lack of awareness are existing and rarely spoken truths within the market (Peng et al., 2016). While having access to smartphones some people who are suffering from chronic diseases are unaware of the support that they can gain from the apps (Peng et al., 2016). Worth mentioning is the fact that not all medical professionals are aware of it as well (Peng et al., 2016). It created another field to be explored and defined in terms of the reasons behind the lack of adherence to mobile technology in certain groups (Peng et al., 2016). The mHealth app literacy might be an area

worth considering while designing social programs in the target groups composed of people suffering from chronic diseases (Peng et al., 2016). Since this particular work is focusing on people who are already using the applications, another consideration might be concentrated on the gamification incorporated in the software used to manage chronic diseases. By providing users with the enjoyable aspects of utilizing the app's features the developers decrease the chances of high user retention (Peng et al., 2016). It is, however, a difficult process and the implementation should be done after a holistic consultation with professionals from medical-related fields including psychologists (Peng et al., 2016). For instance, being able to see the progress in the app behavior improvements or the increased frequency of self-checkups should be designed in a way that will not negatively affect the patients and lead to inappropriate reactions such as decreased motivation due to the negative progress indicated via the application (Peng et al., 2016). Early detection of new changes that are the effect of some chronic diseases is vital for the mitigation of potential negative outcomes of the progression of symptoms. Moreover, continuous control and data aggregation allow for better predictions and suggestions that can be personalized for the individual patient. Appliances such as external sensors or measuring devices that are integrated with the app such as Higo Sense can measure temperature, check ears, measure breath parameters, heart rates, skin condition, and many more depending on the disease characteristic (Higo Sense, 2022; Peng et al., 2016). Thanks to the aforementioned possibilities the on-demand adaptation or intervention is more likely to happen in the required timeframe, minimizing costs and irreversible changes that might happen without taking appropriate measures (Peng et al., 2016).

In the study about the advantages and disadvantages of mHealth in chronic disease management and support, Hamine et al. (2015) brought important points regarding actual implications that technology might have on people's lives. The direct positive outcomes can be correlated with death and disability prevention which are at the core of proceeding further with other benefits (Hamine et al., 2015). The list expands and covers the pros as improved medical service delivery, and direct impact on the patients' achieved outcomes finishing with the aspect of community creation and animation (Hamine et al., 2015). Supportive networks of people suffering from chronic diseases are made thanks to registrations completed in the apps (Hamine et al., 2015). People can then be connected together and chat about their individual experiences regarding everyday life with their individual medical conditions (Hamine et al., 2015). It constitutes a factor that is uplifting and can be beneficial in terms of mutual recommendations about the products and lifestyle changes to increase quality of life (Hamine et al., 2015). Another benefit of mHealth is that patients feel they are under control and are less likely to forget about the medications or other prescribed activities (Hamine et al., 2015). Therefore, they feel less anxious about their conditions while applying the right mobile health technology (Hamine et al., 2015). Nevertheless, there are also disadvantages indicated by the researchers. These can be named as potential errors of the technology and therefore the higher rather than lower level of anxiety while considering the daily living with chronic disease (Hamine et al., 2015).

## 2.4 mHealth for diabetes self-management

The influence, benefits, and challenges of mobile health applications in diabetes self-management in most scenarios comply with the ones described in the previous chapter about mHealth in chronic diseases. However, to make the analysis of the existing impact on people with diabetes more specific, the research on articles regarding this chronic disease specifically was performed. The common ground was found in terms of the accompanying feeling of the presence

of, informally so-called wingman, being the individual overseer of the daily measured results and behaviors (Okazaki et al., 2012). The support and supervision are also perceptible for diabetes while receiving reminders about the medications and appropriate execution of advised therapy (Okazaki et al., 2012). Following the notifications and tips, if the user is aware and assured about their accuracy, they can lead to improved consistency while living with the necessity to constantly watch one's self (Okazaki et al., 2012). Especially considering the overall diet recording or daily physical activity and corresponding to the measurement results (Okazaki et al., 2012). The value of continuous supervision via ongoing control of the specific parameters is possible thanks to a wireless data transfer between measuring devices and the app (Okazaki et al., 2012). However, the information input is sometimes done manually (Okazaki et al., 2012). The general progression of the development of mHealth apps is leading towards increased automation inasmuch it was observed that the manual input of information is discouraging and usually leads to loss of engagement with the app (Okazaki et al., 2012). On the other hand, the personalization aspect, as well as the mobile diabetes monitoring functionality, are perceived as complementary benefits which are increasing the popularity and driving the further enhancements of the applications (Okazaki et al., 2012). Being able to give and receive immediate feedback in the app from a guiding medical professional that can provide on-demand communication increases the perceived security of the patients (Okazaki et al., 2012). Other factors that were determined to be crucial while considering mHealth for diabetes management are blood glucose and insulin monitoring, as well as integration with the devices that are providing the read-out of these data (Okazaki et al., 2012). Interventions performed thanks to mHealth support for patients suffering from type 2 diabetes showed a positive outcome in terms of the patients' life quality, as well as reduced cost for assistance and therefore increased accessibility for users with a lowered emphasis on their socio-economic status (Al-Blooshi et al., 2020). The researchers Al-Blooshi et al. (2020) found out that there is still a noticeable gap between the mobile health applications for diabetes and the intention for their use. The mentioned discrepancy is a subject that remains under the careful eye of researchers and app publishers who are willing to keep increasing the value that their applications aim to provide (Al-Blooshi et al., 2020). Overall, the general group of key stakeholders who in this particular case are diabetologists, diabetes themselves, and publishers of the applications are gradually increasing their involvement as the spread of the technology and its advancement is outweighing the additional effort of incorporating apps into daily life (Al-Blooshi et al., 2020).

According to Boodoo et al. (2017) 1 in 10 people are suffering from diabetes worldwide. Possible sequelae that might be a result of improperly treated diabetes are decreased quality of life over time, as well as various health implications (Boodoo et al., 2017). One of the possible complications is the occurrence of diabetic foot ulcers which is usually leading to decreased mobility of the patient (Boodoo et al., 2017). Nevertheless, once again, it was alleged that as a result of the growing mHealth contribution there is a chance of enhancing the quality of life for diabetes (Boodoo et al., 2017). However, it was also emphasized that despite a growing number of research with positive outcomes about mHealth, there is still not enough evidence about the effectiveness of the applications in terms of the interventions, especially considering the diabetic foot ulcers (Boodoo et al., 2017). It was found that the in-app education content is being appreciated by the users (Årsand et al., 2012). Moreover, the notifications containing short messages with tips and some practical advice about diabetes turned out to be simplifying one's life with chronic conditions (Årsand et al., 2012). On top of that, the researchers Årsand et al. (2012) observed a significant need for information about the disease. It was emphasized that the necessity for more knowledge was observed in particular after being diagnosed with diabetes (Årsand et al., 2012). The area of examination considered the forecasts of the future

conditions as well based on cumulative data from the certain periods (Årsand et al., 2012). The accuracy of predictions turned out to be dependable on the amount and type of data collected over time as well as the quality of the trained models which were used for predictions (Årsand et al., 2012). Therefore, the actual accuracy of the predictive algorithms might be determined to be dependent on the number of users who will be uploading their data to the app on a constant basis and thus be contributing to the training of the machine learning models (Årsand et al., 2012). To give the example, conducting a diabetes diary is one of the ways to increase the specificity of the collected data and therefore empower the personalization of the decision support system to serve it better (Årsand et al., 2012). To push the progress even further, one of the unique goals companies have is to create an algorithm-based recognition system to assess the type of food based on its picture (Årsand et al., 2012). It would additionally support diet management because knowing the macro impact of consumed food would make the whole dietetics planning significantly simpler (Årsand et al., 2012). Supplementary, growing the datasets with pictures of nourishment would add up to the data being used to train algorithms and consequently their accuracy (Årsand et al., 2012).

Considering all the benefits of mHealth for diabetes one should not forget about the security and privacy risk concerns (Maniam, Dhillon & Baghaei, 2015). This matter should be taken into account by the developers as one of the core areas while creating the actual app (Maniam, Dhillon & Baghaei, 2015). Moreover, all the users should beware of the type of software that they are using, meaning that they should verify the publisher of the application or get advice about it from a trusted and qualified source (Maniam, Dhillon & Baghaei, 2015). Another point that was brought by Maniam, Dhillon, and Baghaei (2015) touches on the aspect of the old routine versus the change necessary to start using the mHealth app. It turned out that it might be challenging especially for the ones who are not used to the wide use of the technology on a day-to-day basis (Maniam, Dhillon & Baghaei, 2015). Nevertheless, it might be unavoidable for them to face the challenge of adapting to using applications in order to accommodate for the limited access to healthcare providers, in developing countries or remote areas especially (Maniam, Dhillon & Baghaei, 2015). Technology anxiety in developing countries where people are less used to the omnipresent technology is one of the factors that need to be considered while designing the user acquisition strategies and their onboarding (Maniam, Dhillon & Baghaei, 2015). Consecutive criteria for expanding the range of mHealth applications in developing countries and remote destinations are the reduction of urgent care visits which was examined and, in some cases, proven to be efficient in the study by Laugesen and Hassanein (2010). Further motivating factors predominant in favor of the mobile health technologies pertained to the challenges in compliance with the treatment monitoring (Laugesen & Hassanein, 2010). Yet, in this particular case research data indicates the difficulties in the adoption of the procedures required for remote supervision (Laugesen & Hassanein, 2010). The benefits of taking the efforts to properly educate the patients have overbalanced the efforts and alternative costs (Laugesen & Hassanein, 2010).

The ascendancy given by the possibility to communicate worldwide via the wireless mediums gave the additional chance for online communities which provide support for diabetes and, therefore added up one more chance for mHealth to utilize the social aspects within the software as one of the features available for registered users (Hilliard et al., 2015). It was observed that having the common ground to talk and exchange experiences can work as the foundation for further engagement with other app functions (Hilliard et al., 2015). Other factors that were assigned a beneficial and significant influence on diabetes while considering the online communities for them were defined as the possibility to self-express themselves, receiving support and feeling connected, or being able to relax and engage in more humorous talks (Hilliard et al.,



2015). On the other hand, it was also found that the digital spaces might lead to more risks of misinformation which is actually happening in various cases (Hilliard et al., 2015). Therefore, despite the internet being a source of endless information, there should be a thick line with distinguishing factors which are indicating verified and reliable information (Hilliard et al., 2015). Some of the existing forums and mobile health applications managed to successfully implement such practices and policies while others have not put enough emphasis on this matter (Hilliard et al., 2015). Nevertheless, assuming informed and vigilant use of digital technologies, one should benefit from the provided conveniences (Hilliard et al., 2015).

## 2.5 The DeLone and McLean information systems success model

Measuring the success of information systems has historically been a challenging affair within the IS field (DeLone & McLean, 1992; Urbach & Müller, 2012) due to their complex nature, interdependence, and multi-dimensionality (DeLone & McLean, 2016). The task becomes even more difficult when evaluating mHealth applications for chronic disease management, since there is a diffusion of different guidelines and a lack of well-grounded ways to evaluate the quality and define success factors (Agarwal et al., 2021).

Many different frameworks and models have been developed and used for this task (Al-Blooshi et al., 2020; van Gemert-Pijnen et al., 2011). However, our scope can be limited to the human-technology interaction models, since they are user-centered (van Gemert-Pijnen et al., 2011), which is a requirement for our study that tries to identify success factors from the perspective of users. These models, as identified by van Gemert-Pijnen et al. (2011) include the technology acceptance models, such as the Technology Acceptance Model (TAM) that was proposed by Davis (1985), and the information system success models, such as the one proposed by DeLone and McLean (1992).

The TAM illustrates the driving factors of technical usage (Davis, 1985). The thought process behind the TAM is that the success of an information system is affected by its perceived usefulness and ease of use (Davis, 1985). However, the TAM is mainly being used in the early development stages of an information system, as a means to predict its potential success (Liao, Palvia & Chen, 2009; Morris & Dillon, 1997; Zheng, 2020). Thus, making this model less than optimal for our study, which aims at identifying the success factors of an existing application.

We opted to go with DeLone and McLean's updated information system success model instead (see Figure 2) for several reasons. It is among the most used and validated frameworks in the field's literature (DeLone & McLean, 2004; Heo & Han, 2003; Ojo, 2017; Petter, DeLone & McLean, 2008). Originally, the updated DeLone and McLean information systems success model was developed for the context of management information systems (DeLone & McLean, 1992). However, it has been proven to be applicable in other contexts as well, including evaluating success factors in eHealth (Chatterjee et al., 2009; Kelley et al., 2011; Korhonen & Miettinen, 2008; Maniam, Dhillon & Baghaei, 2015; Ojo, 2017; Petter & Fruhling, 2011; Sadegh et al., 2018; van der Meijden, 2003), as well as mHealth (Alam et al., 2020; Cordoba et al., 2021; Keikhosrokiani et al., 2020; Okazaki et al., 2012). Thus, it is considered highly applicable to our research topic. According to DeLone and McLean (2003), the success of an information system is affected by six different dimensions, thus making the adoption of it highly comprehensive. The model describes these dimensions and the associations between them as (DeLone & McLean, 2003):

Information quality, which refers to the semantic level and covers the characteristics of an information system's output (DeLone & McLean, 2003; Urbach & Müller, 2012). To measure this dimension of the system, the accuracy, timeliness, completeness, relevance, ease of understanding, personalization, security, as well as consistency of the output are being assessed (D'Ambra & Rice, 2001; DeLone & McLean, 2003; King & Epstein, 1983; Molla & Licker, 2001; Palmer, 2002; Srinivasan, 1985; Urbach & Müller, 2012). Additionally, studies also include currency, dynamism, and variety as part of this dimension's measures (D'Ambra & Rice, 2001; Jen & Chao, 2008; Molla & Licker, 2001; Palmer, 2002).

System quality, which refers to the technical level and how users perceive the system (DeLone & McLean, 2003; Urbach & Müller, 2012). When measuring this dimension, the focus is on the system's performance, as perceived by the users, as well as its ease of use (Urbach & Müller, 2012).

Service quality, which was added as a dimension in the updated version of the model (DeLone & McLean, 1992; DeLone & McLean, 2003). It refers to the quality of the support users of the system receive, as well as their training on how to use it (DeLone & McLean, 2003; Urbach & Müller, 2012).

Use, which refers to the way users behave when interacting with the system (DeLone & McLean, 2003). It can be measured by examining the nature of use, the use or nonuse of supporting devices or software, navigation or usage patterns, the frequency and time of use, as well as the type of usage: mandatory or voluntary; informed or uninformed; effective or ineffective (DeLone & McLean, 2003; Jen & Chao, 2008). DeLone & McLean (2003) also highlight the need for researchers to examine the extent, quality, and appropriateness of the system's use, since its functionality might not be fully used for the intended purposes. Finally, Doll & Torkzadeh (1998) mention reliability and general applicability as further measures for system use.

Intention to use, which refers to the objective users have when interacting with the system (DeLone & McLean, 2003). It is an attitude of the user, rather than a behavior (DeLone & McLean, 2003). Intention to use can be measured by examining the motivation to use the system, the intentions for future use of the system, as well as by examining the users' preference for alternative information systems (Agarwal & Prasad, 1997; DeLone & McLean, 2003; Karahanna, Straub & Chervany, 1999; Petter, DeLone & McLean, 2008; Urbach & Müller, 2012).

User satisfaction, which refers to the perceived satisfaction level of the system's users (DeLone & McLean, 2003; Urbach & Müller, 2012). It can be measured by examining the users' overall satisfaction level and attitude toward the information system, the coverage of their expectations, as well as the system's continuous usage (DeLone & McLean, 1992; DeLone & McLean, 2003; Jen & Chao, 2008; Urbach & Müller, 2012; van der Meijden, 2003).

Net benefits, which refer to the level of positive or negative impact the system has on the objective of the stakeholders (DeLone & McLean, 2003; Urbach & Müller, 2012). They are the results of the system's use (DeLone & McLean, 2003). Along with user satisfaction, net benefits are considered as the most important dimensions that affect a system's success (DeLone & McLean, 2003; Jen & Chao, 2008; Ojo, 2017; Urbach & Müller, 2012). They can be measured both on an organizational and individual basis (DeLone & McLean, 2003; Urbach & Müller, 2012). According to DeLone and McLean (2003), for each study, it should be defined what is considered a benefit, for whom, as well as what level the analysis is performed at. For the purposes of this study, net benefits are considered anything that has a direct impact on the diabetes

management of the system's user, measured on an individual basis. Net benefits can be measured by examining how users perceive the advantages and disadvantages of using the system (DeLone & McLean, 2003; Jen & Chao, 2008; Ojo, 2017). They can also be measured by examining the changes the system causes on the users' practices (Jen & Chao, 2008; Østbye et al., 1997; Sicotte et al., 1998).

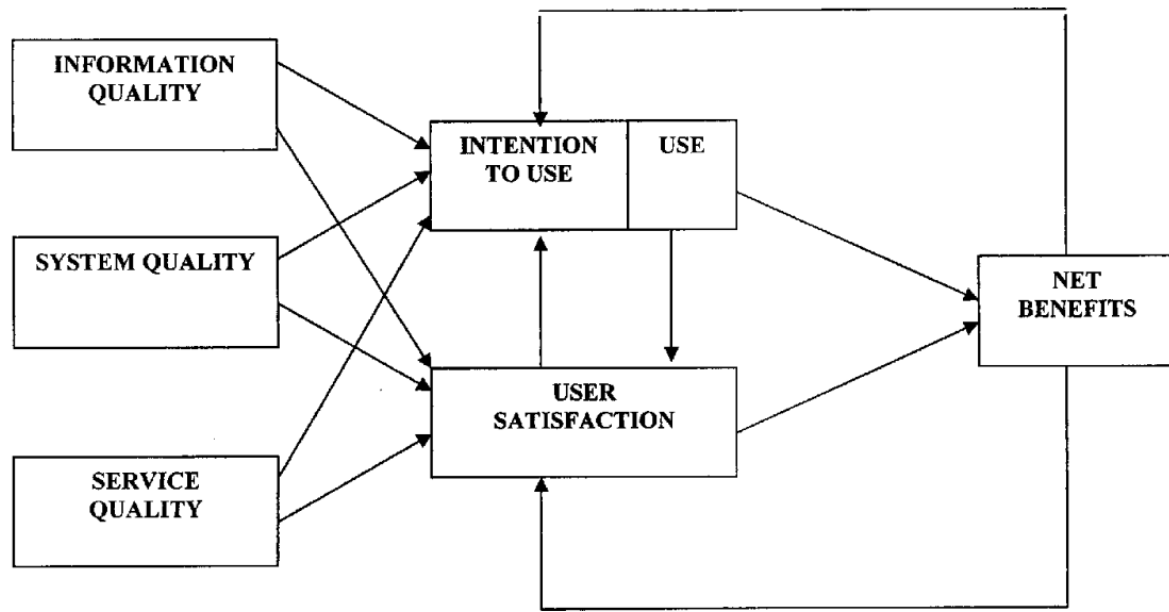


Figure 1: The updated DeLone and McLean information systems success model (DeLone & McLean, 2003, p.24)

## 2.6 The DeLone and McLean information systems success model for mHealth

The DeLone and McLean information systems success model has been used as a framework to evaluate information systems in many different contexts (DeLone & McLean, 2003), including eHealth (Chatterjee et al., 2009; Kelley et al., 2011; Korhonen & Miettinen, 2008; Maniam, Dhillon & Baghaei, 2015; Ojo, 2017; Petter & Fruhling, 2011; Sadegh et al., 2018; van der Meijden, 2003) and mHealth (Alam et al., 2020; Cordoba et al., 2021; Keikhosrokiani et al., 2020; Okazaki et al., 2012).

Petter and Fruhling (2011) with their study explored the success of an emergency response eHealth system. They used the DeLone and McLean information systems success model, which was adjusted to their case, to conduct an online survey targeting users of the eHealth system (Petter & Fruhling, 2011). The outcomes of their study indicate that overall quality has a positive effect on user satisfaction, as well as intention to use (Petter & Fruhling, 2011). Furthermore, they found that system use, intention to use, as well as user satisfaction, all positively affected the individual impact of the system on its users, which consequently also affects the system's organizational impact (Petter & Fruhling, 2011). In their final remarks, they concluded

that changes have to be introduced to success models such as DeLone and McLean's model when evaluating the success of emergency eHealth systems (Petter & Fruhling, 2011).

Ojo (2017) adopted the DeLone and McLean information systems success model in the context of hospital eHealth systems. From the conducted survey Ojo (2017) found that system use is significantly influenced by the overall quality. Furthermore, he discovered that specifically information quality also had a substantial effect on user satisfaction, while system use, in general, did not (Ojo, 2017). However, system use was found to influence the perceived net benefits of the system (Ojo, 2017). Additionally, Ojo (2017) determined that perceived net benefits were not considerably influenced by user satisfaction. In his final remarks, Ojo (2017) concluded that the DeLone and McLean information systems success model was appropriate for evaluating hospital eHealth systems.

Korhonen and Miettinen (2008) studied a Finnish eHealth system for diabetes care in order to examine its use by healthcare professionals in a natural setting. They adopted the DeLone and McLean information systems success model to identify the quality factors that affect the use of the system, as well as the user satisfaction (Korhonen & Miettinen, 2008). Their findings suggest that the eHealth system they examined had several information quality issues due to unstructured data input, lack of use training, as well as poor patient cooperation (Korhonen & Miettinen, 2008). They make a point of the importance of information quality, especially in eHealth systems (Korhonen & Miettinen, 2008).

Okazaki et al. (2012) adopted the DeLone and McLean information systems success model as a framework to conduct a survey aimed at evaluating the opinions and user acceptance of mobile diabetes monitoring systems among physicians in Japan. Their findings suggest that perceived value and net benefits were the primary motivators for using mobile diabetes monitoring, while age also had an effect as well (Okazaki et al., 2012). Even though their findings showed that overall system quality does not have an effect on the intention to use directly, it has an indirect effect through perceived value (Okazaki et al., 2012). Furthermore, they discovered that user experience, gender, as well as privacy, and security concerns do not have a major impact on intention to use (Okazaki et al., 2012).

Keikhosrokiani et al. (2020) developed a conceptual framework based on the DeLone and McLean information systems success model to assess an mHealth system that supports the management of chronic diseases such as hypertension and arrhythmia. They conducted a survey among healthcare professionals to identify human interaction factors that affect a system's success and how they are influenced by intention to use, as well as user satisfaction (Keikhosrokiani et al., 2020). They found that important success factors include ease of use, system performance, and system responsiveness (Keikhosrokiani et al., 2020). Additionally, their findings suggest that information quality, privacy, trust, and mHealth literacy have a significant impact on the system's use, while instead user satisfaction, as well as service quality parameters do not (Keikhosrokiani et al., 2020). Finally, their recommendation for designing mHealth systems for managing chronic diseases is for quality, trust, and user satisfaction to be maximized, the risk of error minimized, and safety optimized (Keikhosrokiani et al., 2020).

Cordoba et al. (2021) conducted a qualitative study using semi-structured interviews to assess the perceived quality and impact of an mHealth application for HIV (Human Immunodeficiency Virus) prevention. Their findings were analyzed by adopting the DeLone and McLean information systems success model as a framework (Cordoba et al., 2021). They discovered that the

app's information was to the point, useful, relevant, and could be easily interpreted by the users (Cordoba et al., 2021). Apart from high information quality, user satisfaction was found to be decent as well, however, the intentions of future use were low due to insufficient app features (Cordoba et al., 2021). The overall perceived quality of the app was high because of factors such as personalization and user-friendliness (Cordoba et al., 2021). Furthermore, they reported that there were no major issues concerning service quality (Cordoba et al., 2021). Finally, they identified several net benefits for the users of the application, including improved decision making and communication, healthier behaviors, reduced healthcare barriers, as well as increased awareness regarding HIV risk (Cordoba et al., 2021). Thus, they asserted that the mHealth application has the potential to effectively contribute to HIV prevention (Cordoba et al., 2021).

## **2.7 Conceptual framework for evaluating success factors in mHealth for diabetes self-management**

As previously mentioned, the purpose of this study is to identify success factors of an mHealth application for diabetes self-management from the perspective of users. We consider success factors to be anything that has an impact on the management of the system user's diabetes. Having illustrated the advantages and relevance of the updated DeLone and McLean information systems success model in the context of eHealth, as well as mHealth, we decided to adopt it in the conduction of our study. However, as DeLone and McLean (2003) point out themselves, it has to be adjusted in the context of the study first. Thus, we decided to create a conceptual framework that is based on the model and adjusted to our requirements.

Literature has shown that user satisfaction and net benefits are the most important dimensions that affect a system's success (DeLone & McLean, 2003; Jen & Chao, 2008; Ojo, 2017; Urbach & Müller, 2012). Additionally, according to Agarwal et al. (2021), the most commonly used criteria to assess the quality of mHealth applications for chronic disease management is user engagement and behavior change. Thus, we consider these dimensions essential to be included in our conceptual framework for evaluating success factors in an mHealth context for diabetes self-management.

One of the strengths of the updated DeLone and McLean information systems success model is that it describes the relationships between the dimensions and how each of them are affected (DeLone & McLean, 2003; Petter, DeLone & McLean, 2008; Urbach & Müller, 2012). The information system's overall quality affects intention to use, as well as user satisfaction (DeLone & McLean, 2003; Petter, DeLone & McLean, 2008; Urbach & Müller, 2012). User satisfaction is also affected by system use, but in return it impacts the intention to use (DeLone & McLean, 2003; Petter, DeLone & McLean, 2008; Urbach & Müller, 2012). Finally, their model displays that net benefits are affected by system use, as well as user satisfaction, and in turn, net benefits impact these two dimensions as well (DeLone & McLean, 2003; Petter, DeLone & McLean, 2008; Urbach & Müller, 2012). For our conceptual framework we decided to include these relationships since their value was validated in similar information systems literature where the model was adopted in an eHealth or mHealth context (Cordoba et al., 2021; Keikhosrokiani et al., 2020; Korhonen & Miettinen, 2008; Ojo, 2017; Okazaki et al., 2012; Petter & Fruhling, 2011).

Because both user satisfaction, as well as net benefits are directly affected by the system use and intention to use dimensions (DeLone & McLean, 2003; Petter, DeLone & McLean, 2008;



Urbach & Müller, 2012), we decided that these two dimensions should also be included in our conceptual framework.

Literature that has adopted the DeLone and McLean information systems success model in an eHealth or mHealth context has shown the significance of overall quality and the effect on user satisfaction, as well as intention to use (Cordoba et al., 2021; Keikhosrokiani et al., 2020; Korhonen & Miettinen, 2008; Ojo, 2017; Okazaki et al., 2012; Petter & Fruhling, 2011). Therefore, overall quality should be included in our framework as well.

According to DeLone and McLean (2003), overall quality has three dimensions: information quality, system quality, and service quality. However, some researchers after analyzing these dimensions decided to use a single aspect to assess user satisfaction with an information system (Petter, DeLone & McLean, 2008; Rai, Lang & Welker, 2002). Thus, we decided to follow a similar approach and measure only a single quality dimension in our conceptual framework, since we also have a limited time frame to complete our study, so that we can arrive at more in-depth conclusions.

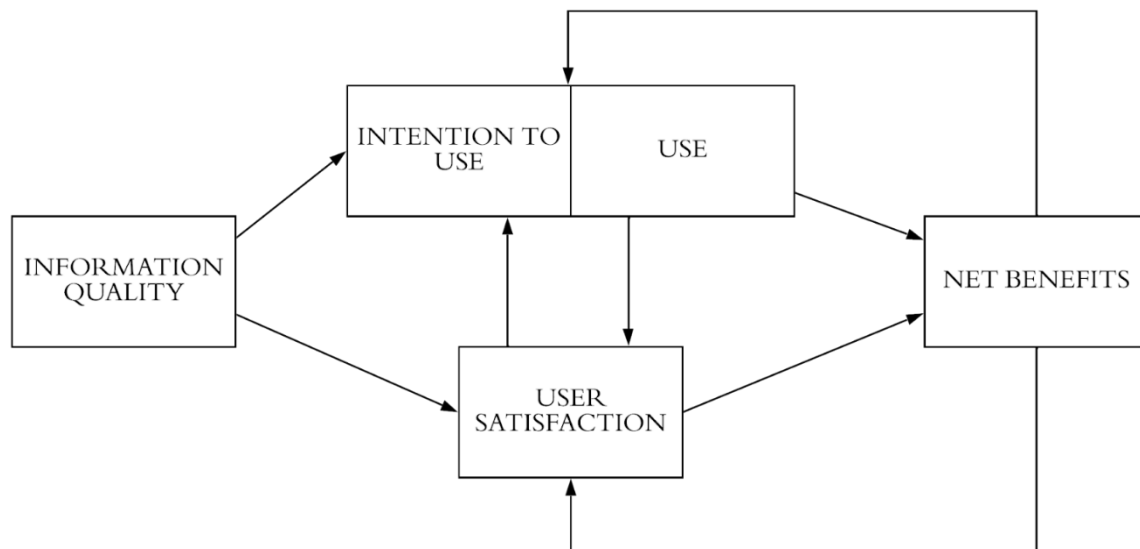
Service quality according to DeLone and McLean (2003) was mainly added to the updated model for e-commerce purposes. Even though its applicability has been validated in different contexts as well (DeLone & McLean, 2003; Urbach & Müller, 2012), its relevance in eHealth is contested (Cordoba et al., 2021; de Korte et al., 2018; Fritz, Tilahun & Dugas, 2015; Keikhosrokiani et al., 2020). Additionally, there is mixed support in information systems literature for the association between service quality and user satisfaction (Chiu, Chiu & Chang, 2007; Choe, 1996; Marble, 2003; Palmer, 2002; Petter, DeLone & McLean, 2008). In an eHealth context there were studies that also found little to no correlation between the service quality and user satisfaction dimensions (Cordoba et al., 2021; de Korte et al., 2018). For the context of our study, since the examined information system is a mobile diabetes self-management application, the support users receive is only in case of system malfunctions and there is no training. Thus, taking into consideration the mixed support for the applicability of service quality in an eHealth context, as well as the specifications of our study, we followed the example of Wu and Wang (2006) and decided to not include it in our conceptual framework.

System quality has generally been viewed as applicable and valid in most contexts (DeLone & McLean, 2003; Urbach & Müller, 2012). However, we decided to not include it in our conceptual framework for several reasons. The most important of which is that there is mixed support in information systems literature for its association with system use and intention to use (Petter, DeLone & McLean, 2008). Studies such as the one conducted by Straub, Limayem and Karahanna-Evaristo (1995) showed that the dimension of system quality is weakly related to system use, while other studies also found a weak relation with intention to use the system (Agarwal & Prasad, 1997; Klein, 2007; Lucas & Spitler, 1999; McGill, Hobbs & Klobas, 2003; Subramanian, 1994). Additionally, system quality examines how users perceive the system on a technical level (DeLone & McLean, 2003). This is not an aspect that is within the scope of our study, since we are focused on the users' perspectives and how they interpret value, disconnected from system limitations. Furthermore, including an additional aspect to our research, given our limited time frame would become an obstacle in the analysis process.

Information quality refers to the semantic level and covers the characteristics of an information system's output, which is in alignment with the aim of our study. It has been viewed as a key dimension in literature for measuring the user satisfaction of an information system (Baroudi & Orlikowski, 1988; Doll, Xia & Torkzadeh, 1994; Ives, Olson & Baroudi, 1983; Lee et al.,

2009; Petter, DeLone & McLean, 2008). Information quality has also been identified as the most important quality dimension in an eHealth context by several researchers that were identifying success factors (Keikhosrokiani et al., 2020; Korhonen & Miettinen, 2008; Ojo, 2017; Oppong et al., 2021; Shim & Jo, 2020). Furthermore, the association between the information quality of a system and its users' satisfaction has been strongly supported by information systems literature (DeLone & McLean, 2003; Iivari, 2005; Petter, DeLone & McLean, 2008; Wu & Wang, 2006), especially at the individual unit of analysis (Almutairi & Subramanian, 2005; Bharati, 2003; Chiu, Chiu & Chang, 2007; Kulkarni, Ravindran & Freeze, 2006; Rai, Lang & Welker, 2002; Seddon & Kiew, 1996; Seddon & Yip, 1992; Wixom & Todd, 2005), which is in alignment with the context of our study. Thus, we have decided for information quality to be included in our conceptual framework.

The final conceptual framework for identifying success factors in an mHealth context for diabetes self-management that was adopted in our study based on the updated DeLone and McLean information systems success model has been illustrated in Figure 2. The examined dimensions, as well as their relationships are depicted. We have also constructed a table (Table 1) based on our analysis of the literature that was performed in chapter 2.5 that summarizes our framework's dimensions, as well as how they can be measured.



**Figure 2: The conceptual framework for evaluating success factors in mHealth for diabetes self-management based on the updated DeLone and McLean information systems success model.**

**Table 1: Summary of the conceptual framework for evaluating success factors in mHealth for diabetes self-management based on the updated DeLone and McLean information systems success model and the examined literature.**

<b>DIMENSION</b>	<b>METRICS</b>	<b>REFERENCES</b>
<b>Information Quality</b>	<p>The characteristics of an information system`s output. This can be measured by examining:</p> <ul style="list-style-type: none"> <li>• Accuracy</li> <li>• Timeliness</li> <li>• Completeness</li> <li>• Relevance</li> <li>• Ease of understanding</li> <li>• Personalization</li> <li>• Security</li> <li>• Consistency of the output</li> <li>• Currency</li> <li>• Dynamism</li> <li>• Variety</li> </ul>	(D'Ambra & Rice, 2001; DeLone & McLean, 2003; Jen & Chao, 2008; King & Epstein, 1983; Molla & Licker, 2001; Palmer, 2002; Srinivasan, 1985; Urbach & Müller, 2012).
<b>Intention to Use</b>	<p>The objective users have when interacting with the system. This can be measured by examining:</p> <ul style="list-style-type: none"> <li>• Motivation to use the system</li> <li>• Intentions of future use</li> <li>• Preference to alternatives</li> </ul>	(Agarwal & Prasad, 1997; DeLone & McLean, 2003; Karahanna, Straub & Chervany, 1999; Petter, DeLone & McLean, 2008; Urbach & Müller, 2012).
<b>Use</b>	<p>The way users behave when interacting with the system. This can be measured by examining:</p> <ul style="list-style-type: none"> <li>• Nature of use</li> <li>• Use or nonuse of supporting devices or software</li> <li>• Navigation patterns</li> <li>• Usage patterns</li> <li>• Frequency of use</li> <li>• Time of use</li> <li>• Type of use (mandatory or voluntary; informed or uninformed; effective or ineffective)</li> <li>• Extent of use</li> <li>• Quality of use</li> <li>• Appropriateness of use</li> <li>• Reliability</li> <li>• General applicability</li> </ul>	(DeLone & McLean, 2003; Doll & Torkzadeh, 1998; Jen & Chao, 2008).



<b>User Satisfaction</b>	<p>The perceived satisfaction level of the system`s users. This can be measured by examining:</p> <ul style="list-style-type: none"> <li>• Overall satisfaction level</li> <li>• Attitude toward the information system</li> <li>• Coverage of expectations</li> <li>• Continuous usage of the system</li> </ul>	(DeLone & McLean, 1992; DeLone & McLean, 2003; Jen & Chao, 2008; Urbach & Müller, 2012; van der Meijden, 2003).
<b>Net Benefits</b>	<p>The level of positive or negative impact the system has on the objective of the stakeholders. They can be measured by examining:</p> <ul style="list-style-type: none"> <li>• Perceived advantages</li> <li>• Perceived disadvantages</li> <li>• Changes caused on the users` practices</li> </ul>	(DeLone & McLean, 2003; Jen & Chao, 2008; Ojo, 2017; Østbye et al., 1997; Sicotte et al., 1998; Urbach & Müller, 2012).

## 3 Research Methodology

Owing to the fact that choosing the right philosophy and methodology is vital for the research, in this chapter the approaches that were applied are presented, motivated, and described. The data collection and analysis process are also introduced along with the ethical considerations that are especially valid in health-related research. Finally, the appropriate scientific quality aspects of the study are identified.

### 3.1 Research philosophy

Highlighting the philosophical basis of the research is important in making the researchers' assumptions known, ensuring that the outcomes are appropriately interpreted, as well as justifying the choices made to carry out the study. There is a disagreement in the research community on which is the most appropriate research philosophy (Chia, 2005). Thus, it is up to the researchers to choose the philosophy that reflects their worldview, while at the same time is appropriate for the research topic.

There is no clear definition for the success factors of mHealth applications that support the management of chronic diseases such as diabetes, since they have not been sufficiently evaluated (Agarwal et al., 2021; Lee et al., 2018; Scott et al., 2020; Wilhide III, Peeples & Anthony Kouyaté, 2016; Zahra, Hussain & Mohd, 2016). According to Recker (2013), interpretivism is a highly suitable approach for topics that are not well explored. Taking this into consideration, the nature of the research topic, as well as existing trends in similar literature (Agarwal et al., 2021; Tabor et al., 2021), interpretivism with a subjectivist perspective seems to be the most appropriate research philosophy. Interpretivism, as a subjectivist philosophy tries to make sense of reality by social means and is used to come to new, richer understandings and interpretations of the social world, as well as different contexts (Recker, 2013; Saunders, Lewis & Thornhill, 2009; Walsham, 2006), which is in alignment with the purpose of the research topic.

The chosen approach requires the subjective evaluation of the collected data. It is unavoidable that the collected data is subjective as well since the varying opinions and perceptions of users of mHealth applications for diabetes self-management was examined. However, a subjective interpretation of the data still yields relevant and useful results for the researched topic (Agarwal et al., 2021; Goldkuhl, 2012; Saunders, Lewis & Thornhill, 2009). The goal of the research could have been achieved even with a small sample of users, as long as the subjectivity of the derived outcomes was acknowledged (Goldkuhl, 2012; Saunders, Lewis & Thornhill, 2009).

### 3.2 Research approach

Selecting an appropriate approach is essential when conducting scientific research in the IS field (Recker, 2013). The question “*What are the success factors of the mHealth application for diabetes self-management from the users' perspective?*” aims to study a socially constructed phenomenon. According to Mingers (2001), multiple paradigms are needed to explore such phenomena, so that the objective, subjective, and the social worlds can be captured. Therefore, we opted for a mixed-methods approach in our study. The mixed-methods approach has been

used to describe research strategies that consciously blend both the qualitative, as well as the quantitative approach within or across the stages of the research process (Driscoll et al., 2007; Johnson & Onwuegbuzie, 2004). According to Patton (2015), this approach allows for more detailed answers to research questions, since the combined methods complement each other. Researchers are able to draw from the strengths, as well as minimize the weaknesses of each individual method (Brewer & Hunter, 1989; Johnson & Turner, 2003; Johnson & Onwuegbuzie, 2004; Venkatesh, Brown & Bala, 2013). The final outcome of this approach, according to Johnson and Onwuegbuzie (2004) is expected to be superior to monomethod strategies.

Both the qualitative (Anderson, Burford & Emmerton, 2016; Cordoba et al., 2021; Mainoti & Isabirve, 2018), as well as the quantitative (Keikhosrokiani et al., 2020; Ojo, 2017; Okazaki et al., 2012; Petter & Fruhling, 2011) approach have been followed by researchers identifying success factors in an eHealth and mHealth context. In mixed methods, the emphasis on each individual approach may be different (Ågerfalk, 2013; Creswell, 2009). As we previously established, the study's context has not been well researched (Agarwal et al., 2021; Lee et al., 2018; Scott et al., 2020; Wilhide III, Peeples & Anthony Kouyaté, 2016; Zahra, Hussain & Mohd, 2016). Thus, to effectively answer the research question, more emphasis was put on the qualitative approach, since it brought insights into the experiences and the perspectives of the users and delivered a thick description of unexplored phenomena (Patton, 2015; Recker, 2013). The quantitative approach acted as an additional way to increase the reliability and generalizability of our findings (McCusker & Gunaydin, 2015; Recker, 2013), which is important since we have a limited time frame to conduct the study.

### 3.3 Data collection methods

Since we are following a mixed-methods approach, we used method triangulation to collect our data, as it allows the combination of multiple data collection methods to get a comprehensive understanding of the research topic (Patton, 1999). Furthermore, method triangulation is able to verify the validity of the data collected by converging information obtained from multiple data sources in order to gain a better understanding of the explored phenomena (Burton & Obel, 2011; Carter et al., 2014). According to Agarwal et al. (2021), who did thorough research in understanding the quality assessment for mHealth applications for chronic disease management, experimental methods are most commonly used for the data collection process. Thus, the methods chosen to be combined are semi-structured interviews and online questionnaires, with the interviews being our primary data collection source.

#### 3.3.1 Interview study

Interviews are considered highly effective when conducting research (Bhattacharjee, 2012; Bryman, 2006; Phellas, Bloch & Seale, 2011). They lead to rich, in-depth data of subjective opinions and therefore are considered suitable for the topic (Bryman, 2006). Semi-structured interviews were selected because the focus was put on the conversation with the participants, which increased their cooperation and willingness to discuss a sensitive topic which was managing diabetes (Recker, 2013). Furthermore, semi-structured interviews allowed for greater adaptability, since interviewers were able to change the questions' order and ask participants for clarifications (Patton, 2015).

When conducting interviews, there are certain pitfalls involved in the process that the researchers have to avoid (Myers & Newman, 2007; Recker, 2013). Recker (2013) noted that interview data runs the risk of having imprecisions. Thus, the interviews' audio was recorded to increase the quality of the transcripts. Pretense and trust issues are often risks associated with interviews as well (Myers & Newman, 2007; Recker, 2013). Therefore, the researchers tried to make the participants feel comfortable and disassociated their answers from any potential repercussions. Offering the transcripts after the interviews and being open about the research process to the participants was also essential in raising the trust levels.

### 3.3.2 Interview participants

Bernard (1994), Bhattacharjee (2012), and Recker (2013) all mention the importance of selecting suitable participants that have knowledge of the research topic. Therefore, a purposive sampling technique was used to select interview participants (Koerber & McMichael, 2008). The requirements of selecting the participants were the following: (a) They had to be diabetics, (b) they had to be users of Intellin diabetes management, the mHealth application for diabetes self-management we chose to evaluate, (c) they had to be adults, so that there were no complications with acquiring the consent of participation, (d) they had to have basic knowledge of operating mobile phones, and (e) they had to own a smartphone.

Since the research subject touches upon the confidential sphere associated with health conditions, it was challenging to find participants for the interviews. To find our participants, we got in contact with a person from Gendius, a company based in the United Kingdom that has developed Intellin diabetes management. By cooperating with the company, they were able to connect us with some users of their application to conduct our interviews. They provided us with their contact details, and we reached out to them via e-mail by declaring the purpose of our study and informing them about the interview process. Additionally, we sent them an informed consent form (see Appendix 10) that contained information about the way the interview data would be processed. The date and time of the interviews were selected by the participants according to their availability. The following table (Table 2) contains an overview of the study's interview participants.

**Table 2: The interview participants.**

Participant	Age	Role	Date	Duration	Means of communication
Speaker 1	22	User	13/04/2022 13:00 CET	25 minutes	Google Meets
Speaker 2	81	User	14/04/2022 11:00 CET	45 minutes	Google Meets
Speaker 3	49	User	20/04/2022 19:00 CET	57 minutes	Google Meets
Speaker 4	58	User	23/04/2022 18:00 CET	34 minutes	Google Meets

Speaker 5	67	User & Co-founder	29/04/2022 11:00 CET	43 minutes	Google Meets
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### 3.3.3 Interview guide

All interviews were conducted via Google Meets, a free video-conferencing software. Even though we only recorded the audio of the interviews, using OBS, a free and open-source software for recording, the cameras during the interview sessions were turned on as well in order to better connect with the participants (Myers & Newman, 2007). The reason we opted for using Google Meets was because all interview participants were located in the United Kingdom, a remote location from the perspective of the researchers who were located at the time in Sweden. Thus, we managed to reduce the complications of the process. Furthermore, it was a convenient solution, since Google Meets is integrated with the account that was provided by Lund University. Since the university's emails were utilized, this made the participants feel more secure about our identity, as they were able to verify our association with the university. Additionally, our full names were displayed during our meetings.

The interviews' opening, introduction, key questions, and closing were prepared by following a guide by Myers and Newman (2007), as well as our conceptual framework (see Table 1) which is based on the updated information systems success framework by DeLone and McLean (2003) to increase the overall quality and structure. The final produced interview guide can be found in the Appendix 1. This guide was used as a basis for the conduction of the interviews. However, since they were semi-structured, there were some slight deviations, depending on the conversations. In general, all interviews started with a short introduction of who the researchers are, what the purpose of the study was, as well as an expression of gratitude towards the respondents' participation. Then, the participants were informed that the audio of the interview would be recorded and processed according to an informed consent form (see Appendix 10) that was sent to them via email earlier. Once they gave verbal consent for the recording, the participants were given the chance to ask questions, as well as introduce themselves. Afterwards, the interview proceeded following the interview guide, which was divided into the following seven different categories:

- **Profiling Questions:** These were generally easy to answer questions that aimed at getting a better perspective on the participants, as well as at making them feel more comfortable. They examined their age, mobile application usage aptitude, the way they discovered information about diabetes in general, how they discovered the application, their affiliation with the company that developed the application, as well as the time span and frequency of the application's usage.
- **Intention to Use:** These questions aimed at examining their motivation for using the application, their goal, as well as their experience with other mHealth apps for diabetes self-management.
- **Use:** The questions explored the functions of the application that the participants were using, as well as which of them they found most useful. They also examined problems that they encountered while using the application and their experience with integrating it with external appliances and software. Finally, they investigated the way the application was used in the participants' communication with their diabetologists and the way they felt about entering their personal data.

- **Information Quality:** This category contained questions that examined the way participants would enter information into the application, as well as their opinion on the information they received from it regarding reliability, trust, completeness, and personalization. Finally, the questions investigated how the participants would apply the information they received from the app in their daily lives.
- **User Satisfaction:** Questions of this category aimed at exploring the participants' general satisfaction level with the application, as well as what did or did not appeal to them. Furthermore, they investigated the time users took to engage with the application on a daily basis and the level to which their initial expectations were fulfilled by the app.
- **Net Benefits:** These questions examined the way that the application influenced the participants' life with diabetes, as well as their perceived advantages and disadvantages of using the app.
- **Debriefing Questions:** The last category had questions that would allow participants to open up about their opinion on the application in general. They investigated the future use of the application in terms of if they would continue using it, as well as what would motivate them to further engage with it. The final question was aimed at allowing the participants to express whatever they believed was important to them regarding the application.

The interviews were conducted with both researchers present, however, only one of them was asking the questions during each session, since according to Myers and Newman (2007), a conversation between two people can reduce the superficiality of the interview and make it more personal. Before the termination of the interview, the participants were offered access to the transcripts that would be produced by the audio recording of the interview for confirmation. We also offered to share the final publication of our research.

### 3.3.4 *Survey study*

In parallel with the interview data collection, a survey was conducted. Since we had a limited time span to conduct this study, surveys are a great approach to produce a fair amount of data in a short time span (Kelley, 2003). Additionally, since surveys collect more data than other approaches, it is likely that the obtained data is based on a more representative sample and can therefore lead to more generalizable results (Kelley, 2003). An online questionnaire was created on Google Forms, which is a free online survey administration software. We used Google Forms as a data collection tool due to its convenience, since it is also integrated with the Google account that was provided by Lund University. The online questionnaire was chosen as a method instead of the paper-based, because they lead to reduced response time, they have lower cost, the data entry and coding are performed more easily, they offer flexibility in terms of format, and respondents are more likely to accept it (Birnbaum, 2004; Boyer et al., 2002; Granello & Wheaton, 2004; Weible & Wallace, 1998). Furthermore, Boyer et al. (2002) found that online surveys lead to fewer incomplete responses, which can be highly beneficial for researchers (Duray et al., 2000; Kathuria, 2000; Miller & Roth, 1994; Vickery, Droge & Markland, 1993).

According to Kelley (2003), data that is collected through surveys likely lacks details or depth on the investigated topic. We believe that by combining the surveys with interviews in the data analysis phase of our study that this issue would rather be mitigated. Missing responses are also a common risk involved in the process (Boyer et al., 2002). However, by using Google Forms as a data collection tool we were able to make all of the necessary questions mandatory, thus



avoiding missing responses entirely. A further concern is that participants may give responses following a pattern of marking questionnaire answers with similar scores across the entire survey; with either mainly high, low, or moderate scores (Boyer et al., 2002). Thus, we checked the responses for data runs before proceeding with the analysis and fortunately did not have this issue (see Appendix 11).

### 3.3.5 *Survey participants*

In order to select suitable participants that have knowledge of the research topic we used a purposive sampling technique (Koerber & McMichael, 2008). The requirements of selecting the participants were the following: (a) They had to be diabetics, (b) they had to be users of any mHealth application for diabetes self-management, (c) they had to have basic knowledge of operating mobile phones, and (d) they had to own a smartphone. However, since the survey was anonymous, we recognize the potential of having respondents that answered the questionnaire and did not fit our target group.

Finding the survey participants also proved to be a challenging affair. Online surveys are known to have a low response rate; thus, they require a large sample (Kelley, 2003). In order to reach as many people as possible in the short time frame of our study we sent out the questionnaire to people through social media platforms and large online communities for diabetics, such as relevant facebook groups and subreddits. Additionally, we resorted to translating the original English version of the questionnaire to two additional languages so as to reach a potentially larger audience. The languages the survey was translated to were Polish by one of the authors who is a native speaker, and Greek by the other author who is a native speaker respectively. The survey started on the 6th of April 2022 and finished on the 6th of May 2022, spanning a total of one month. In the end we managed to gather a total of 25 respondents, 7 from the English version, 6 from the Greek, and 12 from the Polish. More in-depth data that describes the characteristics of our respondents is presented in chapter 4.2, as well as Appendix 11.

### 3.3.6 *Survey guide*

The questionnaire was prepared by following a guide by Granello and Wheaton (2004), as well as the remarks made by Kelley (2003) so as to increase the overall quality. The questions were designed in accordance with our conceptual framework (see Table 1). This was done in order to ensure that the findings from the two methods could be comparable and follow a similar structure.

In the beginning of the questionnaire, we included a short introduction that contained certain information about our study, such as our names, our role, our affiliated University, our location, the purpose of the survey, details of the type of respondents we were looking for, how the responses would be used, processed, and stored, as well as our contact information in the form of Lund University email addresses. This was done to ensure transparency with our participants.

Regarding the questionnaire's layout, we avoided using the upper-case letters only approach, since this format is tough to read (Kelley, 2003). We instead opted to go with regular capitalization. The questions were all numbered and grouped by subject to avoid confusion (Kelley, 2003). In the first part of the survey, we gather some general information about our participants, such as gender and age group. We used clear and simple language to avoid misinterpretations

to a certain extent. We did this by avoiding two in one questions (e.g. “How satisfied were you with this application and applications in general?”), double negatives, as well as questions that were leading (Kelley, 2003). We also chose to have mainly closed questions with pre-coded responses so as to make the data analysis easier and the process for the respondents quicker (Kelley, 2003). However, we included a couple of open questions where pre-coding was impossible. The type of questions we used in our survey were single select, multiple select, free text, as well as seven-point grade scale ones, ranging from 1 being “Strongly disagree” up to 7 being “Strongly agree”.

The produced questionnaires for each individual language can be found in Appendix 2 for the English version, Appendix 3 for the Polish version, and Appendix 4 for the Greek version. The collected data from the three conducted surveys was translated back to English, so that it could be utilized as a singular data source in the data analysis phase of our study. The translated unprocessed data can be found in Appendix 11.

### 3.4 Data analysis methods

The data analysis process that was followed is explained and motivated in this chapter. First, we describe the data analysis of the interviews, our main data source. Afterwards, we explain the analysis of the survey data. Finally, the triangulation process that was implemented in the study is presented.

#### 3.4.1 Interview study

After collecting the relevant data from the interviews in the form of audio recordings, it is essential to analyze it in order to answer our research question (Patton, 1990). The first step of the analysis process is to create the transcripts. Trint, an audio transcription software was utilized for this task. The audio recordings from the interviews were converted to text with Trint. Because the results of the software were not perfect, the researchers manually made corrections on the produced transcripts, which were sent for confirmation to the interview participants in order to raise trust levels, as well as mitigate potential errors and misunderstandings.

This led to a plethora of data that eventually had to be made sense of (Patton, 1990). Thus, coding was implemented to analyze the interview data, since it appears to be the most appropriate method to transform a large quantity of qualitative data into useful information (Recker, 2013). Coding is a data analysis method that structures the collected data and categorizes it with the use of tags or labels (Patton, 1990). More specifically, deductive coding is implemented, since the aim of the research is to come to conclusions from already established concepts known from the theory using new empirical data (Bhattacharjee, 2012; Saunders, Lewis & Thornhill, 2009). The deductive approach allows for arriving at novel conclusions that can be cross validated with prior research (Saunders, Lewis & Thornhill, 2009). The coding themes that were selected were in accordance with the conceptual framework (see Table 1) that was based on the updated DeLone and McLean information systems success model. If we were to follow an inductive approach instead, then the themes would emerge from the collected data (Patton, 2015).

For the coding process Nvivo, a qualitative data analysis software was utilized. To verify the process and achieve a certain level of quality, confirmability, and trustworthiness (Saunders,



Lewis & Thornhill, 2009), multiple coding is implemented. Each individual researcher performed the coding process independently using Nvivo and the final results were cross-validated and discussed among the researchers until a consensus was reached. So that the codes could be more visible, color coding was implemented, and a unique coding ID was assigned to each dimension of the conceptual framework. The coding scheme has been illustrated in Table 3 and the final results of the process can be found in the Appendix 5 to 9.

**Table 3: Coding scheme.**

Dimension	Color	ID
Intention to Use	TURQUOISE	ItU
Use	YELLOW	U
Information Quality	ORANGE	IQ
User Satisfaction	GREEN	US
Net Benefits	MAGENTA	NB

After the completion of the coding process, the results were used in chapter 4.1 in order to produce the empirical findings. These followed a similar structure according to the conceptual framework (see Table 1).

### 3.4.2 Survey study

The purpose of analysing our survey responses was to summarize the collected data so that it can be easily understood. We used histograms, pie charts, bar charts, as well as a table to represent a summary of the answers. These graphs were all created using Microsoft Excel. Microsoft Excel is a paid spreadsheet software that has a plethora of capabilities including graphing tools. We chose it since one of the authors had expertise in using it. Additionally, it was a convenient option since it was provided by Lund University. Following the recommendation by Recker (2013), a short description was written in order to explain the graphs and highlight frequencies, tendencies, as well as patterns that were observed on the answers received for each individual question. Finally, it is worth mentioning that we used all 25 responses in our data analysis, since we deemed them relevant, and no data runs, or incomplete responses were spotted.

### 3.4.3 Triangulation

After the themes were identified by each individual data source, we implemented the triangulation of our findings. To perform this, we followed the triangulation protocol that has been proposed by Farmer et al. (2006). The first step was shorting the outcomes of each individual source (Farmer et al., 2006). The outcomes were categorized into similar themes, in accordance with our research question, to find out where the two approaches overlap or diverge, and to what degree (Farmer et al., 2006). This process is called convergence coding and the degree of overlap or divergence was categorized as: (a) agreement, (b) partial agreement, (c) silence,

when one of the two approaches covers a certain theme, while the other does not, or (d) dissonance, when the approaches disagree (Farmer et al., 2006). This process was performed by each individual researcher separately to ensure better outcomes (Saunders, Lewis & Thornhill, 2009). The next step was for the researchers to compare their results and handle their disagreements to arrive at a united set of outcomes for the triangulation (Farmer et al., 2006).

Finally, the empirical findings, the survey results, the triangulation results, and the theoretical background were all combined to produce the content of the discussion chapter and ultimately arrive at the study's conclusions.

### 3.5 Ethical considerations

Ethical considerations were especially significant in this study since although it was within information systems it also touched confidential spheres associated with health conditions that are recognized as sensitive. In our study we communicated our actions precisely to the best of our abilities in order to be transparent and avoid misconduct (Recker, 2013).

The previous chapters explained that the study was conducted by applying mixed methods research with interviews and surveys as data collection methods. Following the recommendations by Recker (2013), the interview study begun only once clear and direct consent from the participants was acquired. It is also vital to minimize the risk of harm that might have arisen during the research for any of the engaged parties (Allmark et al., 2009). According to Allmark et al. (2009), this can be done by assuring comfort and establishing trust among people involved. Thus, as described in chapter 3.3, we were as transparent as possible with our purpose, affiliations, motives, as well as the handling of the collected data.

In case of suspicion of misinterpretation, the clarification of the message was assured by the interviewees. Nevertheless, multiple interpretations were unavoidable (Klein & Myers, 1999). Therefore, we offered the interview transcripts to the participants and gave them the option to make adjustments to their statements before the study's official publication.

Diving deep into the experiences and feelings of the interview participants required securing the information acquired and avoidance of abuse and misuse of the data (Recker, 2013). However, as highlighted by Hammack-Aviran, Brelsford, and Beskow (2020) there are no clear regulations on how to handle data collected from mHealth applications in this context. The general, existing rules still apply and need to be distinctively obeyed (Hammack-Aviran, Brelsford, & Beskow, 2020). As complete anonymity was almost impossible to be maintained (Recker, 2013), strict confidentiality has been applied to the research, which was communicated to the individuals via an informed consent form (see Appendix 10) that they read and accepted before the interview process.

A similar approach was taken for the survey study as well. To ensure transparency, we communicated our purpose, affiliations, motives, as well as the handling of the collected data by including an introduction at the beginning of the survey. However, we also shared this information when distributing the survey to potential participants. Participation was strictly voluntary without exercising any form of pressure. Specifically for the survey data collection we decided for it to be completely anonymous to increase trust and eliminate any reservations

regarding the confidentiality of the identity of our participants. Anonymous means that none of the answers could be traced back to the participants.

According to Hammack-Aviran, Brelsford and Beskow (2020), it is important for researchers to ensure the security of the collected research data. Therefore, the software used in the data collection and analysis for both the interview and survey process was carefully examined to have appropriate protection features. The hardware was also properly secured, and the collected data was kept without the access of third parties to prevent unauthorized data access.

### 3.6 Scientific quality

There is no single optimal way to ensure scientific quality when conducting research (Seale, 1999). Nevertheless, there are certain steps that researchers can follow in order to achieve a certain level of quality (Seale, 1999). Scientific research should be reliable, transparent, valid, and sufficiently generalizable (Bhattacharjee, 2012; Meyrick, 2006).

Reliability comes in two forms according to Bryman (2006); external and internal. As previously mentioned, carrying out replicable research when following a mixed-methods approach is difficult. Therefore, relying on external reliability is almost impossible (Bryman, 2006). The focus will instead be on the researchers' interpretations of the data collected; thus, the reliability will be internal (Bryman, 2006).

Bhattacharjee (2012), Corbin, Strauss and Strauss (2008), as well as Meyrick (2006) all argue that the research outcomes should be derived from the data collected and in alignment with the research approach, as well as the data analysis process. By displaying a clear and transparent pathway that was followed to arrive at the outcomes of the research allows readers to validate the researchers' decisions made during the process (Meyrick, 2006). Erlandson et al. (1993) call this pathway confirmability trail. They argue that it is a technique of rigor and is essential for conducting quality research (Erlandson et al., 1993). Thus, we explain and justify all actions taken during the research process to the best of our capabilities and base our findings on the interview and survey results.

For the analysis, as mentioned in chapter 3.4.1, deductive and multiple coding was used in order to arrive at conclusions from the interview data. Following a deductive approach allowed for arriving at novel conclusions that have been cross-validated and reinforced with prior research (Bhattacharjee, 2012; Saunders, Lewis & Thornhill, 2009), while the coding themes came from well-established prior research (see chapter 2).

The researchers' objectivity was determined by establishing a critical distance between them and the data collected, which was achieved using multiple coding techniques (Meyrick, 2006). Additionally, since a triangulation approach was utilized, the researchers were able to overcome intrinsic biases that arise from single-method studies (Jack & Raturi, 2006). Single-method studies have inherent flaws in general and the outcomes that can be reached are limited (Jack & Raturi, 2006; McGrath, 1981). Thus, it is preferable to obtain verifying evidence by combining a variety of methods, which complement each other (Jack & Raturi, 2006; McGrath, 1981). This provides richness and rigor that would otherwise be unobtainable with single-method studies (Brewer & Hunter, 1989; Cain & Finch, 2018; Denzin, 2015; Jack & Raturi, 2006; Johnson & Turner, 2003; Johnson & Onwuegbuzie, 2004; Seale, 1999). The method triangulation

approach that was followed also enhances the theory-building process by accounting for the contradictions (Cain & Finch, 2018; Denzin, 2015; Seale, 1999).

Meyrick (2006) and Bhattacharjee (2012) both mentioned the importance of respondent validation of the data collected to ensure authenticity. Apart from keeping the participants' anonymity and being transparent about the process, the final interview transcripts were offered to them before the data analysis commenced. However, it was up to them if they wanted to make any adjustments.

Grounds for the study have been demonstrated to make research outcomes generalizable (Meyrick, 2006). Since a small sample of five individuals was questioned during the data collection process, the generalizability of the proposed research is likely to be low (Lee & Baskerville, 2003). Therefore, we decided to follow a triangulation approach and combine the interview findings with the results from a survey that reached a wider audience. According to Knafl and Breitmayer (1991) and Turner, Cardinal, and Burton (2017), this approach increases generalizability. Nevertheless, by giving as much detail as possible about the participants, as well as the context in which they have been studied, the readers can make their own judgments about the generalizability of the research outcomes (Meyrick, 2006).

## 4 Empirical findings

Throughout this chapter the empirical findings of our study are presented following the same structure as our conceptual framework (Table 1). These findings represent the participants' perceptions and opinions on each category of the framework. We start with the findings from the interview study, followed by the results from the survey. Finally, a comparison of the empirical findings produced by each method is presented, following the triangulation protocol proposed by Farmer et al. (2006).

### 4.1 Results from the interview study

In this chapter we present the empirical findings that came from the data collected through the interview study. These findings are drawn from the coded transcripts that can be found in the Appendix 5 to 9. We use references in the text to quote the participants in the form of “parenthesis”, followed by the participant, followed by a “comma”, followed by the comma separated row numbers where the quote is located, ending with a “parenthesis”. For example, the reference (Speaker 1, 40, 45) in quoting the participant of interview number 1 on what they said in rows 40 and 45.

#### 4.1.1 *Intention to Use*

While talking with the users about the reasons behind applying the mHealth application for diabetes self-management in their lives the answers brought up some common ground as well as more individual and single responses. Some of the respondents such as Speaker 1, emphasized that the functionalities available in the examined app were also present in the insulin pump they were using (Speaker 1, 30). Therefore, it was less common to actively engage with the app (Speaker 1, 30). Moreover, Speaker 1 engaged in using the app to contribute to the research specifically and give feedback after one and a half months of using the software (Speaker 1, 36). On the other hand, Speaker 2 appreciated the personalization that the app is giving in terms of individual feedback which was one of the motives to use the app (Speaker 2, 45). Nevertheless, while Speaker 2 favored the tips received, the intention to further engage with the app would be motivated by receiving even more feedback (Speaker 2, 92). The same applied to Speaker 3 who indicated the need to be informed by the app about new evolutions in the diabetes space (Speaker 3, 45). The correlation between Speaker 2 and the app was also brought to a more advanced level because of the direct recommendation that one of the universities gave about the application (Speaker 2, 39). Therefore, it also constituted the intention to use the app (Speaker 2, 39). When asked for the main objective of using the app Speaker 1 stated the consequent ascertainment:

Trying to just get a good average blood sugar. Trying to make injections and whatnot just simpler and quicker and just less inconvenient than it used to be (Speaker 1, 44).

Speaker 3 started using the app to see what kind of added value it can provide and how in general the application is working (Speaker 3, 75). The main intention for Speaker 3 was to use the examined application as a tool to input and store the blood pressure results (Speaker 3, 45).

Integration with different external appliances came across as important in the responses (Speaker 1, 42; Speaker 3, 65; Speaker 4, 98; Speaker 5, 40). Overall, the experiences were different across respondents with Speaker 1 and Speaker 3 mentioning that they found some shortages in terms of compatibility. On the contrary, Speakers 4 and Speaker 5 described the broad range of appliances being integrated while using the app, such as blood cuffs, weight scales, and blood glucose sensors (Dexcom) (Speaker 4, 98; Speaker 5, 38). It was also emphasized by Speaker 4 that “nobody wants 15 apps on their phones” which really defines the added value of the integration with external appliances (Speaker 4, 98, 110). Supplementing the topic regarding the flow of information Speaker 5 said that it is essential to have automated data upload instead of manual input to enhance the intention to use the app, which was the case considering the mHealth tool being described here (Speaker 5, 44). Additionally, users usually have used more than one application for diabetes self-management to test different solutions or because it was a part of the device they were already using.

When asked about the intention to use, the spin-off of the topic turned out to be common ground for almost all interviews, as they focused on functions that are not part of the examined application right now. Speaker 1 indicated twice that the integration with the currently used software, such as LiberLink 2, would provide a noticeable added value to the process of managing diabetes (Speaker 1, 44, 62). Similarly, Speaker 3 recalled not being able to sync the blood sugar from FreeStyle Libre into the app (Speaker 3, 65, 75). The worth noticing contradiction here is that Speaker 5 mentioned that the app is able to integrate with various systems and devices and no problems in this area were identified (Speaker 5, 26). Since the insights about what could be added to the application were found to be valuable, it was decided to include them in more detail in the 4.1.6 chapter called “Other empirical findings”.

The examined application was described as the one offering more than its existing competitors on the market (Speaker 1, 48). Speaker’s 4 motivation to initially start using the app was the fact that his wife, who is also a nurse, started working in the company that is the developer of the examined application (Speaker 4, 32, 96). Then the intentions evolved, and one of the objectives to use the app was to put the blood results in so that they can be compared with the national averages and recommended values (Speaker 4, 38). Therefore, Speaker 4 described it as the intention to be informed by the app, whether the results are acceptable or below/above average (Speaker 4, 38). It was added that the results could be used during the diabetes reviews (Speaker 4, 20).

Speaker 5 as one of the co-founders of the application who is also suffering from diabetes stated that one of the intentions to use the app is because it was invented by him (Speaker 5, 28). Yet, it was also indicated that the app is giving the relevant information about the disease (Speaker 5, 28). It “cuts down the background noise”, which was also confirmed by Speaker 4 (Speaker 4, 116; Speaker 5, 28). However, they also added that the app could perform better in terms of the search function (Speaker 4, 116). Additionally, having access to the mHealth application was found to support the daily management of diabetes (Speaker 5, 28).

#### 4.1.2 Use

The examined application for diabetes self-management is mostly being used daily or even a few times per day by Speaker 1, Speaker 2, and Speaker 5 (Speaker 1, 38; Speaker 2, 19; Speaker 5, 26). Speaker 2 stated that the app is used twice or possibly three times per day and therefore has all the historic diabetes related records in it (Speaker 2, 19, 35). Additionally,



being on the move frequently was one of the factors causing less frequent use of the app, especially while at the same time being on an insulin pump (Speaker 1, 38, 42). The situation would change when being on daily injections, causing the app to be used more frequently (Speaker 1, 38). The functions indicated to be used by Speaker 1 were inputting carbohydrates, blood sugar, injection suggestions, and calculation of Body Mass Index (BMI), with the input of carbohydrates being the favored function (Speaker 1, 54, 56). While asked the same question, Speaker 2 described that they used the app to record the insulin levels every time a new reading is available from the sensor, as well as the amount of insulin that is being taken every time (Speaker 2, 47). After being encouraged to elaborate more and asked about the most useful function Speaker 2 said:

I filled in my blood glucose each day, my activity. I put that in about every two or three months. Um, my blood pressure, I change. I take that roughly on a weekly basis ... My body mass, ... And the last bolus. ... the graph, I think, ... That's the one I use most because that's a year (Speaker 2, 51, 58).

Speaker 5 stated that they were using the app integrated with many different appliances such as a blood pressure cuff, Dexcom, Apple health, a weight scale, and a smartwatch (Speaker 5, 26, 38). They were also using it to capture details about exercise, blood glucose, activity, and blood pressure or to calculate parameters such as BMI (Speaker 5, 26, 30, 38). Therefore, the app was being used daily and frequently as it became the hub that “pulls the data from different apps” (Speaker 5, 26).

Speaker 3 used the app less frequently and mainly for the purpose of blood pressure monitoring as a simple capture tool, after being advised by a medical professional to do so (Speaker 3, 45, 73). Similarly, Speaker 4 reported using the app infrequently, possibly once per month, and mainly to collect the blood results, whenever they were received so as to have them available in one place, if necessary, for instance during a check-up (Speaker 4, 20, 36, 62, 74). Additionally, the tips received from the app were found to be valuable to use from time to time by Speaker 4 (Speaker 4, 44, 62). Yet, without putting the data in the app frequently, the number of prompts received is lower and the full potential of the app is untapped (Speaker 3, 129). Additionally, Speaker 3 reported to be aware about what the app does, however, functions such as the ability to link the exercise data from different sources were not actively used because they were perceived as too complicated to utilize (Speaker 3, 53). Nevertheless, the integration was tried once with a FitBit device out of curiosity, which ended up with the user not getting any useful insights from the app (Speaker 3, 91). Moreover, Speaker 3 indicated that the app was not used long enough to determine the further effects and results of using it and that changing the casual routine to adapt to systematically using the app is difficult (Speaker 3, 119, 155).

From the perspective of problems encountered while using the application Speaker 1, Speaker 2, and Speaker 4 all stated that the initial setup was challenging (Speaker 1, 58; Speaker 2, 51; Speaker 4, 48). Specifically, they found difficulties in understanding several professional medical terms such as triglycerides, blood parameters, or latest versus short-acting bolus (Speaker 1, 58; Speaker 2, 51; Speaker 4, 48). Therefore, it was tough to go through with the setup without further explanation (Speaker 1, 58; Speaker 2, 51; Speaker 4, 48). To overcome this issue Speaker 1 had to find out the meaning of those words on their own (Speaker 1, 60). This worked out well, however, constituted a difficult part of using the system (Speaker 1, 60). On the same topic, Speaker 4 emphasized that without professional help in explaining the terminology used in the app it would be difficult to complete the initial setup (Speaker 4, 50). In the area of problems, Speaker 3 also added that the integrations are “not easy enough” to use (Speaker 3,

53). Similarly, Speaker 5 mentioned that the app could do better in terms of handling the data received from external devices such as Dexcom (Speaker 5, 36). Moreover, the view containing records about the amount of insulin taken was not visible on the main dashboard of the app (Speaker 2, 94). It was hidden elsewhere which was found to be an obstacle while using the application (Speaker 2, 94).

No use of integrations with any specific external appliances was declared by Speaker 1 and Speaker 4 mainly because they did not find it necessary (Speaker 1, 62, 64; Speaker 4, 52). Speaker 2 also stated that they were not using them, however, they mentioned that they would consider doing so in the future (Speaker 2, 70). Considering that, the data was entered predominantly in a manual way by them (Speaker 1, 62; Speaker 2, 70; Speaker 4, 68).

The app was said to be used in the communication and during visits with their doctor or diabetologist by Speaker 2, and Speaker 5 (Speaker 2, 73; Speaker 5, 42). Speaker 2 highlighted that the app was found to be helpful by their diabetic nurse (Speaker 2, 73). Specifically, it enabled a form of communication where Speaker 1 would share the data gathered by the app in the form of charts, as well as information about with the highest and average levels of measurements (Speaker 2, 73). On the other hand, Speaker 1 and Speaker 4 declared no utilization of the examined app during medical check-ups, with Speaker 1 once again mentioning that for their specific situation it was unnecessary (Speaker 1, 66, 68; Speaker 4, 60). Nevertheless, if they were on daily injections, the app would be used more to communicate with their diabetologist (Speaker 1, 66, 68).

No concerns or reservations about entering their data in the application were determined by the majority (Speaker 1, 72; Speaker 2, 75; Speaker 4, 64). On the contrary, Speaker 3 reported some concerns, however, the fear about it was more general rather than related directly to the app (Speaker 3, 95).

#### *4.1.3 Information Quality*

In terms of information accuracy Speaker 1, Speaker 3, Speaker 4, and Speaker 5 trust the information received from the application and believe it is reliable (Speaker 1, 82; Speaker 3, 97; Speaker 4, 70; Speaker 5, 46). They believe that it has been validated and confirmed by healthcare professionals (Speaker 3, 97; Speaker 5, 46, 64) and “every notification that goes out is referenced clinically” (Speaker 5, 46). Speaker 1 trusted the information because it confirmed everything they knew from their healthcare professionals and living as a diabetic (Speaker 1, 80). Another reason for trusting the application was discussed by Speaker 4, who commented on in-app advertisements (Speaker 4, 42). They trust more the information presented by applications that do not include advertisements, such as the one under examination, and believe that it is more valid in general (Speaker 4, 42).

However, even though Speaker 3 and Speaker 4 trust the information from the application, they both make a point that they use it as guidance (Speaker 4, 70), or as a “discussion point rather than as a fact or action” (Speaker 3, 97). Speaker 3 also believes that the information presented by the application could be more reliable (Speaker 3, 106). They commented that if there was a percentage of reliability next to the information presented in the app, then they would be able to trust it more and make their own decisions about it (Speaker 3, 106).

On the topic of reliability and trust, the participants also mentioned that in general, they trust information received by healthcare professionals more than applications (Speaker 1, 84; Speaker 3, 57; Speaker 4, 70). Characteristically, Speaker 3 mentions that “we should be aware enough that it is an app” and “it's not a doctor, and therefore there is going to be a flaw within it” (Speaker 3, 57).

In terms of information timeliness and completeness, the participants made several remarks. In general, they were content. Nevertheless, they highlighted a few areas where the application could do better. More explicitly, Speaker 3 mentioned that “There's often not enough data” (Speaker 3, 97). They also noted that the information that is present in the application is lacking data collection and information about diet, which is considered important, since it is one of the “major contributions to what impacts your short-term blood sugars” (Speaker 3, 110). Furthermore, they expressed their desire for a “richer set of data and information” (Speaker 3, 135), as well as more information in terms of tips (Speaker 3, 121).

Speaker 1, Speaker 2, and Speaker 3 all declared that the application did not present new information for their case (Speaker 1, 78; Speaker 2, 19, 77; Speaker 3, 123). However, they also said that the information from the application would be of high value to a new diabetic (Speaker 1, 78; Speaker 2, 19, 77; Speaker 3, 123). Specifically, Speaker 1 stated that:

Generally, I know all this stuff anyway, just from having diabetes for so long. But I could imagine for a newer, newly diagnosed person, it'd be really helpful (Speaker 1, 78).

Similarly, Speaker 2 commented that “Whatever is there, I know of it from other sources. And I think it would be very useful as an app for other people, especially new diabetics” (Speaker 2, 77).

Finally, on the dimension of information quality, a few remarks were made by the participants regarding the application's personalization. There were a few conflicting opinions on this topic. More explicitly, Speaker 1 and Speaker 5 believe that the application is fairly personalized, on a similar level to other diabetes self-management applications (Speaker 1, 86), and because it contains all of their history and clinical markers (Speaker 5, 50). On the other hand, Speaker 3 and Speaker 4 did not find the applications personalized (Speaker 3, 119; Speaker 4, 78). Speaker 4 believes that the information is “fairly general” (Speaker 4, 78) and Speaker 3 commented about the application's tips that “they're not personalized” and that they “didn't notice that they were” (Speaker 3, 119).

Another point where there was disagreement is on the desirability for information personalization. Speaker 5 wanted personalization (Speaker 5, 48). They mention that “it's all about personalization” (Speaker 5, 48). Whereas Speaker 4 was adamant about not trusting diabetes self-management applications if they were personalized (Speaker 4, 78, 80, 88). Specifically, they stated that they “wouldn't trust something that was purporting to be very personal” (Speaker 4, 78) and that they would question its viability (Speaker 4, 78), and the motives behind it (Speaker 4, 80). In general, they “wouldn't believe it then” (Speaker 4, 88).

#### 4.1.4 User Satisfaction

While examining the user satisfaction of the application the participants reported a decent overall satisfaction level, although they believed that it could do better (Speaker 1, 32, 110; Speaker 2, 82; Speaker 4, 86; Speaker 5, 56, 58). With the exception of Speaker 3 that rated the applications as “one, two out of 10” (Speaker 3, 127).

Each of them also mentioned several attributes of the application that particularly appealed to them, as well as aspects of it that they disliked. For example, Speaker 1 seemed to like the application’s simplicity, and its ease of use (Speaker 1, 32, 92). Additionally, they expressed their contentment with the application’s features (Speaker 1, 32). Specifically, they liked the healthcare, the activity, the blood pressure, and the BMI features (Speaker 1, 32). Speaker 2 also seemed satisfied with the applications’ features; however, they did not mention any one in particular (Speaker 2, 86).

Speaker 3 mostly liked the support it provides for their diabetes management (Speaker 3, 63), as well as the user experience (Speaker 3, 129). They also mentioned that the consolidation of the data points appealed to them as well (Speaker 3, 53, 129, 139), however, they believe that it could do better in that regard (Speaker 3, 53).

Speaker 4 found the blood results feature useful (Speaker 4, 38) and liked the suggestions they received from the app (Speaker 4, 88). Speaker 1 seemed also satisfied with the suggestions (Speaker 1, 32). However, they were disliked by Speaker 2 and Speaker 3 respectively (Speaker 2, 94, 99; Speaker 3, 45, 131). They reported that they wanted “more guidance and more feedback” (Speaker 2, 99) and they “didn’t get enough out of them” (Speaker 3, 131). Furthermore, Speaker 3 reported that they “haven’t found the execution very good” and that by having diabetes for a long time, the suggestions were “a bit obvious” (Speaker 3, 45). Speaker 3 also disagreed with Speaker 4 on the topic of the reports, as they believed that they were not well executed, “a bit dated”, “a bit clunky”, and that they did not flow well (Speaker 3, 141).

Speaker 5 seemed to be satisfied with the app’s personalization (Speaker 5, 50). They said that it is relevant to them (Speaker 5, 50). Nevertheless, Speaker 2 did not share the same opinion, as they believed that it is not informative enough (Speaker 2, 19). Moreover, Speaker 5 believed that the integration with external appliances and software is easy (Speaker 5, 40). They used phrases such as “It works really well” and “pretty seamless” to describe it (Speaker 5, 40). On the other hand, Speaker 1 seemed rather dissatisfied with that aspect (Speaker 1, 92, 94, 102), as they characteristically mentioned that they had to flip between their diabetes self-management apps, which using their own words was “quite annoying” (Speaker 1, 94). Speaker 3 was also dissatisfied with the integration with external appliances and software (Speaker 3, 93). They mentioned specifically “It didn’t seem to give me anything” (Speaker 3, 93). Since they had a hard time using those integration features, they expressed their dissatisfaction with the manual entry of data that they had to perform (Speaker 3, 75, 83, 129). They said that “the effort to enter the data in manually was too great” (Speaker 3, 75) and that “if I’ve got to open the app and type it in, I don’t, because that extra two seconds” (Speaker 3, 83). According to them, this is one of their biggest challenges with the app, since as they stated: “unless you’re going to type in your input every day ... it’s not really valuable” (Speaker 3, 129).

A few common positive views on the application were shared between participants. Both Speaker 1 and Speaker 4 believed that the application was fast to use (Speaker 1, 94; Speaker 4, 92). Furthermore, Speaker 1, Speaker 3, and Speaker 5 liked the application’s layout, and its

design (Speaker 1, 32, 110; Speaker 3, 139; Speaker 5, 58). Speaker 5 for instance mentioned that “it looks very efficient”, “it looks clinically”, and that “it looks like a serious piece of kit” (Speaker 5, 58). Finally, Speaker 1, Speaker 4, and Speaker 5 all expressed their satisfaction regarding the absence of in-app advertisements, as well as the lack of a price for using the app (Speaker 1, 92; Speaker 4, 88; Speaker 5, 58). Specifically, they said that they liked that “there's no hidden costs or anything ... no in-app purchases” (Speaker 1, 92), and that they “don't get bombarded with advertisements” (Speaker 4, 88).

There was also a shared negative view on the application's output by Speaker 2 and Speaker 3 (Speaker 2, 41, 82; Speaker 3, 139). They characteristically stated that they are not getting very much back from it (Speaker 2, 41) and that the “information from Gendius at the moment is zero” (Speaker 2, 82).

Regarding their initial expectations before using the app, Speaker 1, Speaker 4, and Speaker 5 all reported them to be sufficiently covered (Speaker 1, 98; Speaker 4, 76; Speaker 5, 60). Specifically, Speaker 1 said that:

I thought it would just be similar to the mylife one, which was a basic calculator. I didn't expect like the lifestyle tips and the additional data that you can put in. So yeah, in that sense it's done better than I thought it would do (Speaker 1, 98).

Speaker 4 reported that “it does what I want it to do” (Speaker 4, 76) and Speaker 5 mentioned that “in a lot of ways it's completely blown me out of the water” (Speaker 5, 60). However, Speaker 2 and Speaker 3 seemed to have rather higher expectations from the app (Speaker 2, 84, 94; Speaker 3, 129). Speaker 3 just mentioned that the application was not really valuable to them (Speaker 3, 129), while Speaker 2 thought that they would have regular input from the app in the form of a “diagram or something that was interpreting the data” (Speaker 2, 84). More importantly, they expected “some sort of correlation ... between sugar level and a suggested level of insulin to take” (Speaker 2, 94). They also expected more feedback and suggestions in terms of diet (Speaker 2, 84).

When asked if they encountered any problems while using the app, Speaker 2 and Speaker 5 gave a negative answer, while Speaker 1, Speaker 3, and Speaker 4 all reported minor issues they ran into (Speaker 1, 68; Speaker 2, 56; Speaker 3, 141; Speaker 4, 48; Speaker 5, 36).

When comparing the application to other diabetes self-management apps that the participants have used in the past Speaker 2, Speaker 4, and Speaker 5 seemed to rather like it more (Speaker 2, 56; Speaker 4, 40; Speaker 5, 28). To express themselves they mentioned that “in the respect of other apps, it's very good” (Speaker 2, 56), “I've downloaded a couple and then pretty much deleted them straight away” (Speaker 4, 40), and “it's better than most things out there” (Speaker 5, 28). Nevertheless, Speaker 3 disagreed, since they used the app mainly for data capture and believed that “the individual apps do it better” (Speaker 3, 145).

When asked if they would continue to use the app in the future, Speaker 2 and Speaker 4 had a positive answer (Speaker 2, 90; Speaker 4, 108). They declared that “There's every likelihood” (Speaker 2, 90) and they would “just carry on using it” (Speaker 4, 108). Speaker 5 would also continue using the application in the future, being the co-founder of the company that developed the app (Speaker 5, 8) and satisfied with its use (Speaker 5, 56, 58). On the other hand, Speaker 1 seemed to not be keen on using the app in the future, unless an integration with the app they were familiar with using was implemented (Speaker 1, 102). They answered that since they



were “on the pump and it does itself, probably not” (Speaker 1, 102). However, they stated that “if you did the integration with the Libre app, I probably would start using it more” (Speaker 1, 102). Speaker 2 did not seem keen on using the app in the future either (Speaker 2, 19). They mentioned that “It’s not sharp enough or informative enough” for them (Speaker 2, 19).

#### 4.1.5 *Net Benefits*

The last dimension that constitutes a part of the framework is net benefits, where during the interviews, users were asked about how the application has influenced their lives with diabetes. Additionally, some of the questions were focused on the advantages and disadvantages of the app. The first person asked about the influence of the app was Speaker 1, who stated that using it for managing their diabetes made their life easier in their day-to-day activities (Speaker 1, 100). Speaker 1 and Speaker 4 declared that the tips presented by the app based on the data worked as helpful guidance in terms of a healthy diet, controlling weight, BMI, or generally keeping track of the key metrics regarding their health (Speaker 1, 84, 90; Speaker 4, 58). Additionally, Speaker 4 indicated that the app includes a collection of different issues about diabetes that helps while looking for something specific (Speaker 4, 104). While talking about the different medical measures, the app was found helpful in pointing to the right place where to put the given type of result (Speaker 4, 20). Speaker 4 also noticed the knowledge gained while using the app (Speaker 4, 100). They acquired more knowledge about blood measures affecting diabetes, as well as the levels they should be kept in (Speaker 4, 100).

On the contrary, Speaker 2 mentioned that despite having put a lot of data in the app, they are hardly getting any results back (Speaker 2, 19). Going further, the app was seen to not deliver enough guidance (Speaker 2, 88) which can be perceived as one of its disadvantages. Speaker 3 also brought some disadvantages that were spotted during the utilization of the app’s functions. The blood sugar management, despite being able to store records, was assessed as poor in terms of giving any data-related insights and correlations (Speaker 3, 65, 91). Moreover, the general analytical aspect of the application was found as a weak point by Speaker 3 (Speaker 3, 141). They emphasized being unaware about what the report was trying to communicate with the provided insights (Speaker 3, 141). This opinion was also shared by Speaker 2 (Speaker 2, 88). Furthermore, Speaker 5 spotted some disadvantages in the area of micromanaging and getting obsessed with controlling one’s own or one’s child’s conditions (Speaker 5, 66). However, Speaker 2 identified some benefits that the app has provided in their daily routine (Speaker 2, 86). To be more specific, the application has brought a regime to their life and a routine that is being repeated every morning, including the consistency of doing the blood glucose tests (Speaker 2, 86, 90).

A significant advantage of the app according to Speaker 2 and Speaker 5 was being able to record and track insulin levels, while also possessing the ability to access previous records (Speaker 2, 88, 90; Speaker 5, 52). This functionality gave them a bigger picture that assisted them in their attempts to keep their levels in control (Speaker 2, 88, 90; Speaker 5, 52). Similarly, Speaker 4 indicated that being able to use historical data as a reference during medical check-ups or visits with healthcare professionals is a valuable support to better adjust the right medications and recommendations based on more than just what is in the official medical history (Speaker 4, 45, 58). Speaker 5 brought attention to the advantages of integrating the app with external devices such as weight scales, Dexcom, blood pressure cuffs (Speaker 5, 42, 44). They also mentioned the added benefit of being able to share their data with medical professionals to get better guidance, an opinion shared by Speaker 4 as well (Speaker 4, 45, 58;



Speaker 5, 42, 44). Speaker 2 and Speaker 4 stated that the charts based on the data input which are generated by the app make the tracking of the results over time possible, as well as allows them to spot some trends in the measures (Speaker 2, 86; Speaker 4, 38, 96; Speaker 5, 50).

The phrase used by Speaker 1 to describe the whole experience was “it's all in one place, which is nice” (Speaker 1, 100). This works as a way to emphasize this crucial capability of the software for them. Additionally, Speaker 3 added that “it's a nice summary that brings it all together” (Speaker 3, 129). The app was also described as a tool that reminds the user about the fact that all different results contribute to the general shape of the health conditions (Speaker 3, 129).

Finally, Speaker 5 identified a noteworthy advantage that comes with using the app for managing their diabetes. It reduces stress levels regarding all the details about blood parameter results, insulin levels, and the medical consultations since, using their words, it acts as some kind of “wingman” supporting them at every step of their daily journey, while also making them feel secure (Speaker 5, 62, 64). All of this is enabled by knowing the parameters, as well as their trend over a specific period of time, and being notified by the app about the most important occurrences (Speaker 5, 62).

#### *4.1.6 Other empirical findings*

Referring to the findings mentioned in the intention to use chapter, more about the topic of increasing the scope of potential utilization of the app will be described. As such, Speaker 1 mentioned that “adding a food diary thing” and a version of the app suitable for smartwatches would work as an intention to further engage with the app (Speaker 1, 44, 108). While talking about the intention to use the app, Speaker 3 also brought up a few interesting points. They mentioned that they would like to see the correlation between the data that is inserted in the app and how it influences the blood sugar levels from a reason and cause perspective (Speaker 3, 53, 79). This desire was also expressed by Speaker 4 (Speaker 4, 52, 54). The focus in this case was put on giving predictions based on the past results and the correlation between the different data entries (Speaker 3, 53, 145).

The next points made were about potential functions that would increase the users' intention to use the app. They mention the potential of adding carbohydrate tracking within the app as well as automatically aggregating, analyzing, and comparing data from multiple sources with the focus on seeing the trend over several years as well as being able to see the daily target patterns, similar to what is happening in the FreeStyle Libre app (Speaker 3, 81, 93, 113, 117, 149). Speaker 3 also talked about repeatable prescriptions through the app, reminders, as well as tips on how to do better the things that are already being done (Speaker 3, 153).

Speaker 4 stated that the app would be more useful if it would contain more search options with trusted sources (Speaker 4, 120). This way, if there was a lack of information in the app, it could be found somewhere in one of the sources that have been validated by clinicians and contained in the app (Speaker 4, 120). Additionally, it was found that a good improvement would be to include detailed explanations about the complex medical vocabulary used in the app, such as describing what triglycerides are or what the difference between the latest and the short-acting bolus was (Speaker 1, 58; Speaker 2, 51). Moreover, Speaker 2 was pointing out that some functions like plotting the insulin levels are available but difficult to find (Speaker 2, 19, 51). Therefore, it would be appreciated to have a better description of what is available and how to

access it (Speaker 2, 19, 51). Additionally, they added that a more personalized experience including more personalized tips would be something worth considering adding within the app (Speaker 2, 19, 51).

Moving forward another issue users faced is connected with misinformation and the bulk of tips available everywhere. Relating to the previously mentioned lack of enough verified and trusted sources of information about diabetes, thanks to applying semi-structured interviews, it was also found that there is a lot of misinformation happening in the online sphere including the ones concerned about diabetes (Speaker 3, 104). Speaker 3 emphasized the challenge of finding the relevant information and the necessity of being aware of possible misleading guidance provided by a plethora of sources (Speaker 3, 97). They gave an example where this happened while his wife started to look for information about diabetes on social media where people posted not verified advice (Speaker 3, 97). It was mentioned that trusted sources exist, however, while being in need of finding tips it might be challenging to find the right source for them (Speaker 4, 120). Speaker 2 indicated that there is a lot of information online that is copied from other sources, and it is difficult to distinguish the good from the bad, especially for new diabetics with limited knowledge about the disease (Speaker 2, 21). Speaker 5 also pointed out the plethora of unverified information about diabetes that is available online (Speaker 5, 12). Additionally, they added that to minimize misinformation and the spread of unqualified tips, all notifications and advice in the app were clinically referenced (Speaker 5, 46).

Having the opportunity to talk to one of the co-founders of the company developing the examined app brought some more insights that are not connected with the objectives of the study. It turned out that the reason behind founding the company was the co-founder's diagnosis of type two diabetes (Speaker 5, 8). Currently, for instance, in the UK there is a possibility to get only 60 minutes of consultation per year to talk about the diabetic condition, therefore one of the aims of developing an app was to ease those who need to manage diabetes (Speaker 5, 12). All of the support that the mobile application intends to deliver is available for free for individuals as said by Speaker 5 (Speaker 5, 14). The goal of Speaker 5 while talking about further development of the app is to make it more individualized with personalized information and tips designed for a particular person (Speaker 5, 12). The utilization of the historical datasets to give better predictions for the patients is the ultimate goal, so patient-centric care can be in the area of the main interests while enhancing the app (Speaker 5, 24, 48). Another, near future, goal is to bring short videos about diabetic news and tips from the medical communities (Speaker 5, 68). Overall, reaching more than half a million downloads of the app worldwide, the co-founder feels that the it is supportive, and it generates a positive impact for its users which drives further improvements (Speaker 5, 14, 60).

#### 4.1.7 *Summary of Empirical Findings*

In the table below (Table 4), the findings are summarized to assist with the understanding and interpretation of the qualitative data gathered during the interview process. Every dimension is presented in a separate row to maintain clarity and appropriate flow of the aspects used based on our conceptual framework. Empirical findings listed as bullet points are later used in the comparison (chapter 4.3), as well as in the discussion (chapter 5).

Table 4: Summary of empirical findings from the interview study.

Dimension	Summary of empirical findings
<b>Intention to Use</b>	<ul style="list-style-type: none"> <li>• The intention to use:               <ul style="list-style-type: none"> <li>○ being able to receive personalized feedback</li> <li>○ being able to receive individual feedback</li> <li>○ being able to receive tips about managing diabetes</li> <li>○ getting a good average blood sugar</li> <li>○ being able to input and store blood pressure</li> <li>○ being able to integrate different devices</li> <li>○ being able to input blood test results</li> <li>○ getting general feedback about the blood test results, e.g. whether is above/below average</li> <li>○ having support in managing diabetes</li> <li>○ users reported to intend to use different applications for diabetes self-management</li> </ul> </li> </ul>
<b>Use</b>	<ul style="list-style-type: none"> <li>• The use of the app:               <ul style="list-style-type: none"> <li>○ most often used daily or monthly</li> <li>○ used to input carbohydrates</li> <li>○ used to input blood glucose</li> <li>○ used to receive injection suggestions</li> <li>○ used to calculate the Body Mass Index</li> <li>○ used to record the amount of insulin</li> <li>○ used to record blood pressure</li> <li>○ used to record the last bolus</li> <li>○ used to gather data from the devices integrated with the app like blood pressure cuff, weight scale or Dexcom</li> <li>○ some users faced problems with the configuration because of complicated words used in the process</li> <li>○ some users found the integration with external devices not easy enough</li> <li>○ data entered automatically</li> <li>○ data entered manually</li> <li>○ used during medical check-ups</li> <li>○ majority reported no concerns about inputting their sensitive data in the app</li> </ul> </li> </ul>
<b>Information Quality</b>	<ul style="list-style-type: none"> <li>• The information:               <ul style="list-style-type: none"> <li>○ is trusted</li> <li>○ is reliable</li> <li>○ is accurate</li> <li>○ is valuable for new diabetics</li> <li>○ lacked timeliness</li> <li>○ lacked completeness</li> </ul> </li> <li>• They use the information as guidance and not as a fact</li> <li>• They trust healthcare professionals more than applications</li> <li>• They have different opinions on the application's personalization</li> </ul>

<b>User Satisfaction</b>	<ul style="list-style-type: none"> <li>• User satisfaction: <ul style="list-style-type: none"> <li>○ decent overall satisfaction level</li> <li>○ simplicity liked by a participant</li> <li>○ ease of use liked by a participant</li> <li>○ the support it provides for their diabetes management was liked by a participant</li> <li>○ the user experience was liked by a participant</li> <li>○ the reports were disliked by a participant</li> <li>○ manual data entry disliked by a participant</li> </ul> </li> <li>• Majority of participants: <ul style="list-style-type: none"> <li>○ seemed satisfied with the app's features (some features that were highlighted were: the healthcare, the activity, the blood pressure, the BMI, and the blood results features)</li> <li>○ have a slightly negative attitude towards the app's integration with external appliances and software</li> <li>○ believe that the application is fast to use</li> <li>○ liked the application's layout</li> <li>○ liked the application's design</li> <li>○ liked the absence of in-app advertisements</li> <li>○ liked that the app was free to use</li> <li>○ seemed to like it more in comparison to other apps</li> <li>○ disliked the application's output</li> <li>○ reported that they ran into minor issues while using the app</li> <li>○ reported that their initial expectations seemed to be sufficiently covered</li> <li>○ reported that they would continue to use the app in the future</li> </ul> </li> <li>• Mixed feeling: <ul style="list-style-type: none"> <li>○ regarding the suggestions from the app</li> <li>○ towards the app's personalization</li> </ul> </li> </ul>
<b>Net Benefits</b>	<ul style="list-style-type: none"> <li>• Identified net benefits: <ul style="list-style-type: none"> <li>○ app made daily life easier</li> <li>○ received tips helped in managing weight, BMI, and healthy diet</li> <li>○ received tips helped in maintaining the track of the general metrics</li> <li>○ being able to track the insulin levels</li> <li>○ being able to revert to past measurement results</li> <li>○ being able to use the data from the app during medical check-ups</li> <li>○ being able to integrate external appliances and gather everything in one place</li> <li>○ received notifications helped in managing diabetes</li> <li>○ some users found the guidance on how to properly input blood results were helpful</li> <li>○ some users gained knowledge about the right blood parameters' levels</li> <li>○ most users benefited from the insights received in the app</li> <li>○ most users found the received analysis and trends beneficial</li> </ul> </li> </ul>

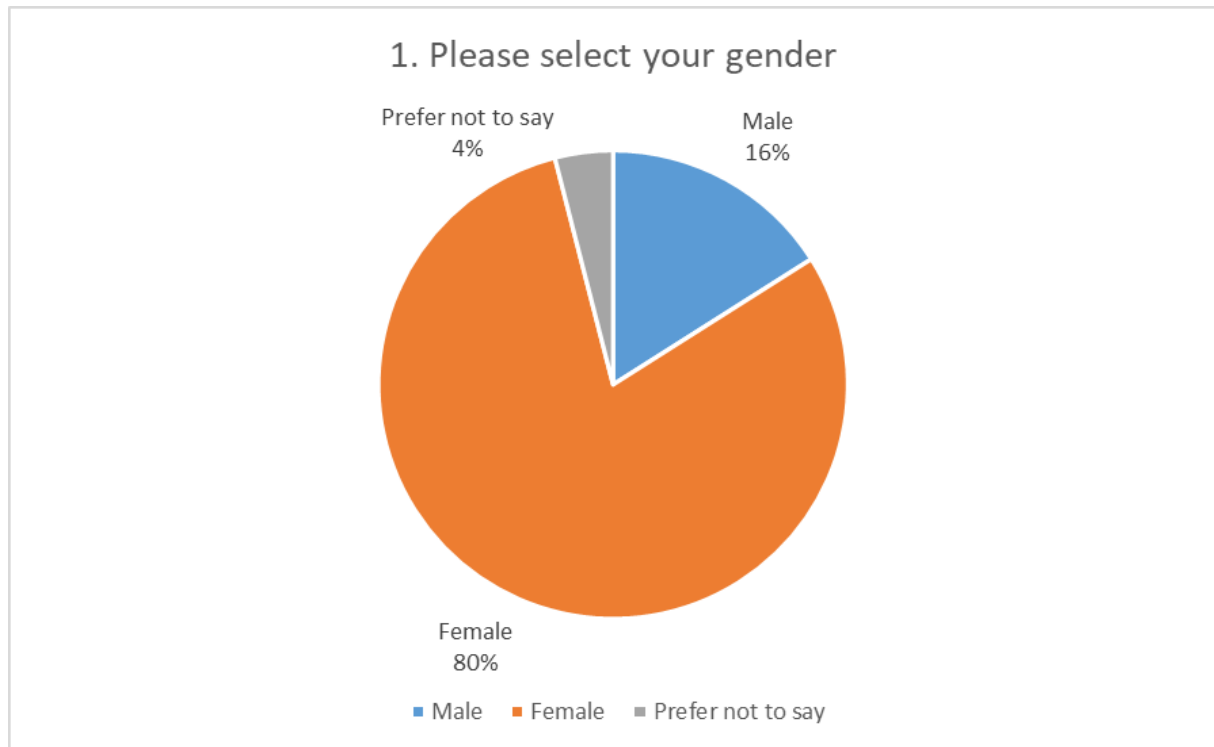
	<ul style="list-style-type: none"> <li>○ some users assessed the insights from the app as neither sufficient nor helpful</li> <li>○ the app structured the daily routine of blood tests and health-related activities</li> <li>○ the app brought the positive regime to user's life</li> <li>○ being less stressed because of more control over the diabetes</li> </ul>
<b>Other empirical findings</b>	<ul style="list-style-type: none"> <li>• Other empirical findings: <ul style="list-style-type: none"> <li>○ adding a food diary to the app might be a good step forward</li> <li>○ adding version of the app for smartwatches might be a good step forward</li> <li>○ adding more detailed data analysis and correlation, e.g. correlating the type of food with how it influences the blood sugar</li> <li>○ adding more predictions in the app based on the input/transferred data might be a good step forward</li> <li>○ adding the carbohydrate tracking might be a good step forward</li> <li>○ adding the way to handle repetitive prescriptions might be a good step forward</li> <li>○ adding the dictionary about difficult terms related to the app as another possible feature</li> <li>○ improving search of external trusted and verified sources about diabetics in the app might be a good step forward</li> </ul> </li> </ul>

The findings presented in Table 4 brought a significant number of insights into identifying the motives behind the intentions to use the app, as well as which features are actually being used. It was followed by the information quality of tips and other content available in the app, user satisfaction, which aimed to present what is the general overview of the application among the participants, as well as net benefits that describe the actual impact of the app on its users. Thanks to the characteristics of semi-structured interviews, it was possible to tackle each dimension in a more in-depth and comprehensive form during the individual discussion with each of the interviewees. The achieved results, as mentioned earlier in this chapter, will be applied in the following chapters of the research.

## 4.2 Results from the survey study

By applying the triangulation protocol by Farmer et al. (2006) the survey was conducted to support the main source of our empirical findings, which were the interviews conducted with the users of Intellin diabetes management. Overall 25 respondents took part in the survey during the time it was published online. Focusing more on the content, the first section of the questionnaire constituted the general information about the study participants, however, since the general metrics are not part of the framework applied in the research, the results will only be presented in this chapter to get a better understanding of the background of the participants.

Therefore, starting with the first question, participants were asked to select their gender. The survey revealed that 80% of the respondents were females, 16% were males, while one person marked the answer “Prefer not to say” (Figure 3).

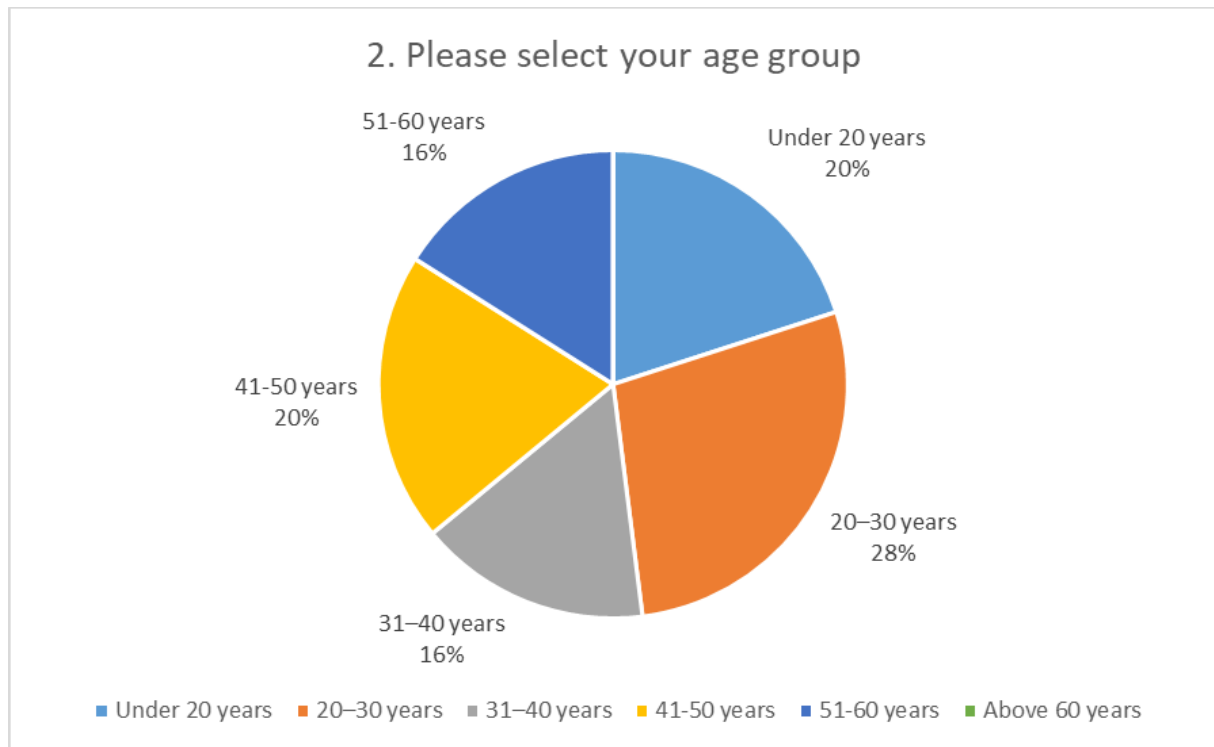


**Figure 3: Results from survey question 1: “Please select your gender”.**

Considering the outcomes, it can be concluded that the majority of the participants were females followed by males and one person of undisclosed gender.

Following the next general question, respondents were asked to select their age group resulting in the almost overall overview of the participants excluding one group. To be more specific there was nobody from the age group “Above 60 years”. Looking at the remaining ranges, the 5 (20%) responses were from people aged 20 years or below, 7 (28%) respondents placed themselves in between 20 and 30 years old, groups from 31 to 40 and from 51 to 60 collected 4 attendees per each group meaning 16% per each range, while the group aged from 41 to 50 years old took the 20% of the pie meaning there were 5 respondents in this particular group (Figure 4).

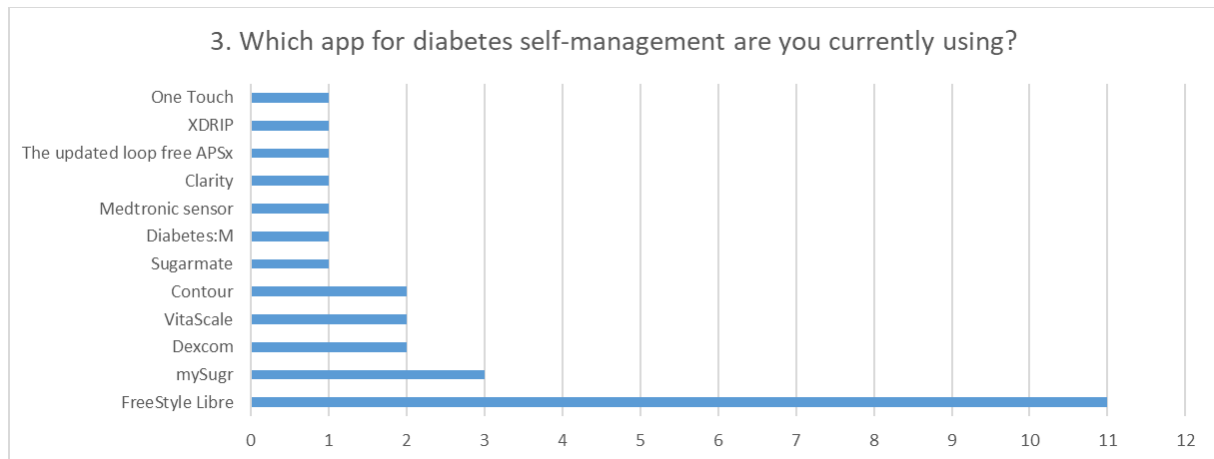




**Figure 4: Results from survey question 2: “Please select your age group”.**

Looking at Figure 4 the distribution of respondents among groups might be considered quite equal excluding the group aged above 60 years old. It means that the study received responses from various age ranges, therefore it gives a better view considering the age itself.

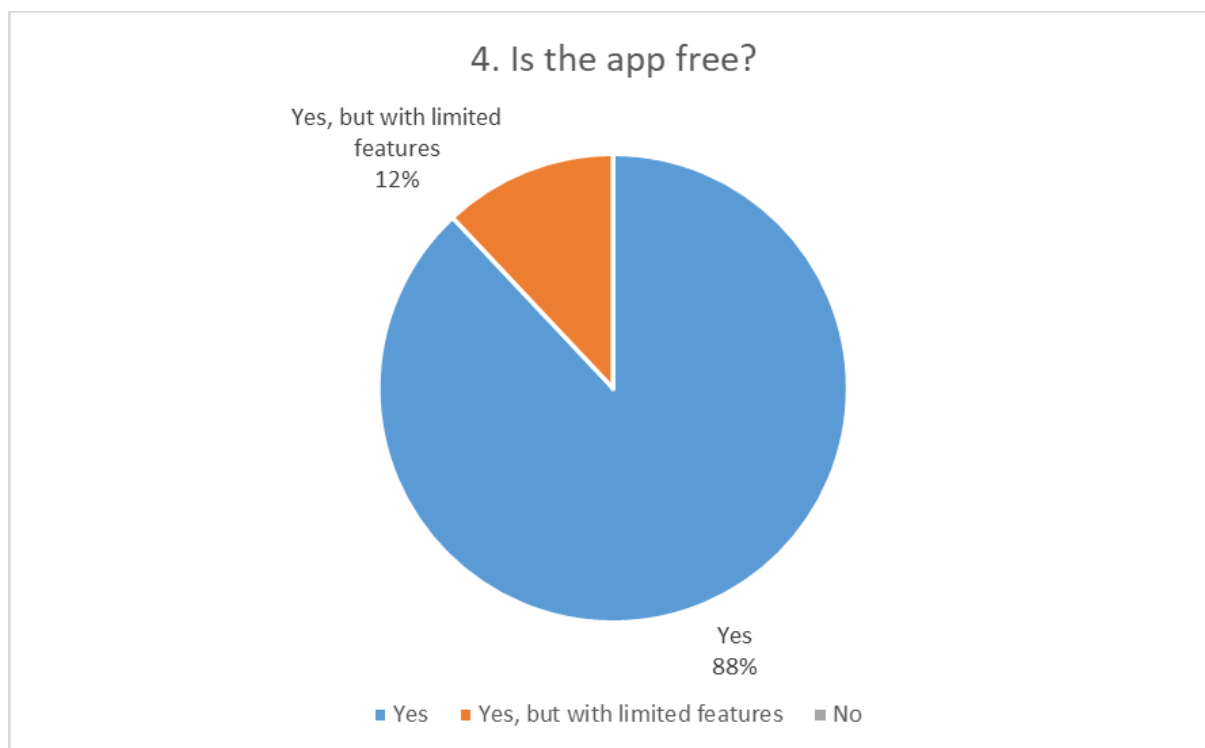
The next question was about the name of the specific app being used for diabetes self-management. Looking at the results, the app FreeStyle Libre is used by almost half of the respondents, meaning precisely 11 people (Figure 5). Other indicated apps were mySugar with 3 users then Dexcom, VitaScale, and Contour with 2 users each followed by the Sugarmate, Diabetes: M, Medtronic sensor, Clarity, the updated loop-free APSx, XDRIP, and One-Touch being chosen by 1 user each (Figure 5).



**Figure 5: Results from survey question 3: “Which app for diabetes self-management are you currently using?”.**

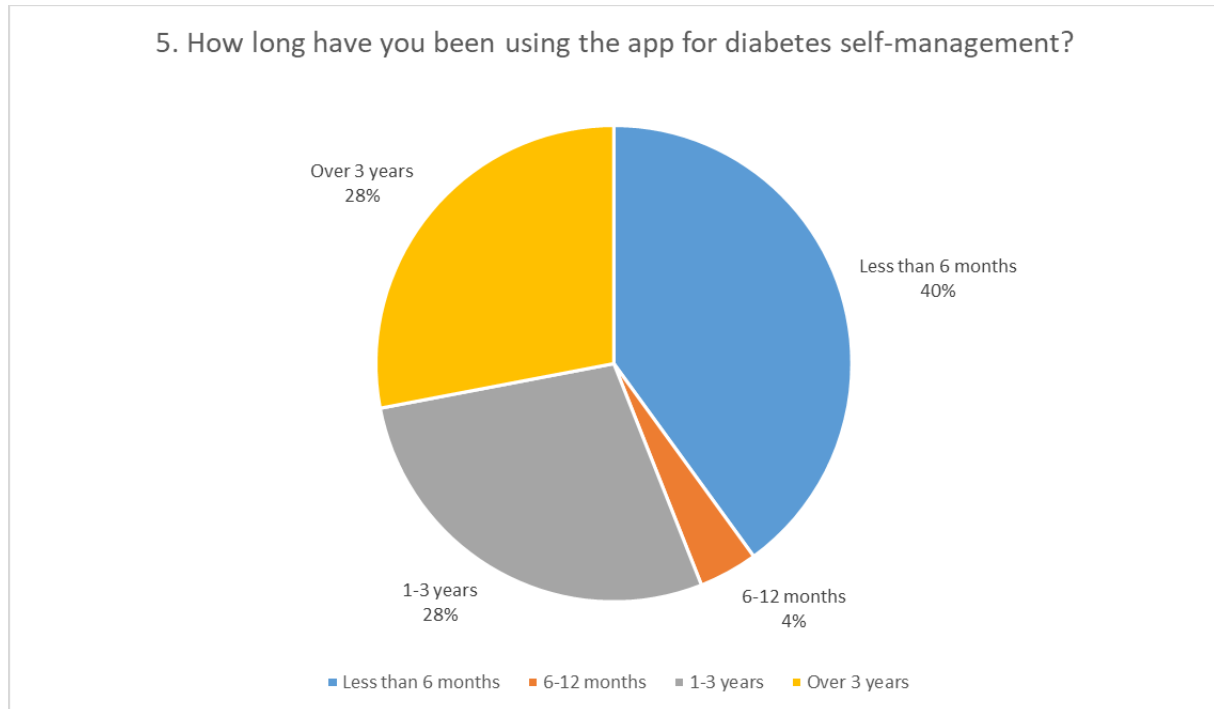
The data from the chart clearly indicates that there is one application that has been chosen by the majority of the respondents in comparison to different solutions listed among the responses. Since the responses could be typed manually in the questionnaire, there were no limitations in the form of predefined answers. Therefore, the presented findings can be found as an accurate distribution of mHealth application for diabetes, considering the attendees' group of this particular study.

Question number four, in the general metrics, was designed to find out “Is the app free?”. Looking at the results below it can be seen that 100% of respondents answered: “Yes” or “Yes, but with limited features” (Figure 6). There were 0% of participants choosing the “No” answer, thus it can indicate that all of the applications considered in question number three were free taking into account at least the basic features.



**Figure 6: Results from survey question 4: “Is the app free?”.**

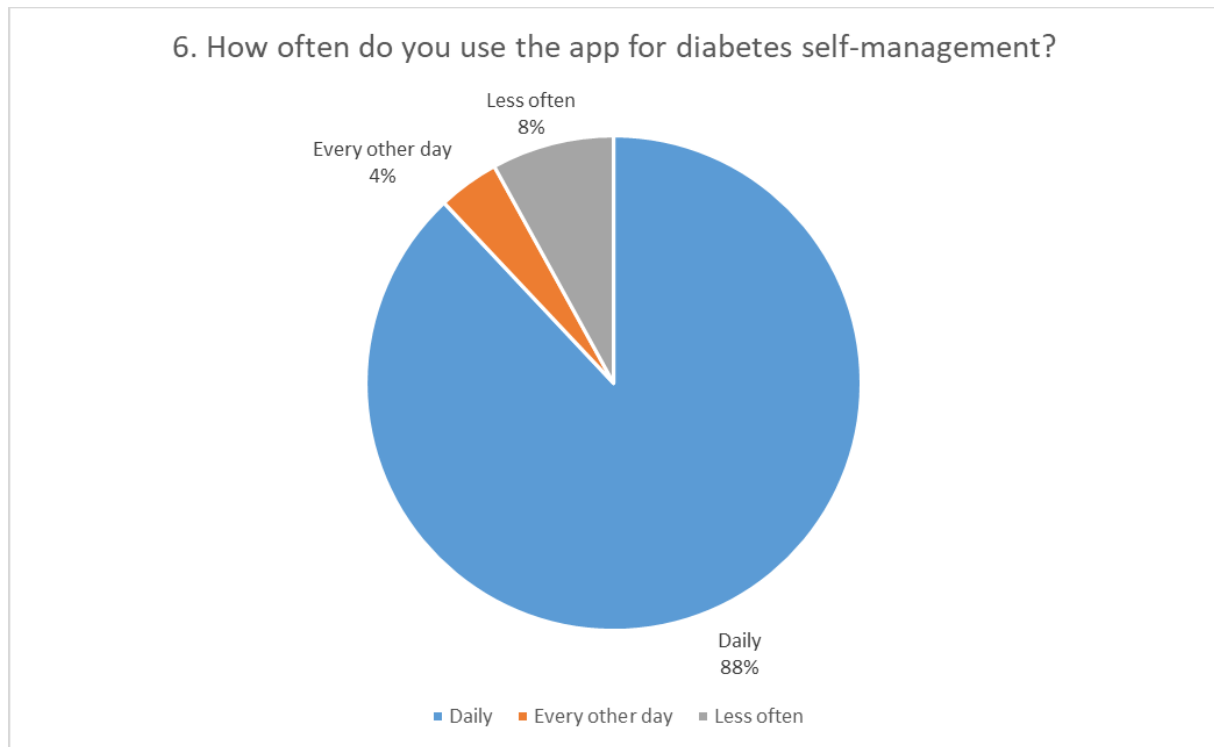
The next question aimed to find out about the time that the app for diabetes self-management has been used by the participant. Findings indicate that the outstanding group consisting of 10 respondents has been using the app for less than 6 months (Figure 7). Then the equal distribution of 7 respondents per group can be seen among people using the app from 1 to 3 years and over 3 years followed by the one person who indicated the use of the app in the range from 6 to 12 months (Figure 7).



**Figure 7: Results from survey question 5: “How long have you been using the app for diabetes self-management?”.**

By looking at the results in this question, it can be found that 40% of the respondents can be called newcomers in the area of mHealth for diabetes self-management since they are using the app for less than 6 months (Figure 7). On the other hand, there are users who seem to be familiar with the application for a longer period of time, especially considering the 28% of respondents using the app for over 3 years.

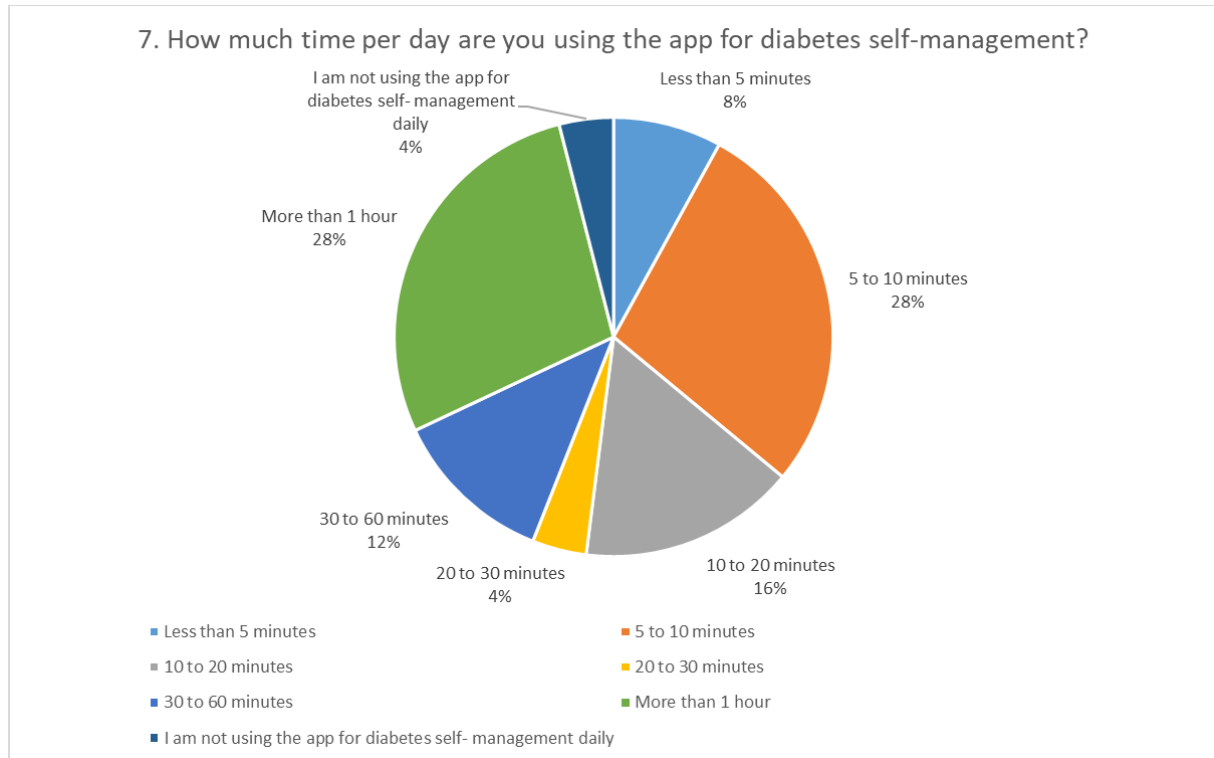
Having the information about how long the app has been used, the following question was designed to find out how often the app is being used. Resulting in the majority of respondents, precisely 22 people, marking that they are using the app “Daily”, the minority of respondents, 2 and 1 attendees, answered that they are using the app “Less often” or “Every other day” respectively (Figure 8).



**Figure 8: Results from survey question 6: “How often do you use the app for diabetes self-management?”.**

The answers given to the question above indicate the continuous monitoring and treatment of diabetes in the context of maintaining all the parameters at the optimum level and recording/reading the necessary information in the app.

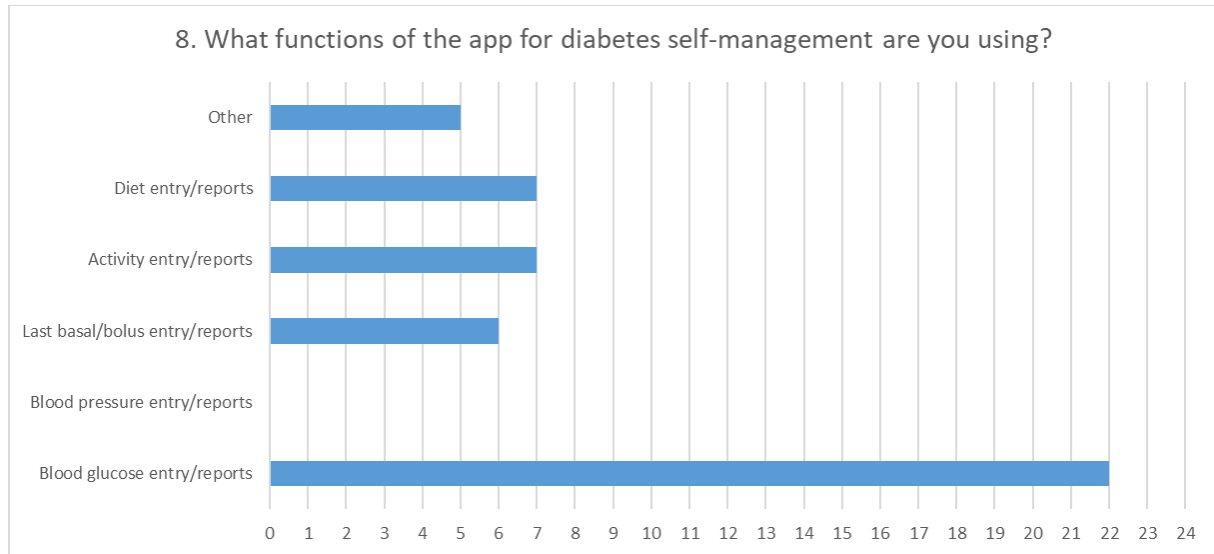
Knowing how often the app is being used, the next, adjunctive, question was to get the information on how much time per day is dedicated to using the app for diabetes self-management. Here the answers are distributed in a consequent way. There were 7 people who responded to using the application from “5 to 10 minutes” per day, with the same number of people indicating the use of the app for more than one hour per day (Figure 9). Then 4 people indicated the range between 10 and 20 minutes daily, followed by the group fitted in between the 30 and 60 minutes interval chosen by 3 respondents (Figure 9). The app has been used for less than 5 minutes per day by 2 people who participated in the survey and per 1 person for each group, the mHealth for diabetes was used for from “20 to 30 minutes” per day or it was not being used daily (Figure 9). After listing all the responses, the differences between time of engagement with the app on a daily basis can be seen by looking at the answers to question number seven.



**Figure 9: Results from survey question 7: “How much time per day are you using the app for diabetes self-management?”.**

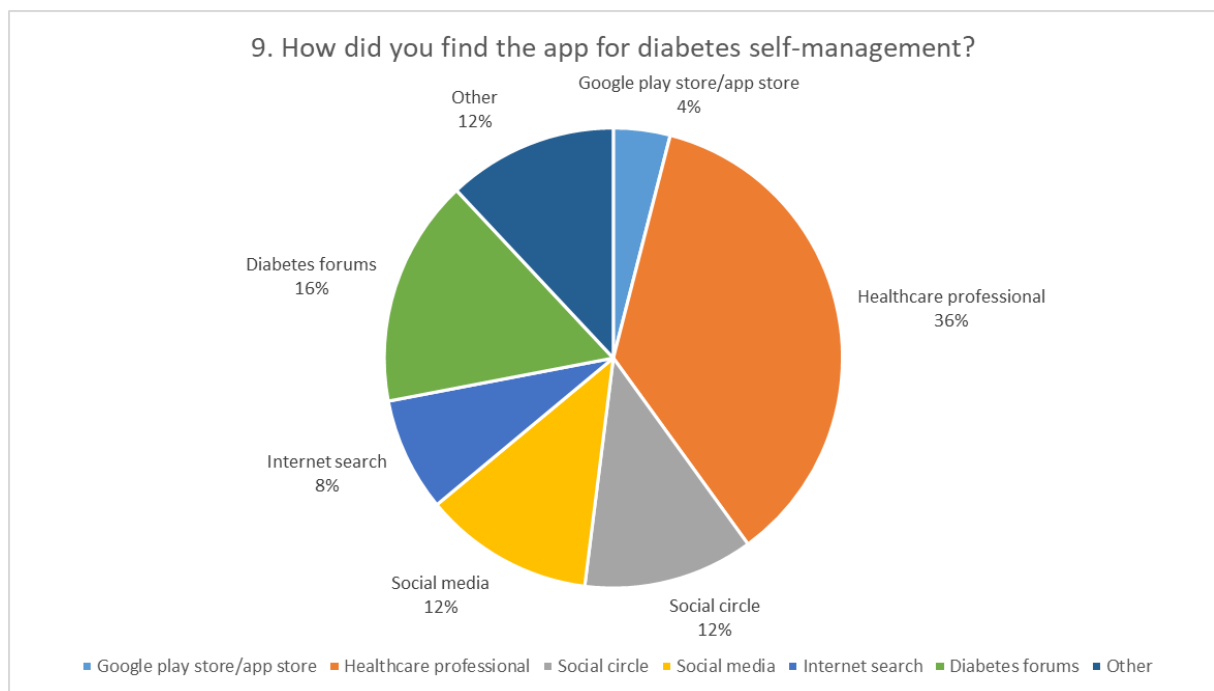
The next question can be found to match the general questions group as well as the use/intention to use questions group, however, it was placed in the general questions in the survey, therefore, it will be described here. The findings brought by question number eight clearly indicate that “Blood pressure entry/reports” were not chosen by any of the participants of the research (Figure 10). On the other hand, the “Blood glucose entry/reports” constitute the major function being used in the apps for diabetes self-management and the answer was marked 22 times (Figure 10). “Activity entry/reports” and “Diet entry/reports” gathered 7 respondents for each of these groups, followed by “Last basal/bolus entry/reports” and “Other” being chosen by 6 and 5 respondents respectively (Figure 10).





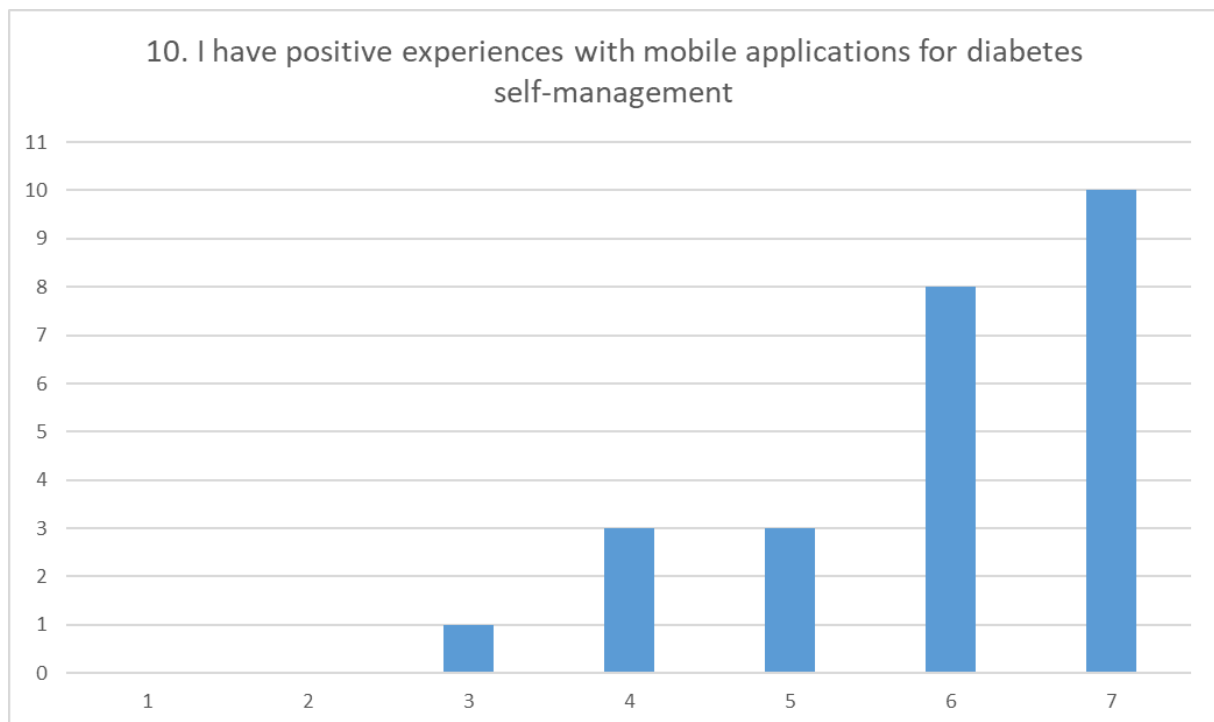
**Figure 10: Results from survey question 8: “What functions of the app for diabetes self-management are you using?”.**

Considering that mHealth is relatively new among users, the survey included the question about how the application was found by the user, meaning what triggered the start of using it. Healthcare professionals turned out to be the group that was most frequently chosen, resulting in 9 people referring to them as someone who told them about the application (Figure 11). Then 4 respondents pointed out the forums for diabetes as the source of information about the app, followed by the “Social circle”, “Other”, and “Social media” which gathered 3 responses each (Figure 11). As the two last categories the “Internet search” and “Google play store/app store” were indicated by the 2 and 1 respondents respectively (Figure 11).



**Figure 11: Results from survey question 9: “How did you find the app for diabetes self-management?”.**

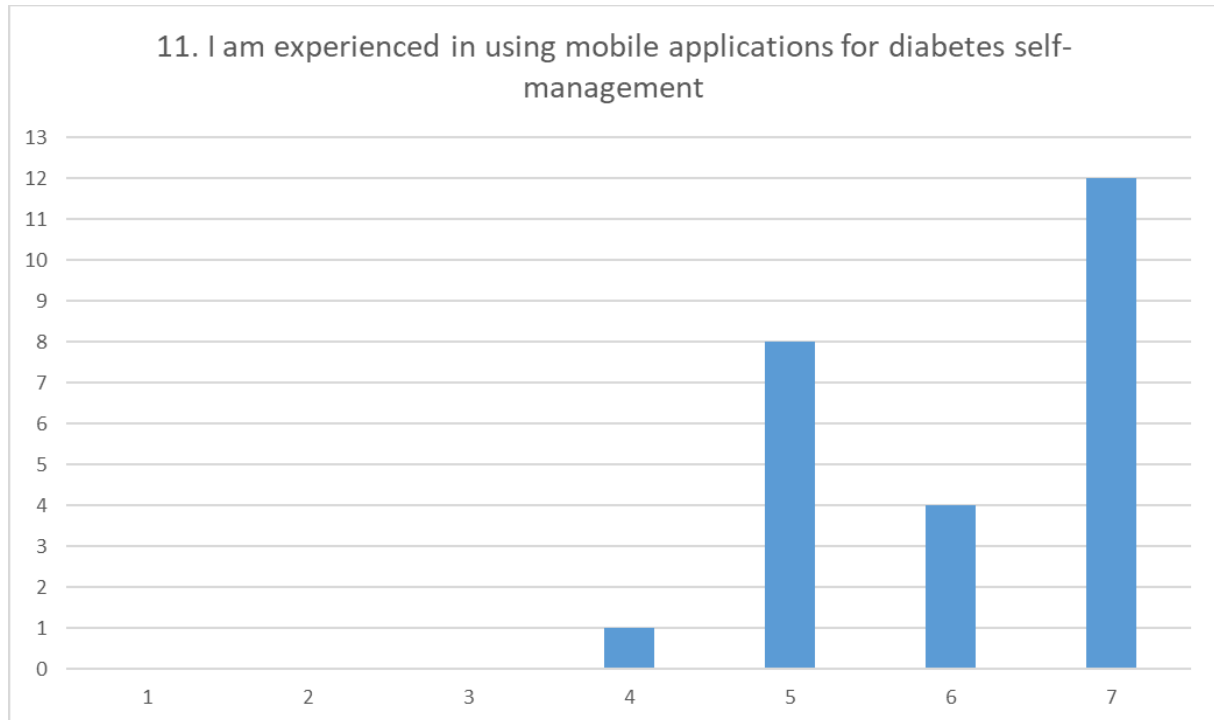
The next question was regarding the positive experiences in terms of mobile applications for diabetes to determine what the real-world feedback on mHealth in this area are. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 10 answered with 7 meaning they strongly agreed with the statement, followed by 8 who answered 6, 3 who answered 5, also 3 who answered 4, and 1 who answered 3 (Figure 12).



**Figure 12: Results from survey question 10: “I have positive experiences with mobile applications for diabetes self-management”.**

The results visible in Figure 12 above indicate that there was only one person who marked 3 on the 7th scale meaning that the majority of users have rather positive experiences while using the app for diabetes self-management.

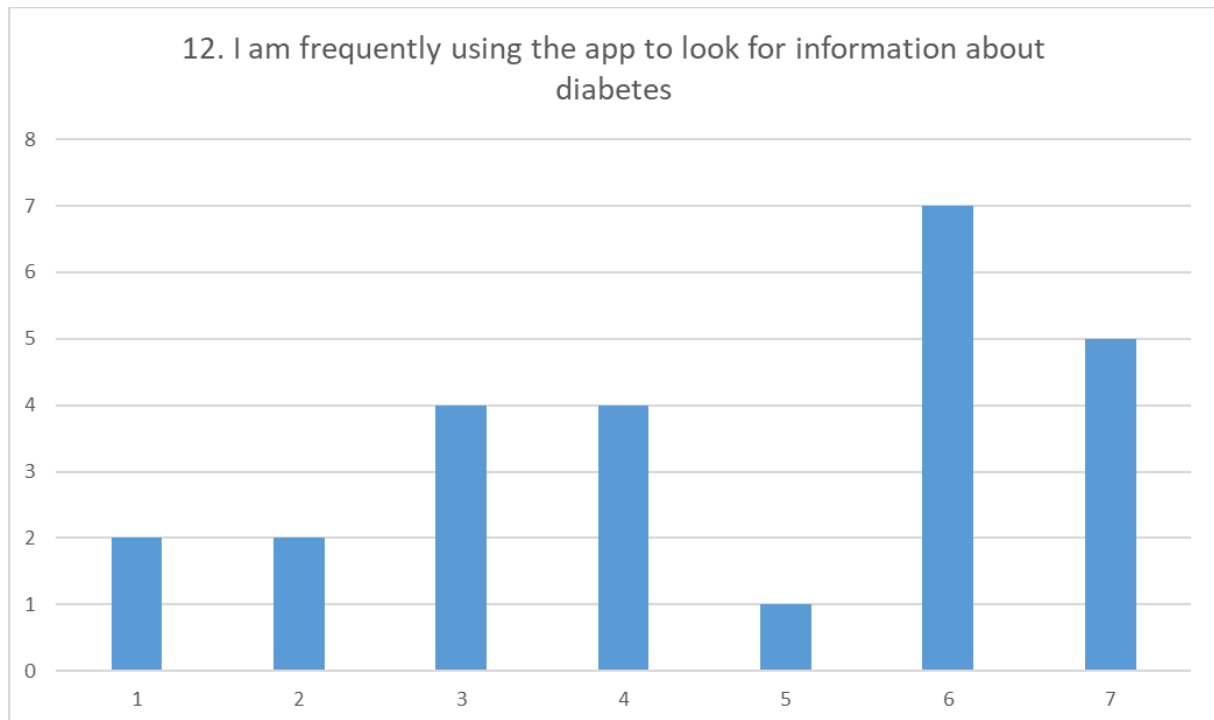
Following question number 11 where the respondents were asked to determine their experience level in using the applications for diabetes. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 12 answered with 7 meaning they strongly agreed with the statement about being well experienced in using the apps, followed by 4 who answered 6, 8 who answered 5, and 1 who answered 4 (Figure 13).



**Figure 13: Results from survey question 11: “I am experienced in using mobile applications for diabetes self-management”.**

The results presented in Figure 13 above can indicate that the respondents were rather confident in their experience in using the mHealth applications for diabetes since only one respondent has answered 4 on the scale meaning the neutral position as it is in the middle of the 7-grade range.

The last question in the general section with number 12 aimed to discover the frequency of using the app for the purpose of looking for information about diabetes. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. The answers to this question were distributed among the whole range. Out of the 25 participants, 5 answered 7 meaning they strongly agreed with the statement about looking for the information about diabetes in the app frequently, followed by 7 who answered 6, 1 who answered 5, 4 who answered 4, also 4 who answered 3, 2 who answered 2 and 2 who answered 1 (Figure 14).



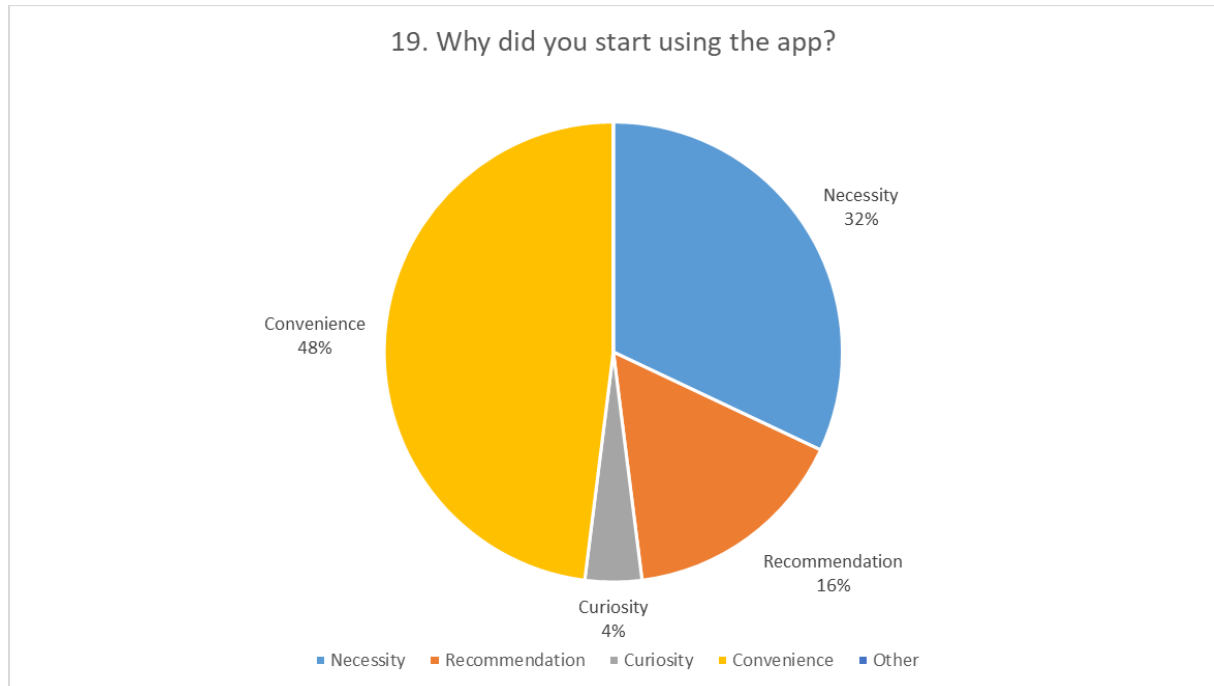
**Figure 14: Results from survey question 12: “I am frequently using the app to look for information about diabetes”.**

The results in this question are quite distributed among the range, therefore it is not clear what the most common way of using the app is considering the information about diabetes. Nevertheless, the prevalence of the respondents who agreed with the statement can still be noticed while looking at the chart (Figure 14).

#### 4.2.1 *Intention to Use*

In the next part of the survey the focus was put on the intention to use. The section was not put in the same order in the actual survey because of the decided flow of the questionnaire. Gathering responses regarding the intentions of using the application was aimed to help in discovering the motives behind actually engaging with the app.

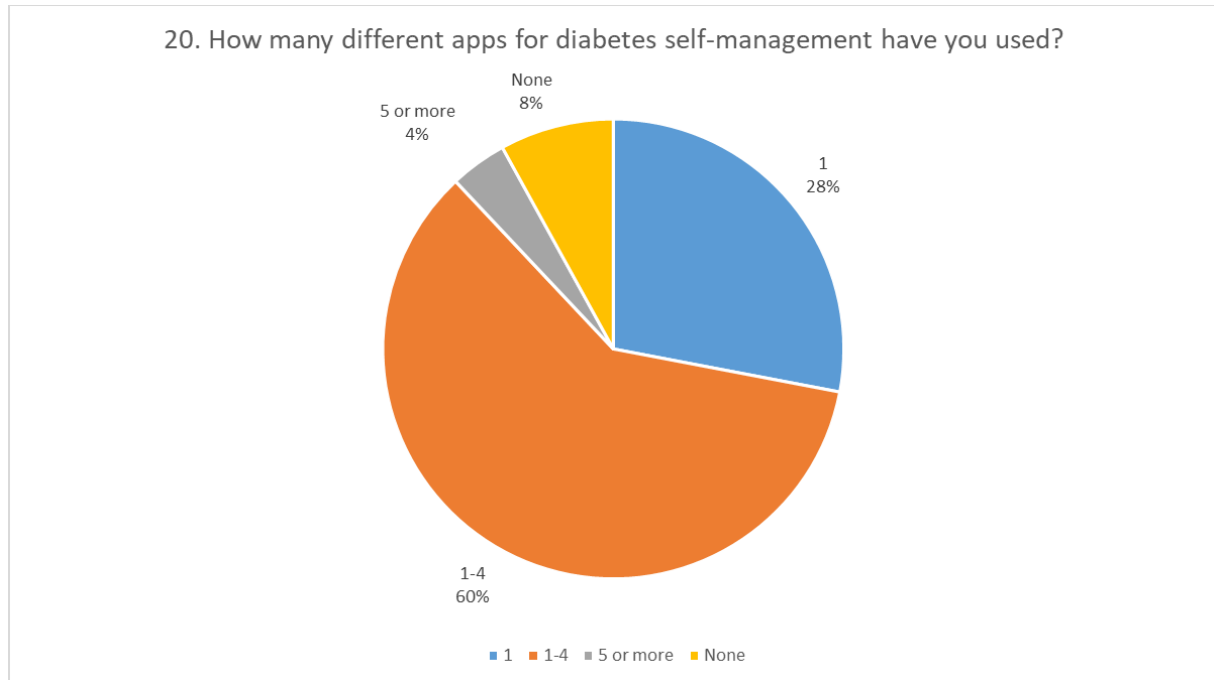
The first question asked in this section related to the reason why the person started using the app in the first place. All the 25 respondents who answered this question with the result of almost half of them, counting 12 participants, reported using the app for the convenience it brings in managing diabetes (Figure 15). The next group consists of people who started to use the application out of necessity, followed by the ones who decided to give the mHealth a try after receiving a recommendation to do so with the result of 8 choices for this reason (Figure 15). The minority, because only 1 respondent indicated starting using the app out of curiosity (Figure 15). None has chosen the “Other” answer to this question despite it being available.



**Figure 15: Results from survey question 19: “Why did you start using the app?”.**

The results described above indicate that mHealth is perceived as something which brings more convenience to their lives while managing diabetes. However, there is another important group where people started to use the application because it was somehow required for them to engage with this kind of solution. Since nobody has chosen the “Other” response it might indicate that the reasons behind using the app are clear and available on the premade list, at least considering the participants of this particular study.

The second question in the intention to use section targeted to check how many different applications the particular user has been using overall. The majority of the answers were in the bracket of 1 to 4 different applications, meaning that 15 respondents have pointed to this particular number of apps (Figure 16). One different application was declared to be used by 7 people followed by the answer “None” chosen by 2 and “5 or more” chosen by 1 (Figure 16).



**Figure 16: Results from survey question 20: “How many different apps for diabetes self-management have you used?”.**

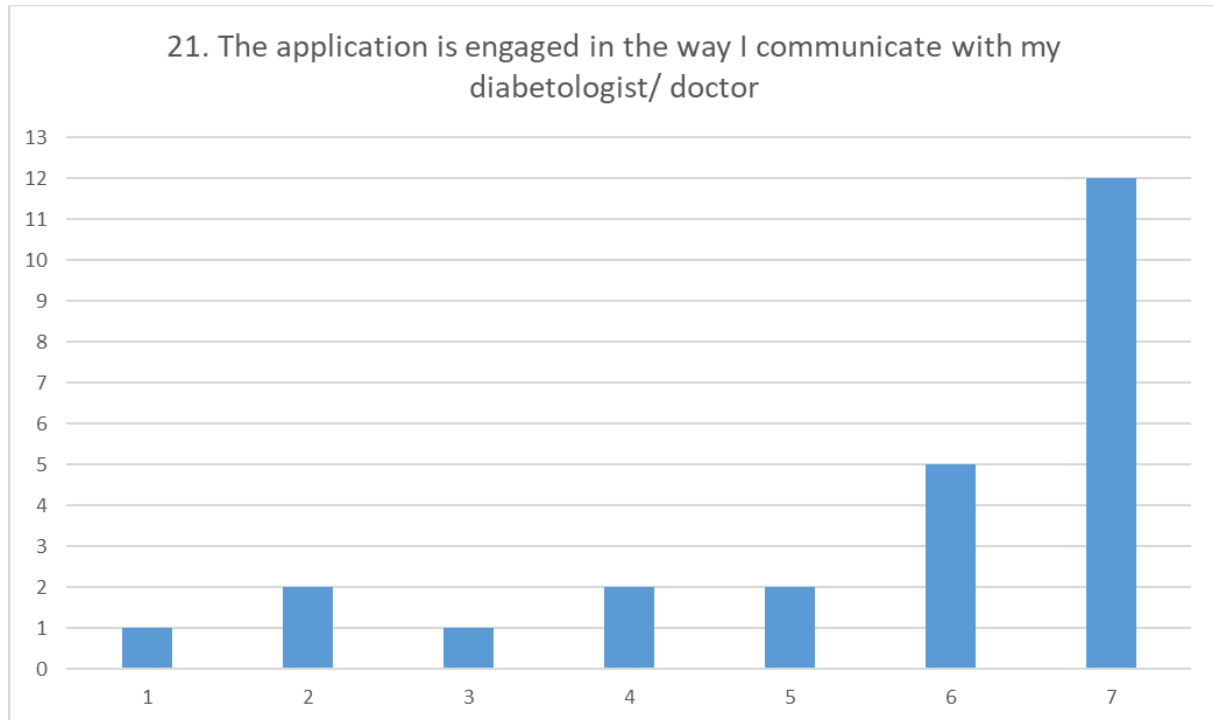
The results brought an insight that more than half of the respondents have been using more than one application in the range from 1 to 4 solutions. It shows the attitude towards testing different applications and perhaps choosing what works best in each individual case. A few people have used 5 or more apps therefore it shows that the trend is following the range from 1 to 4 different solutions.

#### 4.2.2 Use

In the actual survey, the section of use was merged with the intention to use, however for the purposes of the framework analysis it is brought up here as an independent part of the questionnaire. This section constitutes to describe the way the applications are being used meaning mainly the functionalities utilized while applying the solution in one’s life.

In the next question, the respondents were asked to indicate to what extent they agree with the statement “The application is engaged in the way I communicate with my diabetologist/doctor.”. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 12 answered with 7 meaning they strongly agreed with the statement, followed by 5 who answered 6, 2 who answered 5, also 2 who answered 4, 1 who answered 3, 2 who answered 2, and 1 who answered 1 (Figure 17).

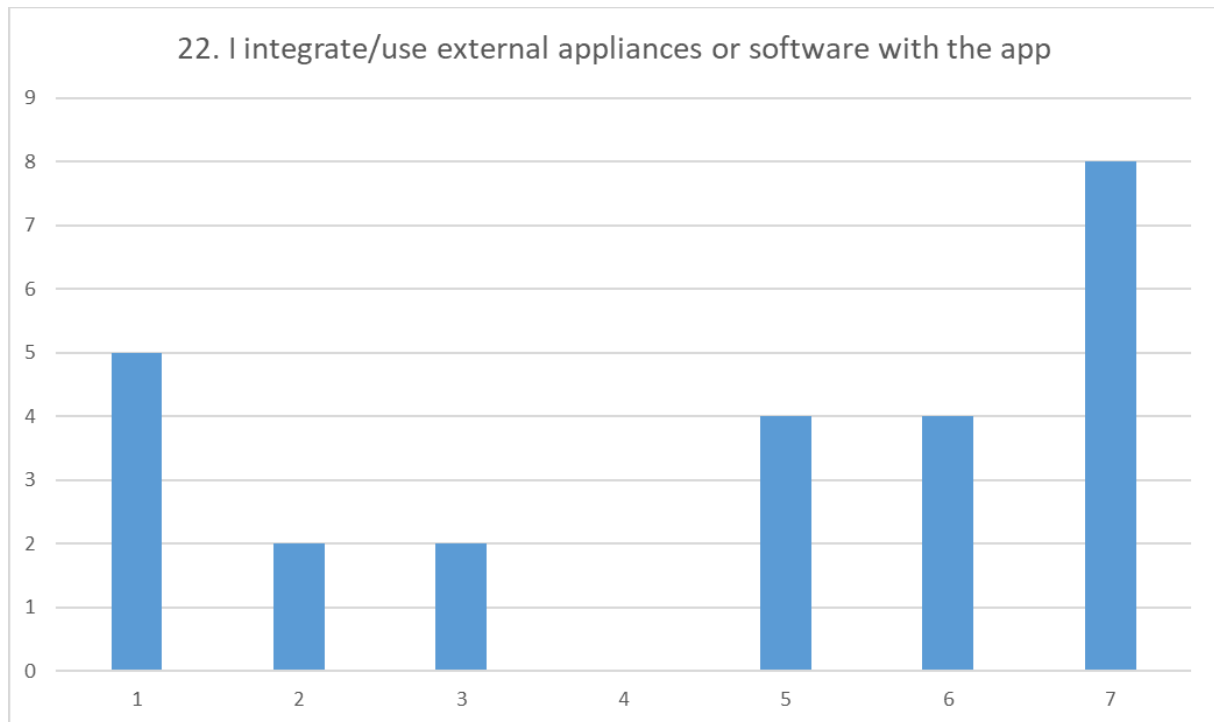




**Figure 17: Results from survey question 21: “The application is engaged in the way I communicate with my diabetologist/ doctor”.**

The results of the question presented above are distributed among all the points on the scale, however, the prevalence is visible when considering the “Strongly agree” answer meaning that the application is usually engaged in the communication with the diabetologist/doctor.

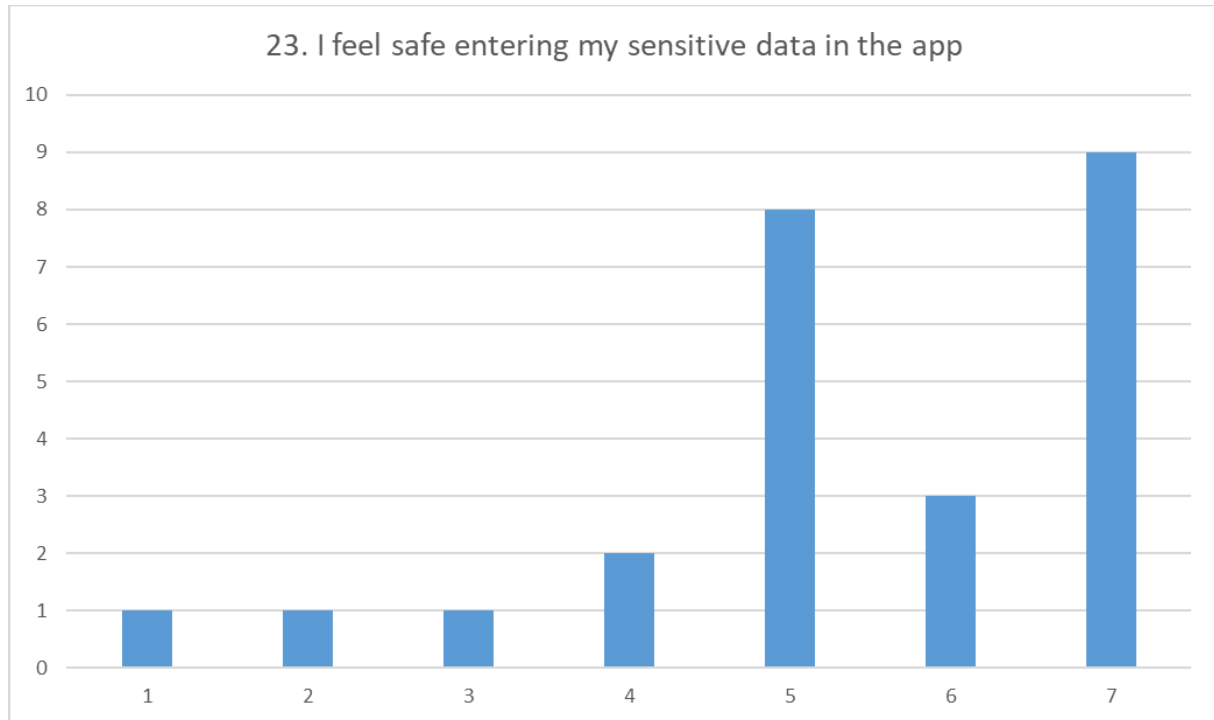
The following question aimed to check whether the users integrate external appliances or software with the app. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 8 answered with 7 meaning they strongly agreed with the statement, followed by 4 who answered 6, also 4 who answered 5, 0 who answered 4, 2 who answered 3, also 2 who answered 2, and 5 who answered 1 (Figure 18).



**Figure 18: Results from survey question 22: “I integrate/ use external appliances or software with the app”.**

The answers visible in Figure 18 indicate that there are some users who do integrate external devices or software with the app, however, it is not crystal clear to determine that the majority of the respondents are doing it. Nevertheless, there are still more respondents on the side of “Strongly agree” in comparison to “Strongly disagree”.

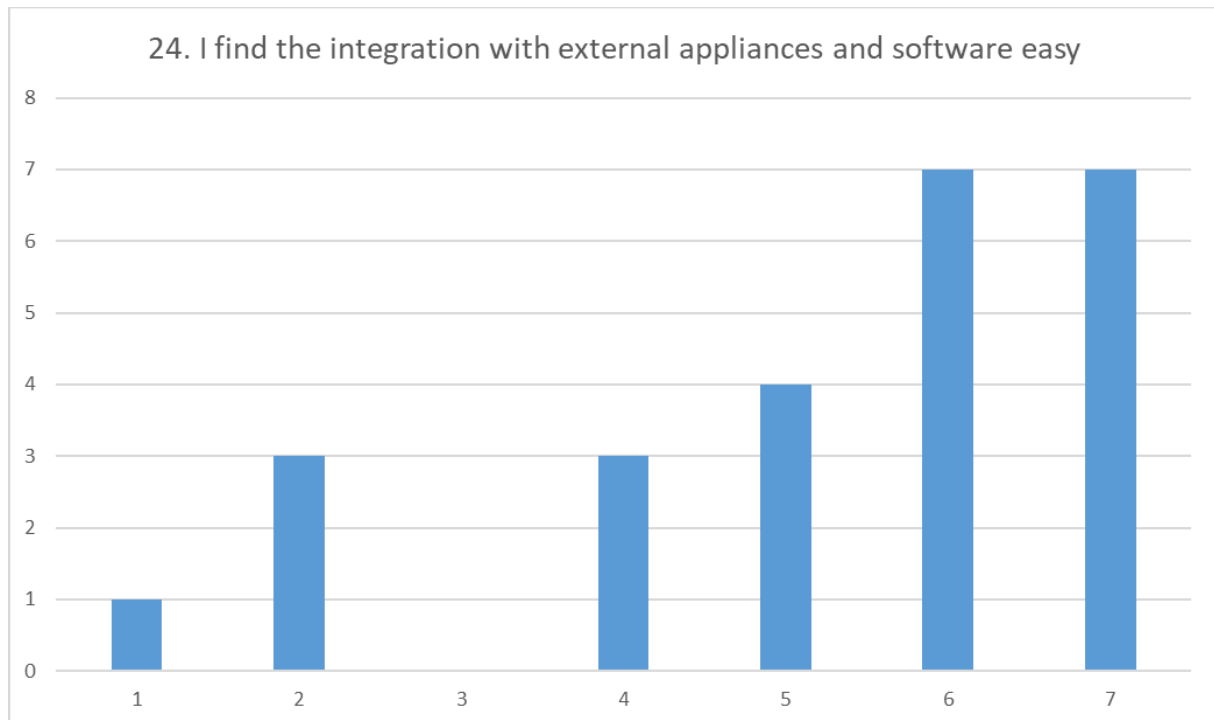
In the next question, the respondents were asked to indicate to what extent they agree with the statement “I feel safe entering my sensitive data in the app”. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 9 answered with 7 meaning they strongly agreed with the statement, followed by 3 who answered 6, 8 who answered 5, 2 who answered 4, 1 who answered 3, also 1 who answered 2, and similarly, the lowest number on the scale, which is 1 received 1 answer (Figure 19).



**Figure 19: Results from survey question 23: “I feel safe entering my sensitive data in the app”.**

The results presented in Figure 19 indicate that the majority of users feel safe when entering their sensitive data in the application. On the other hand, there were only a few respondents marking levels lower than 4 on the scale.

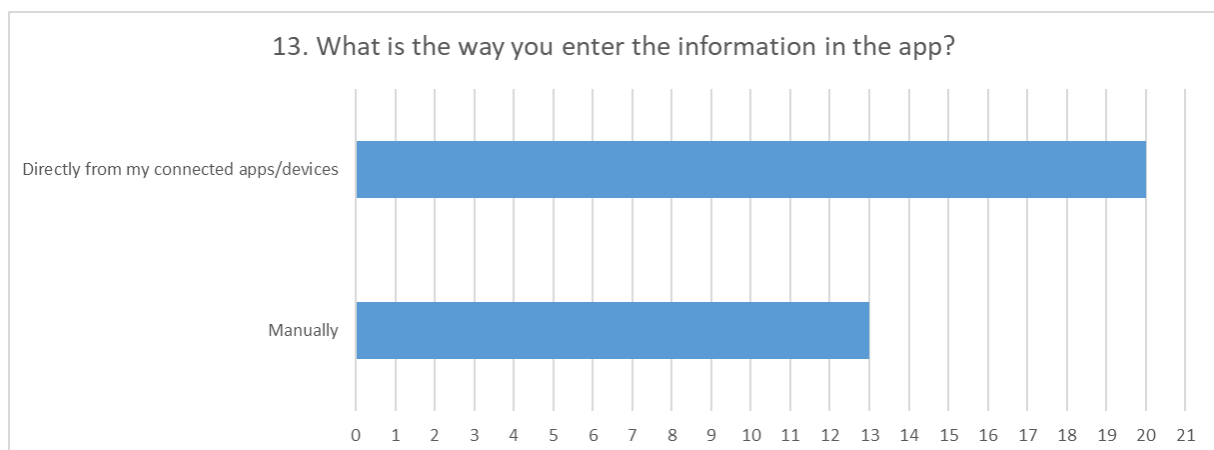
The following and last question in this section aimed to check whether the users find the integration with the external devices and software easy. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 7 answered with 7 meaning they strongly agreed with the statement that the integration is easy to perform, followed by 7 who answered 6, also 4 who answered 5, 3 who answered 4, 0 who answered 3, also 3 who answered 2, and 1 who answered 1 (Figure 20).



**Figure 20: Results from survey question 24: “I find the integration with external appliances and software easy”.**

The answers collected to the question about the ease of the integration of external devices or software indicate that the majority of respondents found the integration rather easy while only a few of them answered that they do not agree with the statement.

The next question was: “What is the way you enter the information in the app?”. This question was answered by all 25 participants, by selecting the option “Manual”, the option “Directly from my connected apps/devices”, or both. Out of the 25 participants, 20 answered “Directly from my connected apps/devices” and 13 “Manually”. We decided to move this question to the use section of the survey results to maintain a coherent flow with the outcomes of the semi-structured interviews. The results can be viewed in the following bar chart (Figure 21):



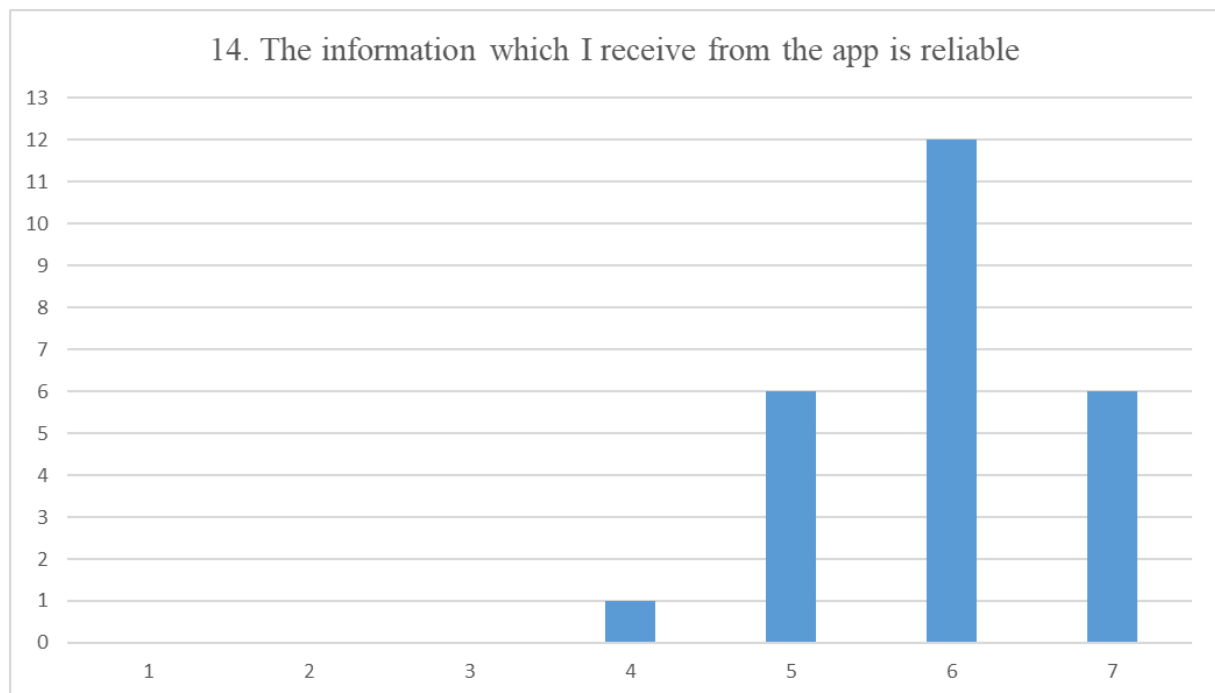
**Figure 21: Results from survey question 13: “What is the way you enter information in the app?”.**

Since 80% of the participants answered that they enter their information “Directly from my connected apps/devices”, we can infer that information is entered in the application mostly automatically (with connected apps/devices) by the participants. However, no conclusion can be drawn regarding manual information entry, since 52% of the participants answered that they enter their information manually.

#### 4.2.3 Information Quality

This part of the survey aimed towards getting a general view of the respondent’s opinion on the information quality of diabetes self-management applications.

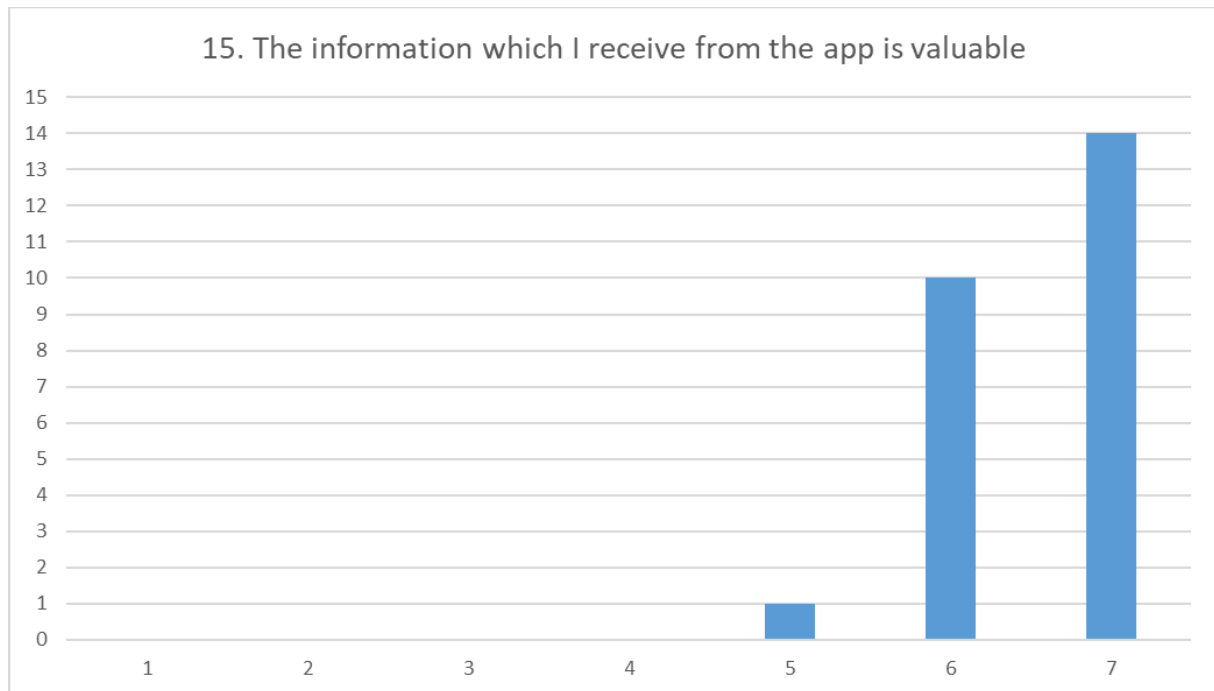
The first question of this section of the survey was: “The information which I receive from the app is reliable”. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one being “Strongly disagree” and seven being “Strongly agree”. Out of the 25 participants, 6 answered with 7, 12 answered with 6, 6 answered with 5, and 1 answered with 4. The results can be viewed in the following histogram (Figure 22).



**Figure 22: Results from survey question 14: “The information which I receive from the app is reliable”.**

None of the participants thought that the application they were using was unreliable, since no answer was below 4. Thus, we can assume that the participants generally believe that the applications for diabetes self-management they were using are reliable.

Following this, the next question was: “The information which I receive from the app is valuable”. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one being “Strongly disagree” and seven being “Strongly agree”. Out of the 25 participants, 14 answered with 7, 10 answered with 6, and 1 answered with 5. The results can be viewed in the following histogram (Figure 23):

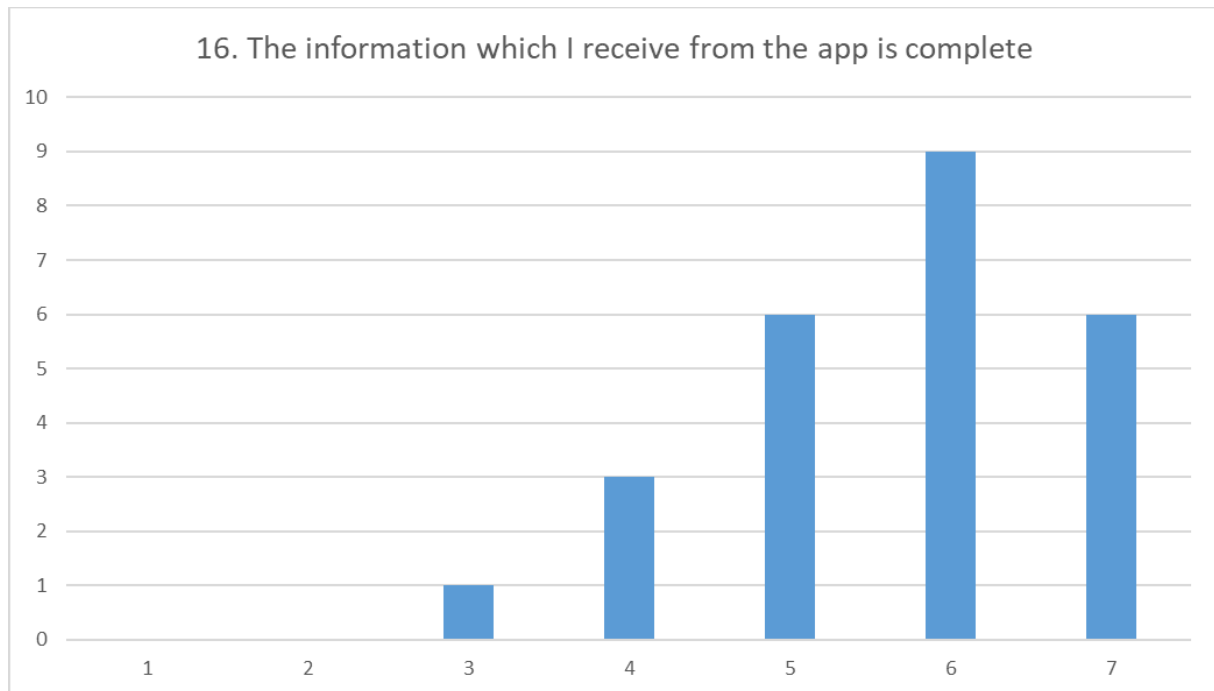


**Figure 23: Results from survey question 15: “The information which I receive from the app is valuable”.**

Given these results, it is safe to assume the participants generally think that the applications for diabetes self-management they were using were valuable to them, since no answer was below 5.

After this, the next question of this section was: “The information which I receive from the app is complete”. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one being “Strongly disagree” and seven being “Strongly agree”. Out of the 25 participants, 6 answered with 7, 9 answered with 6, 6 answered with 5, 3 answered with 4, and 1 answered with 3. The results can be viewed in the following histogram (Figure 24):

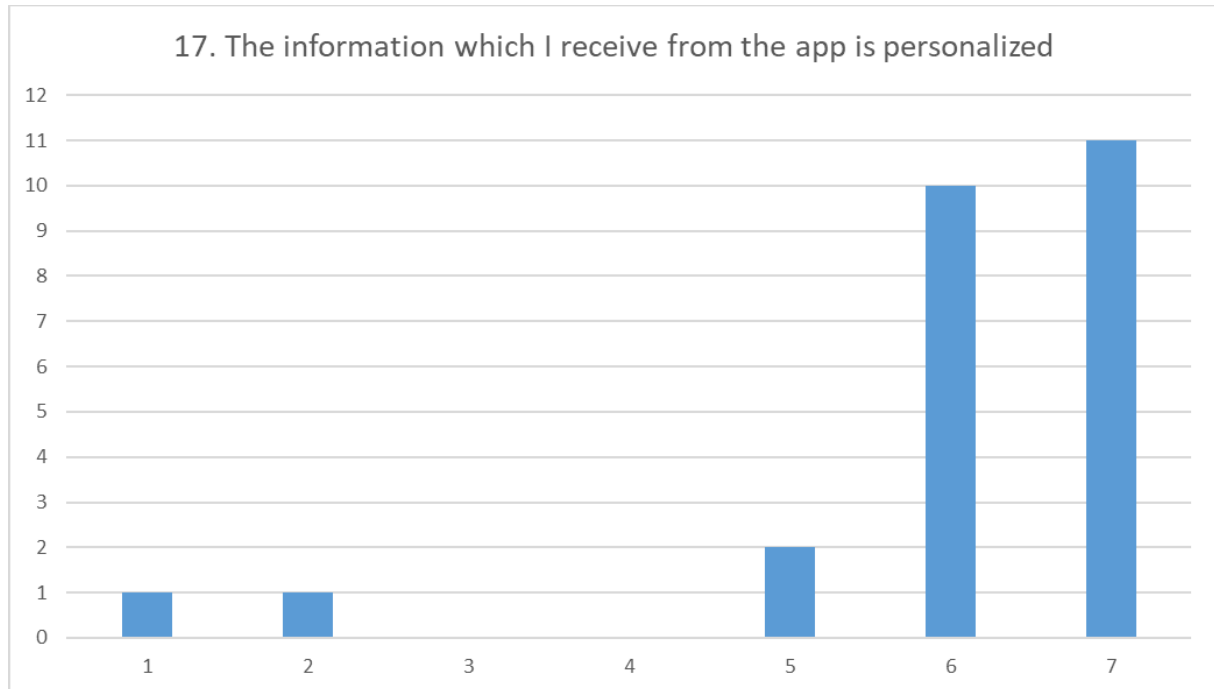




**Figure 24: Results from survey question 16: “The information which I receive from the app is complete”.**

From this question`s results, it seems that the participants thought that the information they received from their diabetes self-management applications was fairly complete, since only one participant answered below 4.

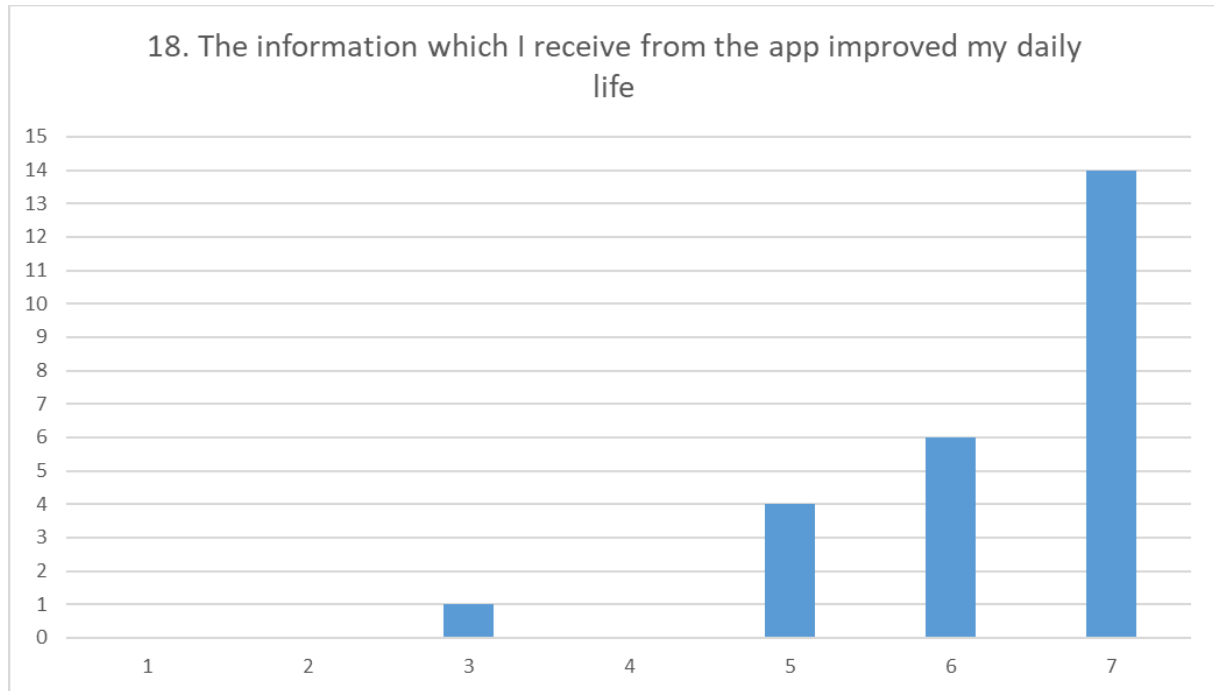
The next question in the information quality section was: “The information which I receive from the app is personalized”. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one being “Strongly disagree” and seven being “Strongly agree”. Out of the 25 participants, 11 answered with 7, 10 answered with 6, 2 answered with 5, 1 answered with 2, and 1 answered with 1. The results can be viewed in the following histogram (Figure 25):



**Figure 25: Results from survey question 17: “The information which I receive from the app is personalized”.**

The outcomes regarding this question show that only two participants answered lower than 5. Thus, we can assume that the applications they were using are generally personalized.

The next and final question of this section was: “The information which I receive from the app improved my daily life”. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one being “Strongly disagree” and seven being “Strongly agree”. Out of the 25 participants, 14 answered with 7, 6 answered with 6, 4 answered with 5, and 1 answered with 3. The results can be viewed in the following histogram (Figure 26):



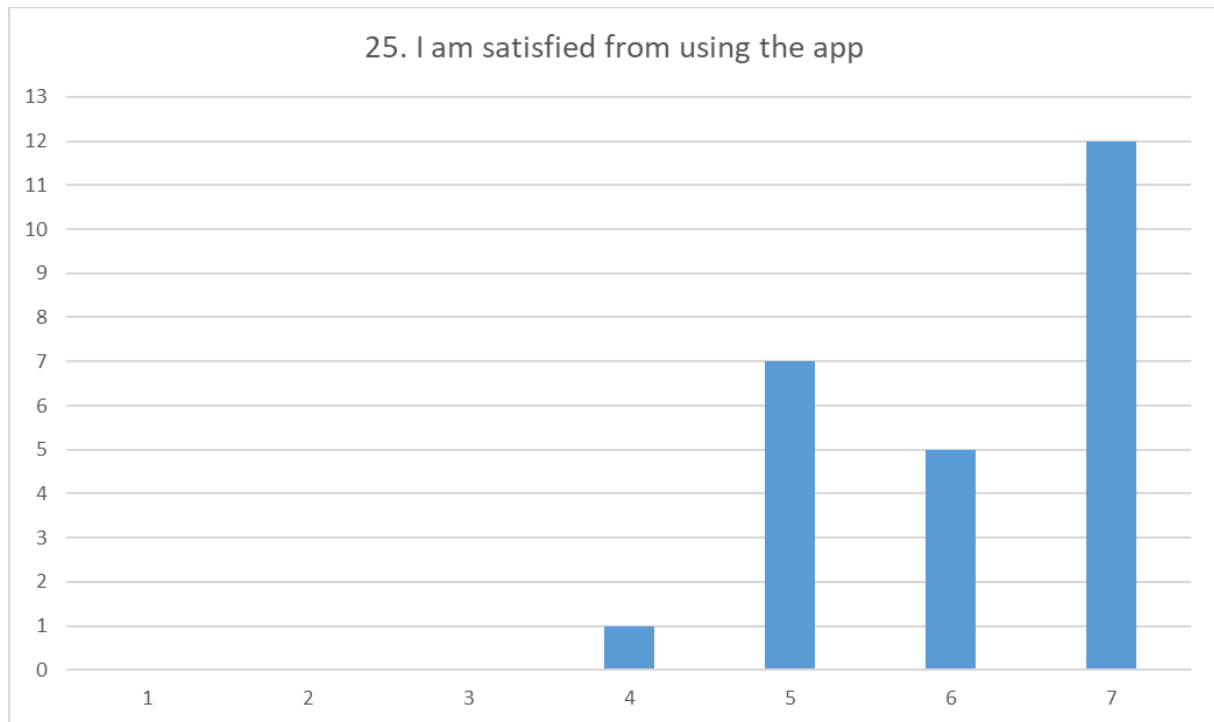
**Figure 26: Results from survey question 18: “The information which I receive from the app improved my daily life”.**

From these results, it seems that the participants thought that the information they received improved their daily life, since only one participant answered below 5.

#### 4.2.4 User Satisfaction

This section of the survey was dedicated to the user satisfaction dimension. Gathering responses regarding the satisfaction of using the application was aimed to help in discovering how the users are evaluating the overall experience of engaging with the app on a regular basis.

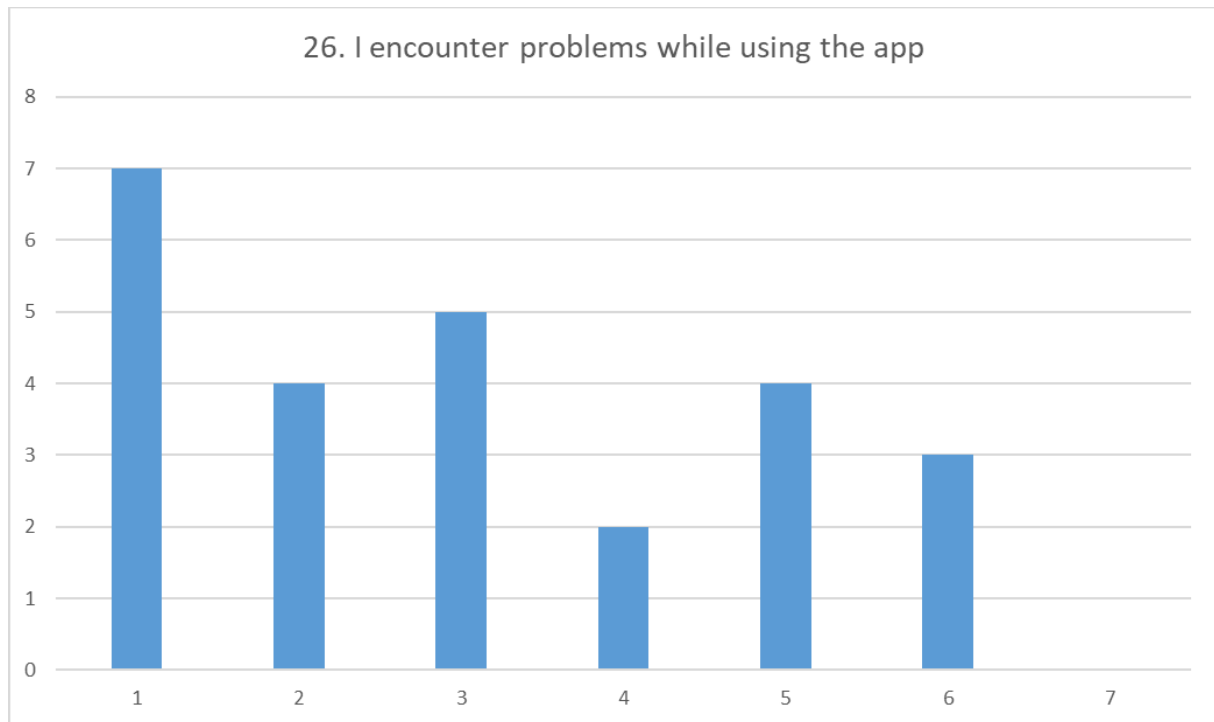
In the first question of the section, the respondents were asked to indicate to what extent they agree with the statement “I am satisfied from using the app”. This broad statement aimed to catch the general feeling about the app. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 12 answered with 7 meaning they strongly agreed with the statement, followed by 5 who answered 6, 7 who answered 5, and 1 who answered 4 (Figure 27). There were 0 answers to the points 3, 2, and 1 on the scale (Figure 27).



**Figure 27: Results from survey question 25: “I am satisfied from using the app”.**

The results visible in Figure 27 can clearly indicate that the vast majority of respondents found it satisfactory to use the application for diabetes self-management. It means that considering the gathered participants and the apps indicated that were used by them, the overall satisfaction level was maintained at a high level.

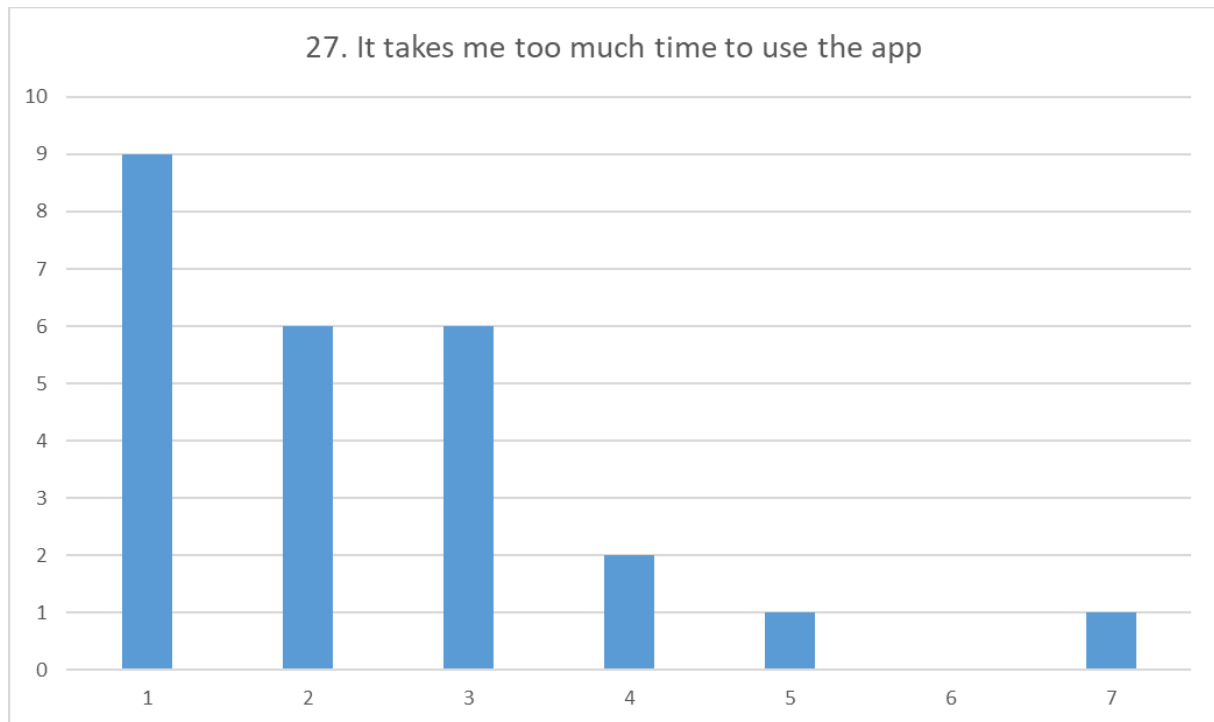
The next question in this section aimed to check whether the users encounter problems while engaging with the app. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 0 answered with 7 meaning they strongly agreed with the statement that the integration is easy to perform, followed by 3 who answered 6, 4 who answered 5, 2 who answered 4, 5 who answered 3, 4 who answered 2, and 7 who answered 1 (Figure 28).



**Figure 28: Results from survey question 26: “I encounter problems while using the app”.**

The distribution of the participants’ answers is seen to be divided between almost the whole scale excluding the number 7 which means “Strongly agree”. It indicated that some users encountered some problems while using the app, but nobody faced an extensive issue to be motivated to mark the highest point in the range. On the other hand, 7 respondents pointed to “Strongly disagree” meaning that there is a group of diabetes who have not faced any issues along the way while using the application.

In the following question of the section, the respondents were asked to determine whether using the app takes too much of their time. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 1 answered with 7 meaning they strongly agreed with the statement, followed by 0 who answered 6, 1 who answered 5, 2 who answered 4, 6 who answered 3, also 6 who answered 2, and 9 who answered 1 (Figure 29).

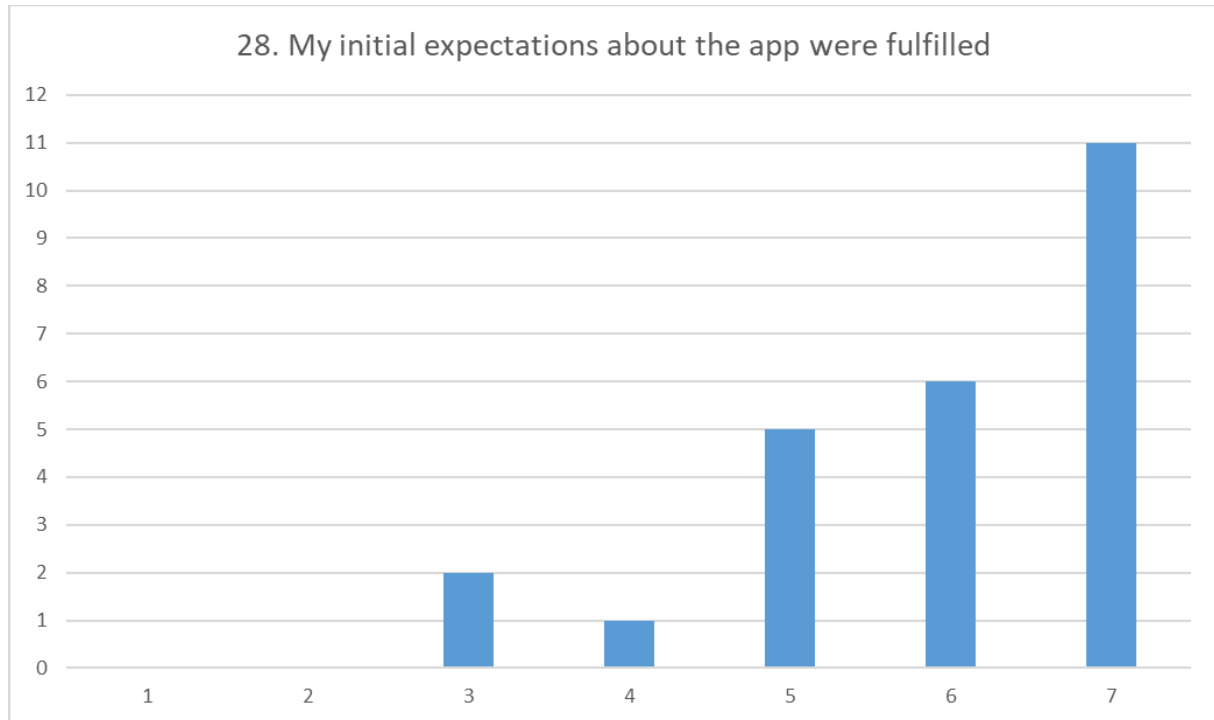


**Figure 29: Results from survey question 27: “It takes too much time to use the app”.**

The cumulation of the answers on the side focusing on disagreement indicated that respondents did not find the app for diabetes self-management to take too much of their time while using it. Only 1 person indicated to indicate 7 meaning the strong agreement with the statement that it indeed takes too much time.

In the next question, the respondents were presented with the statement to indicate to what extent they agree with the following “My initial expectations about the app were fulfilled.”. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 11 answered with 7 meaning they strongly agreed with the statement, followed by 6 who answered 6, 5 who answered 5, 1 who answered 4, and 2 who answered 3 (Figure 30). There were 0 answers to points 2, and 1 on the scale (Figure 30).

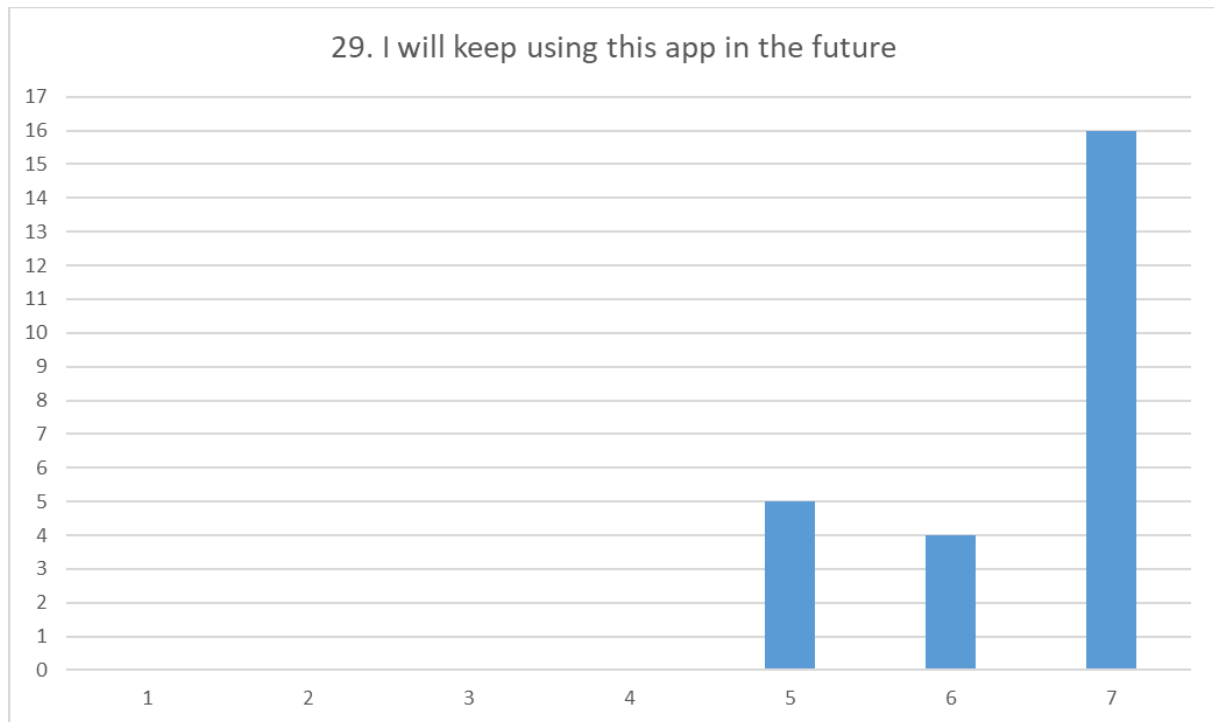




**Figure 30: Results from survey question 28: “My initial expectations about the app were fulfilled”.**

The outcomes in this question showed that most of the respondents agree with the statement that their initial expectations were fulfilled. Only 2 answers were given to point 3 on the scale meaning there is no strong disagreement with the statement, therefore it can be concluded that the app mostly met users’ requirements.

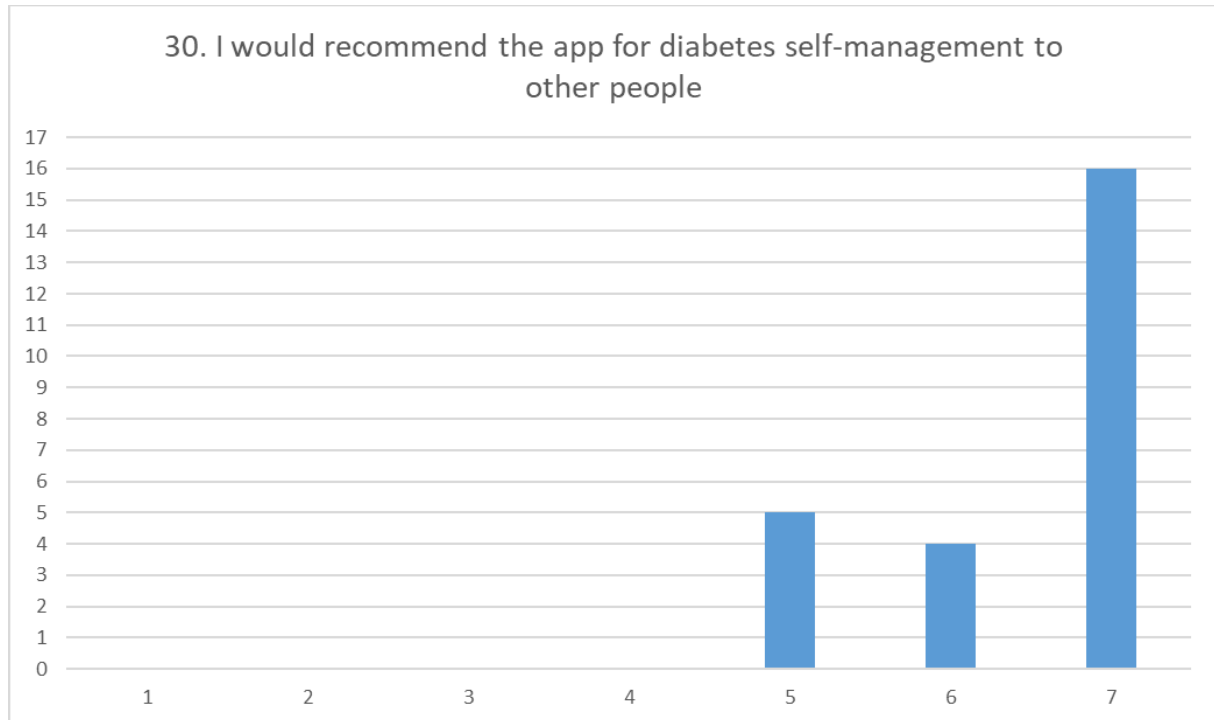
In the following question of the section, the respondents were asked to determine whether they will keep using the application in the future. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 16 answered with 7 meaning they strongly agreed with the statement, followed by 4 who answered 6, and 5 who answered 5 (Figure 31). There were 0 answers to points 4, 3, 2, and 1 on the scale (Figure 31).



**Figure 31: Results from survey question 29: “I will keep using the app in the future”.**

Highly accumulated answers on points 7, 6, and 5 indicate a strong willingness to keep using the application for diabetes self-management meaning that the continuous use of the solution is rather possible with the users who participated in the questionnaire.

In the next and last question in this section, the respondents were presented with the statement to indicate to what extent they agree with the following “I would recommend the app for diabetes self-management to other people.”. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 16 answered with 7 meaning they strongly agreed with the statement, followed by 4 who answered 6, and 5 who answered 5 (Figure 32). There were 0 answers to points 4, 3, 2, and 1 on the scale (Figure 32).



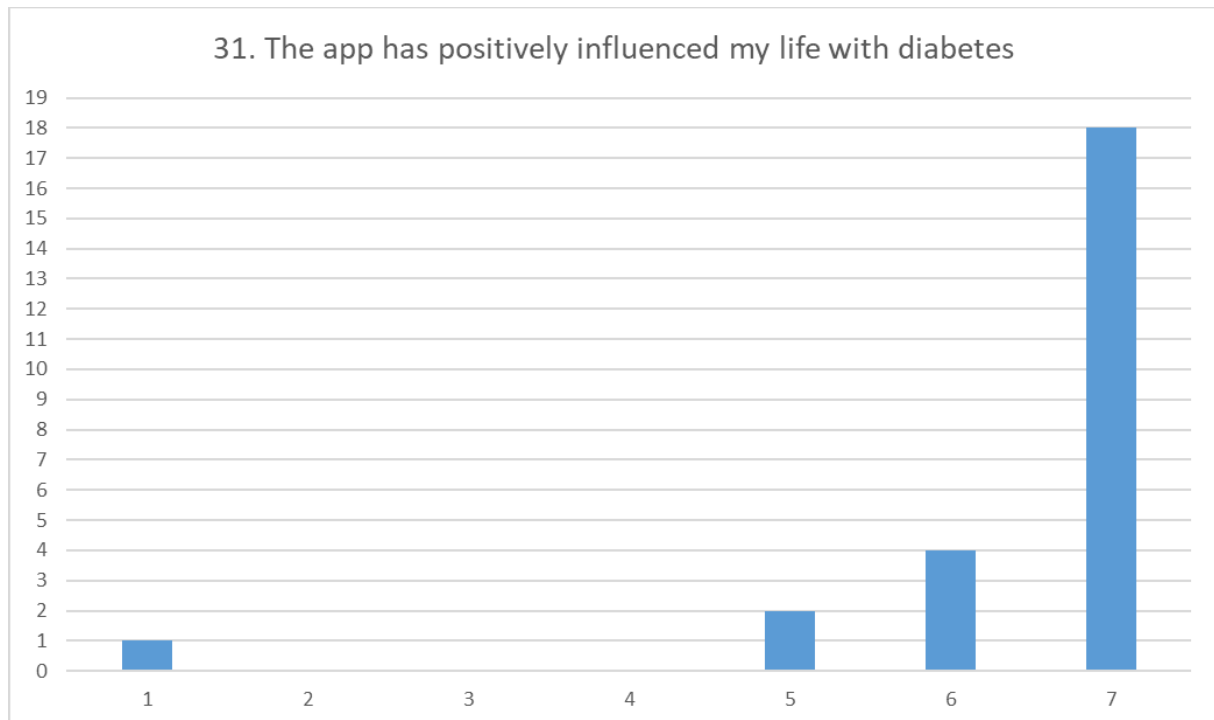
**Figure 32: Results from survey question 30: “I would recommend the app for diabetes self-management to other people”.**

Similarly, to the previous question, in Figure 32 above it can be seen that there is a strong agreement on recommending the mHealth app for diabetes to other people meaning there is enough value in there to share it with others who might possibly also benefit from existing solutions. There were no answers below point 5 on the scale which additionally strengthens the result in this particular question.

#### 4.2.5 Net Benefits

This section of the survey was dedicated to the net benefits dimension, which is the last considered in the applied framework. In this particular part of the survey, the questions were designed in a way to get to know the actual benefits that the users have gained by using the app for diabetes self-management.

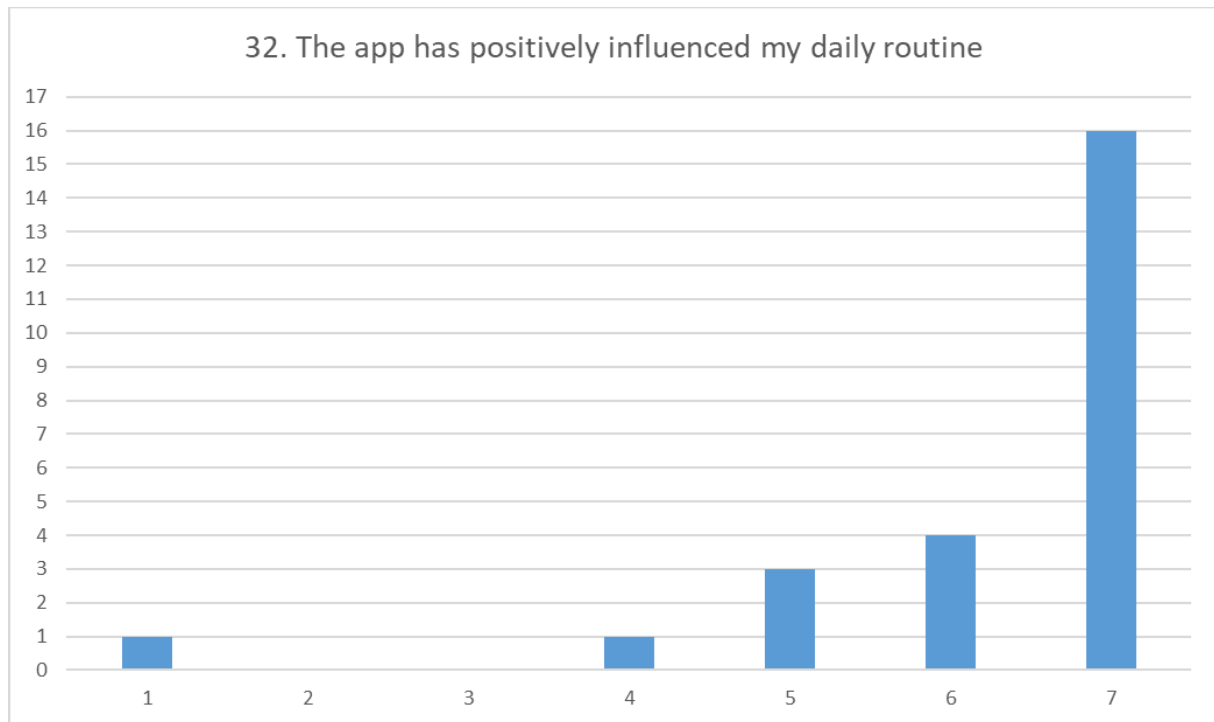
In the first question of this section, the respondents were asked to determine whether the app has positively influenced their life with diabetes. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 18 answered with 7 meaning they strongly agreed with the statement, followed by 4 who answered 6, 2 who answered 5, and 1 who answered 1 (Figure 33). There were 0 answers to points 4, 3, and 2 on the scale (Figure 33).



**Figure 33: Results from survey question 31: “The app has positively influenced my life with diabetes”.**

The chart above clearly indicates that mHealth for diabetes has definitely positively influenced the participants’ lives with diabetes, since the majority, meaning 24 respondents, have chosen an answer above 4 with 18 of them strongly agreeing with the statement. Only 1 person marked 1 on the scale meaning strong disagreement about the positive influence of the app.

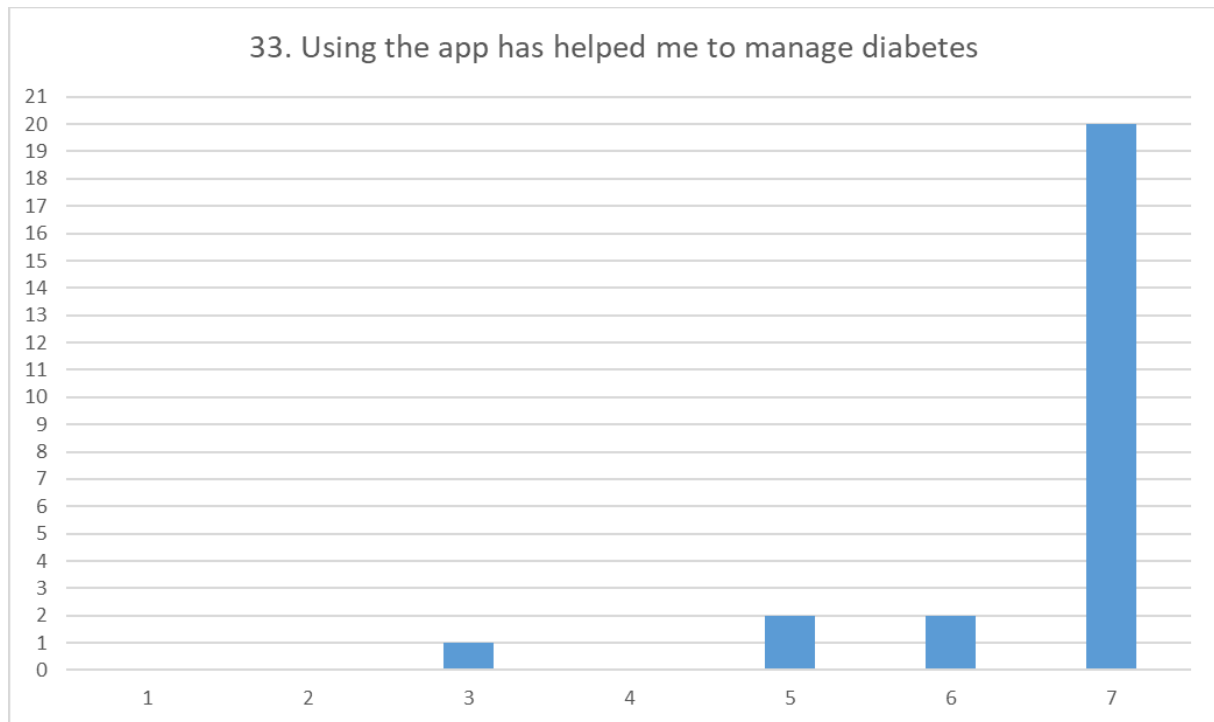
In the next question of this section, the respondents were presented with the statement to indicate to what extent they agree with the following: “The app has positively influenced my daily routine.”. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 16 answered with 7 meaning they strongly agreed with the statement, followed by 4 who answered 6, 3 who answered 5, and 1 who answered 4 (Figure 34). There were 0 answers to points 3, and 2 on the scale (Figure 34).



**Figure 34: Results from survey question 32: “The app has positively influenced my daily routine”.**

The responses to the question asked above clearly indicate that mHealth for diabetes has positively influenced the participants’ daily routine, since the majority, meaning 23 respondents, have chosen an answer above 4 with 16 of them strongly agreeing with the statement. One attendee decided to be neutral by answering 4 on the scale. Only 1 person marked 1 in the mentioned range, meaning strong disagreement about the positive influence of the app on the daily routine.

In the next question, the respondents were asked to determine whether using the app was helpful in terms of managing diabetes. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Strongly disagree” and seven meaning “Strongly agree”. Out of the 25 participants, 20 answered with 7 meaning they strongly agreed with the statement, followed by 2 who answered 6, also 2 who answered 5, and 1 who answered 3 (Figure 35). There were 0 answers to points 4, 2, and 1 on the scale (Figure 35).

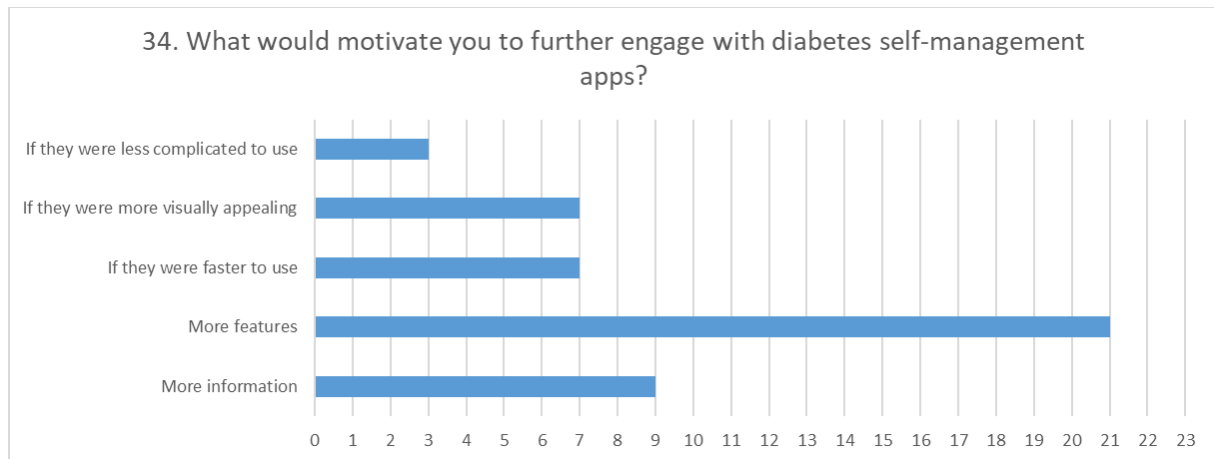


**Figure 35: Results from survey question 33: “Using the app has helped me to manage diabetes”.**

Looking at the answers to the question above it can be clearly seen that mHealth for diabetes has helped the participants with managing diabetes, since the majority, meaning 24 respondents, have chosen an answer above 4 with 20 of them strongly agreeing with the statement. One attendee chose to slightly disagree with the statement by answering 3 on the scale. Nevertheless, the emphasis on the strong agreement is strongly visible considering this particular question.

The next question was designed to investigate what are the factors that would motivate the user to further engage with the app so that the insights into the users’ needs could have been found. The participants had a choice between 5 different options, but more than one option could have been chosen. All 25 participants answered this question resulting in 21 respondents who marked that they would like “More features” so that it would further motivate them to engage with the application (Figure 36). Followed with the “More information” marked as important for 9 participants, “If there were more visually appealing” chosen by 7 people, “If they were faster to use” also chosen by 7 people, and “If they were less complicated to use” chosen by 3 respondents (Figure 36).

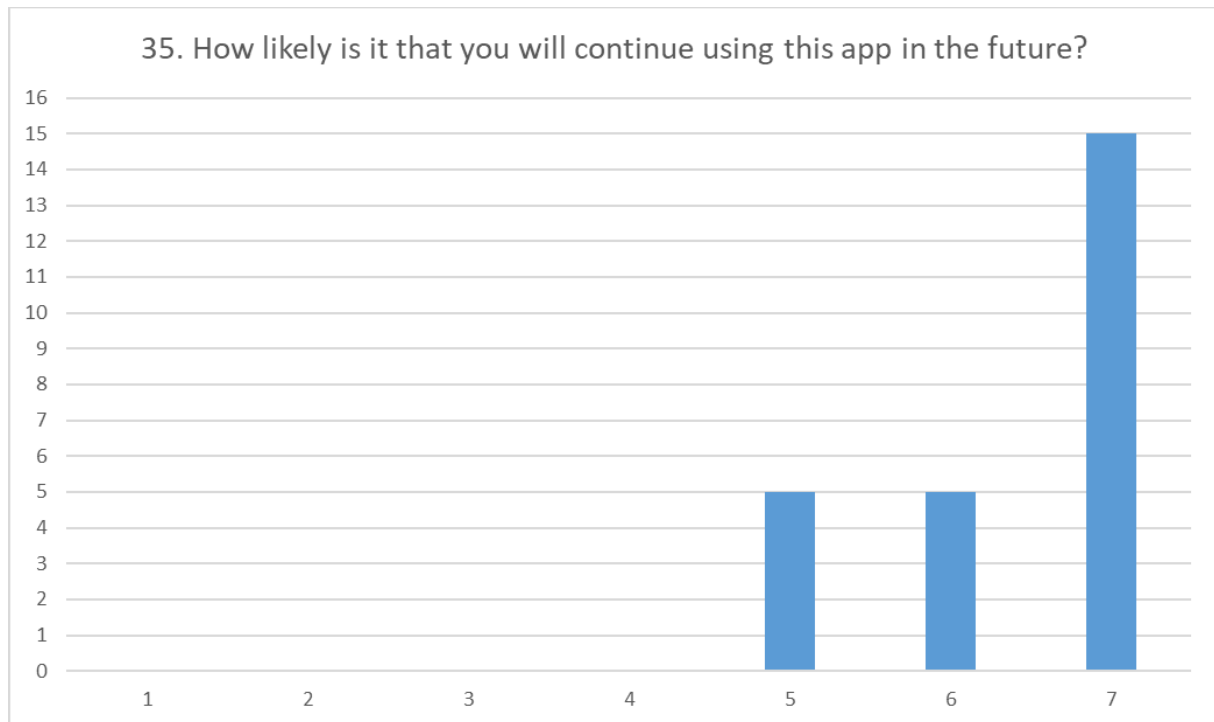




**Figure 36: Results from survey question 34: “What would motivate you to further engage with diabetes self-management apps?”.**

The answers to question number 34 brought valuable insights on what would be the factors that would motivate users to further engage with the app. By looking at the results the number of features is applicable to the majority of users, therefore, it indicates that there is still potential for designing new functionalities in the existing products.

In the next question of this section, the respondents were presented with the statement to indicate “How likely is it that you will continue using this app in the future?”. All 25 participants answered this question, by selecting an option on a scale of one to seven, with one meaning “Highly unlikely” and seven meaning “Highly likely”. Out of the 25 participants, 15 answered with 7 meaning they will continue using the app with a high probability, followed by 5 who answered 6, and 5 who answered 5 (Figure 37). There were 0 answers to points 4, 3, 2, and 1 on the scale (Figure 37).



**Figure 37: Results from survey question 35: “How likely is it that you would continue using this app in the future?”.**

The responses to the question asked above clearly indicate that there is a strong likeliness to continue using the mHealth application for diabetes self-management, since all respondents, meaning 25 people, have chosen an answer above 4 with 15 of them who chose the highest point on the scale. It can be concluded that people with diabetes who have been using the app to better manage their conditions are willing to continue using it in the future.

The last question asked in the survey was an open-ended question to gather any final thoughts or considerations the participants might have had by asking them “Is there anything else you would like to say about the app?”. Out of 25 participants, 8 of them answered this question by writing a few words in the open text field in the survey. Some of the responses among participants about what additional information they would like to add were “Integration with different meters or cgm would be nice”, “Wish my doctor would integrate his office and use this app”, “I would like to see the info from my smartguard at my mobile phone and smartwatch”, other types of responses were about the general outcomes that the app is giving like “It definitely helps to control diabetes” (Figure 38). The last type of response was just a simple “No” meaning no more comments regarding the app (Figure 38).

36. Is there anything else you would like to say about the app?

Integration with different meters or cgm would be nice
Wish my doctor would integrate his office and use this app
I would like to see the info from my smartguard at my mobile phone and smartwatch
Easy to use and quick to get info
No
Dexcom cannot generate a report in xls / csv format, only pdf is possible. For this reason, it is not possible to integrate reports from e.g. insulin pump and dexcom
It definitely helps to control diabetes
It is helpful in controlling diabetes.

**Figure 38: Results from survey question 36: “Is there anything else you would like to say about the app?”.**

The open question brought some more insights about the experiences regarding using the app for diabetes self-management among participants. It can be seen that the users have some wishes about what else the app could do to provide more benefits for them as well as there are some general positive feelings about the application. As this was the last question in the survey, the following subchapter will work as the summary of the questionnaire results altogether.

#### 4.2.6 Summary of Survey Results

The summary of our survey results is categorized according to our conceptual framework and is presented in the table below (Table 5). The bullet points were created based on the collected data from all respondents in order to assist with the understanding and interpretation of the quantitative data gathered during the survey process. These findings are later used in the comparison (chapter 4.3), as well as in the discussion (chapter 5).

**Table 5: Summary of survey results**

Dimension	Summary of survey results
<b>Intention to Use</b>	<ul style="list-style-type: none"> <li>The intention to use: <ul style="list-style-type: none"> <li>convenience was indicated as the most common reason to use the app, followed by necessity</li> <li>users have typically used 1-4 different apps for diabetes</li> </ul> </li> </ul>
<b>Use</b>	<ul style="list-style-type: none"> <li>The use of the app: <ul style="list-style-type: none"> <li>mostly used daily</li> <li>function mostly used “Blood glucose entry/reports”</li> <li>used for diet entry/reports</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>○ used for activity entry/reports</li> <li>○ used for last basal/bolus entry/reports</li> <li>○ the app was found to be usually engaged in the communication with the diabetologist/doctor</li> <li>○ 72% of participants integrate the app with external appliances or software</li> <li>○ the majority felt safe when entering the sensitive data in the app</li> <li>○ the majority found the integration with the external devices or software easy</li> <li>○ blood pressure was not chosen by any participant in the survey</li> <li>○ information is entered in the application mostly automatically (with connected apps/devices)</li> </ul>
<b>Information Quality</b>	<ul style="list-style-type: none"> <li>• The information: <ul style="list-style-type: none"> <li>○ is reliable</li> <li>○ is valuable</li> <li>○ is complete</li> <li>○ is personalized</li> <li>○ improved users' daily life</li> </ul> </li> </ul>
<b>User Satisfaction</b>	<ul style="list-style-type: none"> <li>• User satisfaction: <ul style="list-style-type: none"> <li>○ vast majority of users responded to be satisfied from using the app</li> <li>○ 64% of users among the participants did not encounter problems with the app</li> <li>○ it does not take too long to use the app for the majority of respondents</li> <li>○ initial expectations about the app were rather fulfilled based on the respondents' answers</li> <li>○ all of the respondents will keep using the app in the future</li> <li>○ all of the respondents would recommend the app for diabetes-self management to other people</li> </ul> </li> </ul>
<b>Net Benefits</b>	<ul style="list-style-type: none"> <li>• Identified net benefits: <ul style="list-style-type: none"> <li>○ positive influence of the app on the life with diabetes was declared by participants</li> <li>○ positive influence of the app on the daily routine was declared by participants</li> <li>○ the app has helped to better manage diabetes according to the vast majority of respondents</li> </ul> </li> </ul>

The summary of the survey results presented in the Table 5 above brought some insights based on the answers that were designed on the 7-grade scale and usually consisted of two extremes either “Strongly agree” or “Strongly disagree”. The outcomes constitute a valuable addendum for the interview results and therefore can work as supplementary statements presented in the comparison of the results as well as in the discussion part. There are, however, parts that are

challenging to be covered by both qualitative and quantitative data sources, nevertheless, the triangulation process explained by Farmer et al. (2006) gives the guidelines to tackle the aforementioned variations.

### 4.3 Comparison of the empirical results

The comparison of the results collected by applying semi-structured interviews and questionnaires is presented in this chapter. The subsequent parts are aligning with our conceptual framework which is based on the updated DeLone and McLean IS success model. Moreover, the triangulation protocol described by Farmer et al. (2006) was applied in this chapter to get a better overview of the findings that are similar, opposite as well as to notice the fields where there are no mentions in one of the data gathering methods. The following denotations were used to determine the convergence between the result: (a) agreement, when the statements were significantly similar, (b) partial agreement, when the statements were similar, (c) silence, when one of the two approaches covered a certain theme, while the other did not, or (d) dissonance when the approaches disagreed (Farmer et al., 2006).

#### 4.3.1 *Intention to Use*

To remain consistent in the flow of analysis of the data the first dimension where the data from the interviews and surveys were compared is the intention to use. The findings were listed in two columns with the last one indicating the degree of convergence following denotations described in the introduction to this chapter.

**Table 6: Comparison of the empirical results - Intention to Use**

Empirical findings	Survey results	Convergence
Being able to receive personalized feedback		Silence
Being able to receive individual feedback		Silence
Being able to receive tips about managing diabetes		Silence
Getting a good average blood sugar		Silence
Being able to input and store blood pressure		Silence
Being able to integrate different devices		Silence
Being able to input blood test results		Silence

Getting general feedback about the blood test results, e.g. whether is above/below average		Silence
Having support in managing diabetes	Convenience was indicated as the most common reason to use the app, followed by necessity	Partial agreement
Users reported to intend to use different applications for diabetes self-management	Users have typically used 1-4 different apps for diabetes	Agreement

The results visible in the table above might indicate that, since the semi-structured interviews allowed for the more in-depth insights from the interviewees, some of the details were not revealed in the survey. Therefore, the table about the intention to use while comparing qualitative and quantitative methods contains many findings which are neither in agreement nor dissonance in terms of gathered data. As a result, the silence between two different data sources appears frequently in the table above (Table 6).

#### 4.3.2 Use

The next dimension considered while comparing the data was the use dimension. In order to gather all the results, the procedure from the first dimension was repeated and adapted accordingly to the triangulation protocol (Farmer et al., 2006).

**Table 7: Comparison of the empirical results - Use**

Empirical findings	Survey results	Convergence
Most often used daily or monthly	Mostly used daily	Partial agreement
Used to input carbohydrates		Silence
Used to input blood glucose	Function mostly used "Blood glucose entry/reports"	Agreement
Used to receive injection suggestions		Silence
Used to calculate the Body Mass Index		Silence
Used to record the amount of insulin		Silence
Used to record blood pressure	Blood pressure was not chosen by any participant in the survey	Dissonance
Used to record the last bolus	Used for last basal/bolus entry/reports	Agreement

Used to gather data from the devices integrated with the app like blood pressure cuff, weight scale or Dexcom	72% of participants integrate the app with external appliances or software	Agreement
Some users faced problems with the configuration because of complicated words used in the process		Silence
Some users found the integration with external devices not easy enough	The majority found the integration with the external devices or software easy	Partial agreement
Data entered automatically	Information is entered in the application mostly automatically (with connected apps/devices)	Agreement
Data entered manually		Silence
Used during medical check-ups	The app was found to be usually engaged in the communication with the diabetologist/doctor	Agreement
Majority reported no concerns about inputting their sensitive data in the app	The majority felt safe when entering the sensitive data in the app	Agreement
	Used for activity entry/reports	Silence
	Used for diet entry/reports	Silence

Similar to the previous dimension, the results were compared accordingly and the extent of the correlations between them was determined according to the interpretation of the results. There are some common points identified in both surveys and interviews, however, due to the more open approach while being able to ask targeted questions, the interviews contain more precise and diverse answers. Nevertheless, it is considered valuable to have certain points of findings being covered in both methods (Table 7).

#### 4.3.3 Information Quality

Through comparison between the empirical findings of the interviews performed and the survey results, we came up with the following results that can be found in table 8.



**Table 8: Comparison of the empirical results – Information Quality**

Empirical findings	Survey results	Convergence
The information is trusted		Silence
The information is reliable	The information is reliable	Agreement
The information is accurate		Silence
The information is valuable for new diabetics	The information is valuable	Partial agreement
The information lacked completeness	The information is complete	Dissonance
They use the information as guidance and not as a fact		Silence
They trust healthcare professionals more than applications		Silence
They have different opinions on the application's personalization	The information is personalized	Dissonance
The information lacked timeliness	The information improved their daily life	Dissonance

The information quality dimension indicated that more of the findings from the interviews are not covered in the survey or the results found in the questionnaire were opposite to the ones identified in the qualitative study. Nevertheless, there was one agreement with the statement describing the reliability of the information and one partial agreement saying about the positive value of delivered information (Table 8).

#### 4.3.4 User Satisfaction

By comparing the empirical findings of the collected interview data with the survey results, we came up with the following table (Table 9).

**Table 9: Comparison of the empirical results – User Satisfaction**

Empirical findings	Survey results	Convergence
Decent overall satisfaction level	Vast majority of users responded to be satisfied from using the app	Agreement
Simplicity liked by a participant		Silence
Ease of use liked by a participant		Silence

The support it provides for their diabetes management was liked by a participant		Silence
The user experience was liked by a participant		Silence
The reports were disliked by a participant		Silence
Manual data entry disliked by a participant		Silence
Majority of participants seemed satisfied with the app's features (some features that were highlighted were: the healthcare, the activity, the blood pressure, the BMI, and the blood results features)		Silence
Majority of participants have a slightly negative attitude towards the app's integration with external appliances and software		Silence
Majority of participants believe that the application is fast to use	It does not take too long to use the app for the majority of respondents	Agreement
Majority of participants liked the application's layout		Silence
Majority of participants liked the application's design		Silence
Majority of participants liked the absence of in-app advertisements		Silence
Majority of participants liked that the app was free to use		Silence
Majority of participants seemed to like it more in comparison to other apps		Silence
Majority of participants disliked the application's output		Silence
Majority of participant reported that they ran into minor issues while using the app	64% of users among the participants did not encounter problems with the app	Dissonance

Majority of participants reported that their initial expectations seemed to be sufficiently covered	Initial expectations about the app were rather fulfilled based on the respondents' answers	Agreement
Majority of participants reported that they would continue to use the app in the future	All of the respondents will keep using the app in the future	Partial agreement
Mixed feeling regarding the suggestions from the app		Silence
Mixed feeling towards the app's personalization		Silence
	All of the respondents would recommend the app for diabetes-self management to other people	Silence

As is evident by observing the comparison results for user satisfaction (Table 9) and similarly with several previous dimensions, the interviews contain richer and more diverse answers. Thus, the table contains a plethora of themes mentioned only in the interviews and not in the survey. However, there are some points where the two methods seem to be in agreement or partial agreement as well. Finally, it seems that the two approaches disagree on one theme.

#### 4.3.5 Net Benefits

The last dimension considered while comparing the data was the net benefits dimension. The results from the empirical findings and survey results were compared according to the triangulation protocol using all the previously described convergence levels (Table 10).

**Table 10: Comparison of the empirical results – Net Benefits**

Empirical findings	Survey results	Convergence
App made daily life easier	Positive influence of the app on the life with diabetes was declared by participants	Agreement
Received tips helped in managing weight, BMI, and healthy diet		Silence
Received tips helped in maintaining the track of the general metrics		Silence
Being able to track the insulin levels		Silence
Being able to revert back to past measurement results		Silence

Being able to use the data from the app during medical check-ups		Silence
Being able to integrate external appliances and gather everything in one place		Silence
Received notifications helped in managing diabetes	The app has helped to better manage diabetes according to the vast majority of respondents	Partial agreement
Some users found the guidance on how to properly input blood results were helpful		Silence
Some users gained knowledge about the right blood parameters' levels		Silence
Most users benefited from the insights received in the app		Silence
Most users found the received analysis and trends beneficial		Silence
Some users assessed the insights from the app as neither sufficient nor helpful		Silence
The app structured the daily routine of blood tests and health-related activities	Positive influence of the app on the daily routine was declared by participants	Agreement
The app brought the positive regime to user's life	Positive influence of the app on the daily routine was declared by participants	Agreement
Being less stressed because of more control over the diabetes		Silence

Similar to aforementioned dimensions, the interviews turned out to be a more insightful source of opinions and information from the participants due to the semi-structured form and the general more detailed approach of this form of data collection. However, the survey also has brought up some statements that have been utilized and the convergence level was assessed based on the outcomes.

## 5 Discussion

In this chapter the empirical findings will be discussed in relation to our conceptual framework, as well as the literature that has been presented (see chapter 2). The goal is to put the outcomes into context so that the conclusion of our study can be formulated. Similarly with the previous chapter we are discussing each dimension following the same structure as our conceptual framework (Table 1).

### 5.1 Intention to Use

The meaning of the intention to use was explained by Urbach and Müller (2012), in the updated version of the DeLone and McLean information systems success framework, as the dimension that describes to what extent the information system is utilized while being used. While evaluating the mHealth app for diabetes self-management, users were asked about the frequency, intensity, reasons, and functions that are being used (Urbach & Müller, 2012). In the study by Petter and Fruhling (2011) intention to use was found to be positively correlated with the impact that it's making on the individual. Users' attitude toward the technology and overall idea of diabetes self-management and monitoring was observed to be directly correlated with the intention to use the application as it was researched by Okazaki et al. (2012) in the study about diabetes self-monitoring adoption among physicians. The subsidiary, net benefits were found to be influencing the intention to use as the more individuals perceived the direct benefits of the software, the higher the intention to use the system was (Okazaki et al., 2012).

The intentions to use were found to be varied depending on the user, however, the common ground was also identified on why the application is utilized to manage diabetes. The general reason behind using the app is to make things more seamless and just easier in terms of daily living with the disease (Speaker 1, 36; Speaker 2, 45; Speaker 5, 38) which confirms the findings of Okazaki et al. (2012), who found the correlation of intentions with the direct individual's impact. Moreover, the answers found in the questionnaire confirmed that users generally intended to use an app for diabetes self-management because of the convenience that it brings resulting in 48% of participants who have chosen this option (Figure 15).

Tips and information provided by the app were found to be a motivator of use, because of the information buzz and misinformation happening in online sources such as social media or unverified websites. The data provided in the interface is validated and approved by the clinicians which are seen as the distinguishing factor among different sources, and it also increases the trust in the product itself. However, there is still a need for further improvements in the area of search and approval of qualified information within the app.

Commonly, the intention to use the app is also affected by the possibility to integrate different devices and make the software some kind of hub and the center of the ecosystem in gathering all the measures from the sensors (Speaker 1, 42; Speaker 3, 65; Speaker 4, 98; Speaker 5, 40). Integrations with blood pressure cuff, weight scale, smartwatch, or Dexcom came across as the most popular among the respondents. Yet, some limitations regarding compatibility were found which might indicate that there is a necessity to further develop the connectivity of the app with different software and devices. It may indicate that the number of appliances being used is growing and maintaining compatibility with all of them becomes a challenge even for well-

established applications. Moreover, the fact that users mentioned counter experiences about the ability to integrate with devices might indicate that the users of the application are not fully aware of the functionalities it provides.

Personalization of the feedback provided by the app is being seen as a motivator to engage with mHealth more as well (Speaker 2, 92; Speaker 3, 45). Nevertheless, it is also perceived as something that should be constantly improving in order to enhance the experience and keep the intention to use the product (Speaker 2, 92; Speaker 3, 45). The individual aspect was found to still be in the first phases of the advancement, meaning that there is still a plethora of possibilities to further refine the sophistication of the tool. It constitutes the space for all the existing and new coming mobile health solutions to focus on the personalization aspect and therefore draw the attention of the users.

Collecting data about the blood pressure, weight, insulin levels, and blood results, like blood sugar is a major factor working as an intention to use the app (Speaker 1, 44; Speaker 3, 45; Speaker 4, 98; Speaker 5, 38). It means that the data, which is crucial for the software to give personalized recommendations, is one of the crucial factors for the mHealth to further succeed and be able to provide the personalization and forecasts for its users. Moreover, the way that data is brought to the device constitutes a factor that is connected with the continuity and length of using the app. If the information is transmitted automatically, the chances of sticking to using the app for a longer period are greater, compared to the situation where the user needs to input the data manually. The described intentions of using the app can indicate that the correlation, identified by Okazaki et al. (2012), between direct and perceived benefits arising from using the app influences intention to use it.

The correlation between intention to use and use of the system was found from the analysis of the collected data. Considering the intention to use, the interviewed diabetics were looking for a way to input, store and check the historic records of blood glucose, blood pressure, and weight (Speaker 3, 45; Speaker 4, 98; Speaker 5, 38), as well as the possibility to integrate with external devices (Speaker 1, 42; Speaker 3, 65; Speaker 4, 98; Speaker 5, 40). Similar statements were noticed in the responses about the use dimension when discussing the utilized functions of the application (Speaker 1, 54, 56; Speaker 3, 45, 73; Speaker 4, 20, 36; Speaker 5, 26, 30, 38).

## 5.2 Use

While discussing the use dimension the parameters that were applied in the previous studies are described by Urbach and Müller (2012) as the functions used, frequency of use, and time spent on using the software. Since the use was an important factor for consideration of mHealth for diabetes self-management, it was included in the study to further elaborate despite this particular dimension being merged with the intention to use for different contexts (Urbach & Müller, 2012; DeLone & McLean, 2003).

Bossen, Jensen, and Udsen (2013) performed a mixed-methods study where they adopted the updated DeLone and McLean information systems success framework. The evaluation of EHR (Electronic Health Records) was the objective of the research and the use dimension was applied in order to find out what is being used among the participants (Bossen, Jensen & Udsen, 2013). However, even though the study differs from the one performed in this research, which focuses on mHealth for diabetes, some common grounds can be found regarding the findings

(Bossen, Jensen & Udsen, 2013). The access to data about crucial health parameters such as blood results was found to be appreciated while being used (Bossen, Jensen & Udsen, 2013). The same applies to the users who participated in our study where they utilized the functions of data collection about one's individual parameters.

The actual use of the examined mHealth application for diabetes self-management was described by its users in the interviews and similarly to the intention to use it was found dependent on the individual user. Nevertheless, some common grounds were identified as well. The app was found to be used daily by more than half of the interviewees, meaning that Speaker 1, Speaker 2, and Speaker 5 have declared to engage with the application on a daily basis, in some cases more than one time per day (Speaker 1, 38; Speaker 2, 19; Speaker 5, 26). Questionnaires delivered similar, yet more straightforward results, meaning that 88% were using the app daily (Figure 8). It can indicate the continuity of applying the functions provided by the software, therefore leading to further engagement with the product. On the other hand, Speaker 1 who had his insulin pump delivered with the factory-made controller noted the less frequent use of the app (Speaker 1, 38, 42). Overall, common functions used in the app were concentrated around inputting the blood glucose, body mass, and blood pressure, calculating BMI, or recording the insulin levels (Speaker 1, 54, 56; Speaker 2, 47; Speaker 3, 45; Speaker 5, 26). On the contrary Speaker 3 indicated using the app less frequently together with Speaker 4 that also reported using the app rather monthly to record the blood pressure or blood results (Speaker 3, 45; Speaker 4, 20). Comparing the findings from the interviews and surveys it is noticeable that the blood pressure appears only in the interviews while in questionnaires that particular option was skipped by all the participants (Figure 10).

The integration with external appliances and software came across as important, valid, or worth trying for some of the participants in the interview study and for the 72% of the survey respondents (Speaker 3, 91; Speaker 5, 26; Figure 18; Figure 20; Table 7). Common devices to integrate were blood pressure cuffs, weight scales, or applications that are connected to the blood glucose sensor (Speaker 5, 26). On the other hand, some users among the survey respondents and interviewees such as Speaker 3 found the integration rather difficult to tackle (Speaker 3, 53). Therefore, there is still room to make the process more effortless and allow for seamless support of mHealth in the area of diabetes. It should indicate that there is a benefit of integration while using the app. Furthermore, the development of further compatibility with external devices as well as simplification of the overall process might be a good direction for expanding application capabilities.

Commonly, the tips and information about diabetes found in the mHealth app were described as helpful (Speaker 4, 44), however, some interviewees said that the information should be more detailed and insightful for diabetes with more advanced experience. Another point, brought up during the discussion about the knowledge of diabetes, revealed that there are complicated and unexplained words used within the app. The use of professional medical terms regarding diabetes was found as one of the challenges faced by Speaker 1, Speaker 2, and Speaker 4, mainly during the configuration process (Speaker 1, 58; Speaker 2, 51; Speaker 4, 48). It means that the education regarding chronic diseases and medical terms around them still should be more emphasized and taken care of while designing the application content.

While talking about incorporating the app in the process of communication with the diabetologist or doctor, Speaker 2 and Speaker 5 indicated the noticeable benefits and enhancements while providing the specialists with the information (Speaker 2, 73; Speaker 5, 42). The survey indicated that 84% of the respondents from the group of 25 people use the app to facilitate



communication with their medical specialists (Figure 17). Overall, it is seen that there is a progression in the digital technologies presence while communicating with healthcare providers. Therefore, it would be worth considering both stakeholders in the process of using the app with the functionalities dependable on each party.

The direct connection between the use and intention to use the system dimensions was found, meaning that there is a both ways influence of these two dimensions, since the correlation was also described in the subchapter 5.1. This is also supported by the examined literature, since in some cases these two dimensions can even be merged (Urbach & Müller, 2012). Speaker 3, who mentioned about the difficulties while using the app was one of the users whose intention to use diminished after facing the issues, which constitutes as a further confirmation of the described correlation (Speaker 3, 53).

Moreover, a relation was determined between the user satisfaction and use dimensions. Once again, the favored aspect of the app was the possibility of adding and storing the parameters regarding the blood results, blood pressure or activity mentioned by participants during the evaluation of user satisfaction (Speaker 1, 32; Speaker 4, 38). Similar statements were found when comparing it to the use dimension (Speaker 3, 45; Speaker 4, 98; Speaker 5, 38). On the other hand, the tips and feedback from the app were correlated with the disliked features (Speaker 2, 94, 99; Speaker 3, 45, 131, Speaker 4, 44). It was stated by the users that they would like to have more advanced guidance from the app (Speaker 2, 94, 99; Speaker 3, 45, 131, Speaker 4, 44).

Additionally, according to Handayani et al. (2018) who collected interview data about the success factors for mHealth implementation, the users valued the use of the app when it had a friendly and clear user interface. This can be correlated with the data collected in this research. It was, however, not part of this particular study, see “Delimitations” chapter 1.5. Nevertheless, it is still relevant to mHealth applications, yet with the necessity to be further evaluated.

### 5.3 Information Quality

The information quality dimension due to its characteristic is focused more on the aspect of the valuable outcomes that can be generated in the app via the user (DeLone & McLean, 2003; Urbach & Müller, 2012). In the case of mHealth for diabetes self-management, it constitutes the information that is provided after inputting the results of measurements such as blood parameters, weight, nutrition habits, or indicators specifically related to diabetes, including blood glucose. The further aspect considered here is the usefulness of the outcomes produced by the system for the actual user, therefore it might impact the overall user satisfaction level (Urbach & Müller, 2012).

The research by Petter and Fruhling (2011) confirmed the correlation between the information quality and user satisfaction as well as the intention to use while evaluating the emergency response medical IS. Therefore, the information output quality and usefulness should remain at the top while designing and developing the mobile applications for chronic disease self-management, as the confirmation of the dimension’s relationship is a significant factor from a development perspective (Petter & Fruhling, 2011; Urbach & Müller, 2012).

Additionally, Okazaki et al. (2012) proved the direct correlation between the information quality and the general quality of the mobile monitoring designed for diabetes, however, from the perspective of the medical professional. Nevertheless, the information quality remains, most likely, an interconnected dimension that influences other aspects significantly (DeLone & McLean, 2003; Petter & Fruhling, 2011; Urbach & Müller, 2012). On the contrary Song et al. (2021) found that information quality does not have a positive influence on user satisfaction which is the opposite of all the findings listed above. It indicates that while information quality still remains a vital dimension, it cannot be generalized about its influence on user satisfaction levels (Song et al. 2021).

During the interviews conducted for the purpose of this research it was found that 4 out of 5 interviewees trusted the information that is received from the app because all the badges said that it was verified by the medical professionals (Speaker 1, 82; Speaker 3, 97; Speaker 4, 70; Speaker 5, 46). Similarly, this was also supported by the survey participants who assessed the information in the apps as reliable (Figure 22). It indicates the trust and authority of the healthcare personnel which is worth noting while considering the achieved results as well as during the development of the mHealth application overall. The clinical reference is important for the perception of the high quality of the information (Speaker 5, 46), with the survey results indicating that the information was found to be valuable (Figure 23). Therefore, according to Okazaki et al. (2012), it might positively influence the satisfaction level. Another observation worth noticing is the lack of advertising within the examined app, which was found as something that improves the experience by Speaker 4 (Speaker 4, 42). Nevertheless, Speaker 3 and Speaker 4 emphasized that despite all the assertions about the information provided it is still perceived more as a guide rather than an indisputable truth. In fact, it would be better if there was a percentage of certainty about information provided by the app (Speaker 3, 97, 106; Speaker 4, 70). These contradicting perceptions can indicate that there is still room for improvement and adaptation in terms of the information and the way that it is presented, especially considering the digital format. It is worth noting that since there is an ongoing progression toward digitizing health, people trust more other people, in this context medical professionals (Speaker 1, 84; Speaker 3, 57; Speaker 4, 70). Therefore, it constitutes a great challenge for the eHealth and mHealth ecosystem.

Even though the link between information quality and user satisfaction was confirmed in our findings, when examining the correlation with use or intention to use the picture was not as clear. Although Speaker 1 trusted the information received and believed it was reliable (Speaker 1, 82), they did not intend to continue using the app in the future (Speaker 1, 102). Similarly, Speaker 3 seemed generally satisfied with the information quality (Speaker 3, 97), however they stopped using the application (Speaker 3, 65). On the contrary, Speaker 2 did not find the information particularly useful (Speaker 2, 19) and was actively using (Speaker 2, 35) and intended to continue using the app in the future (Speaker 2, 90). In general, the rest of the interview participants (Speaker 4, 70; Speaker 5, 46), as well as the survey respondents (Figure 22) seem satisfied with their apps and intend to continue using them in the future (Speaker 4, 108; Figure 31). Thus, we consider the correlation between information quality and system use, or information quality and intention to use rather weak, since our outcomes contained inconsistencies.

Some speakers found the application to be lacking certain functions in the area of diet or more advanced data analysis with detailed insights and more data provided (Speaker 3, 97, 110, 135). Moreover, the information presented in the app was assessed as rather general for the experienced diabetics, yet valuable for new diabetics who need to gain experience and are in need of

overall best practices, warnings, and more personalization (Speaker 1, 78; Speaker 2, 19, 77; Speaker 3, 123). Considering the personalization, the opinions were contradictory, which could be caused by the different experience levels and demands of the users (Speaker 1, 86; Speaker 5, 50; Speaker 3, 119; Speaker 4, 78). However, it is still a point to be considered by the development teams. On the other hand, the information quality was assessed as complete and personalized by the survey respondents (Figure 24; Figure 25). In general, it brings the concept of more advanced analytics and more information regarding the nuances in details which in combination with the percentage of certainty would work as a proper source for all ranges of experience with diabetes.

## 5.4 User Satisfaction

User satisfaction refers to the perceived satisfaction level of the system's users (DeLone & McLean, 2003; Urbach & Müller, 2012) and is considered to be one of the most important dimensions that affect a system's success (DeLone & McLean, 2003; Jen & Chao, 2008; Ojo, 2017; Urbach & Müller, 2012). Overall satisfaction levels were decent according to the interview participants (Speaker 1, 32, 110; Speaker 2, 82; Speaker 4, 86; Speaker 5, 56, 58) and similar results were displayed in the survey (Figure 27), where the participants also reported that they were satisfied with the apps for diabetes self-management that they were using. However, in both the interview (Speaker 1, 32, 110; Speaker 2, 82; Speaker 3, 127; Speaker 4, 86; Speaker 5, 56, 58), as well as the survey (Figure 36) participants would want more out of their apps. Similarly, Peng et al. (2016) in their study about mHealth applications found that users and patients want an all-in-one solution, which is usually difficult to achieve. This is also reinforced by the fact that a common complaint among a couple of interview participants was the application's output (Speaker 2, 41, 82; Speaker 3, 139).

The users' attitude toward the application was generally positive. There were no major issues reported (Speaker 1, 68; Speaker 2, 56; Speaker 3, 141; Speaker 4, 48; Speaker 5, 36) and the majority seemed to prefer the app to alternatives (Speaker 2, 56; Speaker 4, 40; Speaker 5, 28). Each of them expressed their opinions on it, however, there were a few points where they seemed to agree on. For instance, they seemed to particularly like the fact that there were no in-app advertisements or costs for using it (Speaker 1, 92; Speaker 4, 88; Speaker 5, 58). Even though the effect of cost on user satisfaction was not examined in the survey, the results indicate that users prefer free to use apps, since 100% of the respondents used free applications to manage their diabetes (Figure 6). In their study about examining success factors for mHealth apps for diabetes self-management, Mainoti and Isabirve (2018) also came to the conclusion that users consider the cost implications of using health apps.

The application's layout and design were also praised (Speaker 1, 32, 110; Speaker 3, 139; Speaker 5, 58) and a particular interview participant highlighted the ease of use and simplicity of the app (Speaker 1, 32, 92). The effect of ease of use on user satisfaction has been validated by several similar studies in the same context. Mainoti and Isabirve (2018) found that diabetic patients look for easy-to-use apps. Similarly, Cordoba et al. (2021) in their research concluded that the perceived quality of the app they examined was affected by its user-friendly interface among other factors. Finally, researchers such as Keikhosrokiani et al. (2020) also support the effect of ease of use on user satisfaction in this context.

Regarding the coverage of initial expectations, the responses were mainly positive (Speaker 1, 98; Speaker 4, 76; Speaker 5, 60). The same seemed to be true for the survey participants (Figure 30), which probably means that the diabetes self-management apps that are available live up to the users' expectations. When asked if they would continue to use the app in the future, both interview (Speaker 2, 90; Speaker 4, 108; Speaker 5, 8, 56, 58) and survey results (Figure 31) have a generally positive response. This result differs from the conclusion reached by Cordoba et al. (2021), where even though they observed general user satisfaction among their participants, the majority did not intend to keep using the app, unless new functions were added. This difference in outcomes could potentially be due to the usefulness and the importance of diabetes self-management apps, since as indicated by the survey (Figure 15), 80% of participants used diabetes self-management apps either out of necessity or convenience. In other words, this means that even if users are not entirely satisfied with the app's functions, they would probably continue using it.

When examining the relationship between user satisfaction and net benefits, we noticed a moderate correlation. Most users seemed satisfied with the app's features, such as the healthcare, the activity, the blood pressure, the BMI, and the blood results (Speaker 1, 32; Speaker 2, 86; Speaker 4, 38), which were also some of the features that benefitted them most (Speaker 1, 84, 90; Speaker 2, 88, 90; Speaker 4, 58). Similarly, most survey participants that were satisfied with the app (Figure 27) also reported positive benefits for managing their diabetes (Figure 33, 34, 35).

## 5.5 Net Benefits

The last dimension of our conceptual framework is net benefits which constitute the indicator of users' success while using the application for chronic disease management (Urbach & Müller, 2012). Therefore, the impact of the IS, in this case, mHealth for diabetes self-management and its impact on daily living with diabetes was measured and assessed to determine the tangible benefits that come with applying the application (Ojo, 2017; Urbach & Müller, 2012). Moreover, according to Urbach and Müller (2012), net benefits and use with user satisfaction are interconnected and, in some ways, more or less dependent on each other. However, considering the net benefits as a dimension itself is still described as valuable for the outcomes of the study.

Overall, a desirable result when it comes to the net benefits dimension is general life quality improvement while living with chronic diseases, such as diabetes that requires daily monitoring and adjustment to maintain good health conditions and general well-being as the precedence (Okazaki et al., 2012). Additionally, net benefits were found to be influencing the intention to use the software as described by Okazaki et al. (2012) in their study about diabetes monitoring from the perspective of physicians.

The benefit that was noted by Speaker 1 and Speaker 4 were the tips provided by the app based on the data that was inputted into the system (Speaker 1, 84, 90; Speaker 4, 58). However, Speaker 1 also mentioned that some of the information provided within the app might be more beneficial for less experienced diabetes, which was also supported by Speakers 2 and 3 (Speaker 2, 19, 77; Speaker 3, 123). Therefore, the conclusion from the achieved results, which are not completely in agreement, might be that there is still the factor of individual perception and meaningfulness of the given function and the benefits it provides. Further engagement in the conversation with the participants brought that one of the significant benefits was the ability to

track the results and key metrics over time, which gave the perception of having much more control over the disease on a daily basis (Speaker 1, 100; Speaker 3, 129). Moreover, guiding towards the right field to input the specific measurement from the blood test results in the app (Speaker 4, 20). The survey results in some way confirmed the interview results by gathering answers which said that the app brought a positive influence on their life with diabetes (Figure 33).

On the other hand, there were also some disadvantages identified by Speaker 2 who mentioned a lot about the weaknesses and poor advancement of the data analytics and prediction functions (Speaker 2, 88). A similar opinion was shared by Speaker 3, as the insights gained from the app after providing the system with data were rather poor, without meaningful data correlations, and sometimes even difficult to interpret (Speaker 3, 65). Moreover, blood sugar management was assessed poorly by Speaker 3, while Speaker 2 and Speaker 5 assessed it as helpful for tracking their levels and getting insights about trends (Speaker 2, 88, 90; Speaker 3, 91; Speaker 5, 52). In general, the ability to track blood insulin, weight, and BMI to maintain systematicity were perceived as a remarkable benefit for the application's users, specifically for Speaker 1, Speaker 2, Speaker 4, and Speaker 5 (Speaker 1, 100; Speaker 2, 88, 90; Speaker 4, 45; Speaker 5, 52). Enhancements in daily routine were mentioned by Speaker 2 who noticed that each morning they have a certain type of regime that the app is structuring (Speaker 2, 86, 90). Similar results were brought by the survey where participants declared that the app has positively influenced their daily routine in terms of activities regarding their chronic disease (Figure 34). The described use case of the app indicates that it is possible to perform changes and adapt to the repeatable behaviors after applying some concept, in this case, the mHealth software that animates the management of diabetes by providing premade parameters that should be typed or transferred into the app.

The continuous data gathering and analysis, thanks to integrations with sensors like Dexcom, despite having lots of advantages, can lead to the micromanagement of one's conditions and over-worrying about some deviations that might as well be natural part of one's organism (Speaker 5, 66). This points to an issue that might be easily fixed by providing professionally certified information about some parameters that might vary during the day, depending on the individual's routine, reactions to some kind of food, as well as other external or internal factors. Therefore, by consulting a diabetologist excessively stressing about one's condition could be avoided. Consulting and performing medical check-ups with a diabetologist is another factor worth noticing while using the app since the user can bring up the historical data with trends during the consultation and therefore receive more detailed recommendations and potential life-style adjustment advice (Speaker 4, 45, 58; Speaker 5, 42, 44). Moreover, the ability to integrate with external appliances and software was found as a noticeable benefit while using the app, since it leads to more accurate and detailed feedback, due to the frequency with which the data is gathered (Speaker 5, 44).

Speaker 5 brought up another noteworthy fact about using the app, mentioning that it de-stresses daily functioning and takes some of the pressure away (Speaker 5, 62, 64). To conclude the benefits presented by the users, we quote Speaker 3, as it is representing the overall concept in a way that was found best considering the evaluated application: "it's a nice summary that brings it all together" (Speaker 3, 129). Additionally, Speaker 1 added that the app is an "all in one place" (Speaker 1, 100). Similarly, the general statement about the positive influence while managing diabetes was also included in the survey where most respondents declared that the application has helped them to better manage their conditions (Figure 35). This can be considered the conclusion of general benefits that the app brings to the daily management of diabetes.

The net benefits dimension was found to be correlated with the intention to use, use and user satisfaction dimensions meaning that the tangible outcomes from the users' perspective were linked to the majority of evaluated areas. Transferring the data, both automatically with integrations and manually, was found as an intention to use the app (Speaker 1, 42; Speaker 3, 45, 65; Speaker 4, 98; Speaker 5, 40, 44). Similar statements were discovered in the actual use of the app while examining the use dimension (Speaker 1, 54, 56; Speaker 2, 47; Speaker 3, 45, 73; Speaker 4, 20, 36, 62; Speaker 5, 26, 30, 38). The user satisfaction examination also revealed positive as well as the negative aspects of the app, for instance the data collection as a gain and tips from the app as lacking comprehensiveness (Speaker 1, 32; Speaker 2, 94; Speaker 3, 131; Speaker 4, 38). In the end, mentioned traits were found out to be underlined as the net benefits of the application for its users, which constitutes as a confirmation of the correlations (Speaker 1, 100; Speaker 2, 88, 90; Speaker 5, 52, 62).



## 6 Conclusion

This mixed-methods study aimed at identifying success factors of mHealth applications for diabetes self-management from the perspective of users by following a conceptual framework that was based on the updated DeLone and McLean information systems success model. To fulfill its purpose, the research question will be answered.

*What are the success factors of the mHealth application for diabetes self-management from the users' perspective?*

The general support and convenience offered by the app while living with diabetes were found on the top of intentions to use the application for diabetes self-management. More detailed research outcomes focused on the possibility to create a central ecosystem within the app to keep track of the key measures and be able to see the trends based on historical results. The users were also motivated to use the app by integrating external devices and gathering the results in one place. Therefore, collecting the data about the blood pressure, weight, insulin levels, and blood results became more seamless, which constituted another intention to use the app. Although it was still possible to enter data manually. However, in some cases, users brought concerns that the integration with external appliances was impossible due to lack of compatibility or complicated processes. Thereafter, the intention to use was decreased, causing less frequent app use. Nevertheless, intention to use remains a valid dimension due to its direct correlation with system use.

As the use dimension was found to be correlated with the intention to use, it was found that the typical activities performed in the app were associated with what was intended. Commonly used functions were mainly associated with inputting or transferring the blood glucose, weight, blood pressure, calculating BMI, and recording insulin levels. The integration with external appliances such as blood pressure cuffs, weight scales, or sensors also came as important while using the app. Additionally while using the app some users found the integration to be difficult to tackle, therefore this can be seen as a point for improvement. Moreover, the app was found to be used daily or monthly depending on the individuals' needs, with more than half of the participants using it daily. Nevertheless, in cases where the insulin pump was applied, the use of the app was noted to be less frequent. Another point concerning the use of the app was complicated, professional vocabulary applied during the configuration process, which was difficult to understand. After all, despite possible complications, the app was still found to be useful during consultations with diabetologists and allowed for more precise recommendations. Furthermore, the use of the app indicated another possible correlation with user satisfaction.

Considering the information from the app, it was described as reliable and valuable. The badges which indicated the validation of provided content by medical professionals enhanced trust. However, the tips were still perceived as the guidance rather than an indisputable fact. Moreover, it was discovered that more experienced diabetics perceived the information as rather general without any in-depth insights and timeliness. Nevertheless, the given tips were assessed as useful for new diabetics and users without much knowledge of the disease. Taking the personalization into account, the opinions varied, yet it is still expected that the features will become more advanced. Since the data analytics and insights provided based on the measurements transferred into the app were found not detailed enough, this might constitute grounds for further



product development. This is also supported by the fact that a correlation between information quality and user satisfaction was found in the study.

The users' attitude toward the application was generally positive, although they expressed their desire for more functions and better overall output. Particularly important seemed to be the effect of cost implications of using the app on their satisfaction levels. We also found a weak correlation between system use and the perceived information quality and satisfaction. Due to the importance of diabetes self-management applications for users, even if they are not satisfied with them, they would probably continue usage.

Net benefits identified by the users of the app can be found correlated with the intention to use, use and user satisfaction dimensions. Primarily, tangible outcomes identified by diabetics who applied the application in their lives were the ability to track the results and key metrics over time, which have enabled the possibility to better control the disease. These metrics include among others blood insulin levels and parameters such as BMI. The ability to integrate external devices was stated to be improving the overall experience and making the process more seamless and automated. Moreover, having historical data accessible with trends over time was useful during the medical check-ups and brought noticeable improvements in the recommendations given by the healthcare professionals. Additionally, the systematicity aspect was also brought as a meaningful improvement after engaging with the app on a daily basis, therefore, gaining the enhancement of daily routine and behavioral adjustments. There were mixed feelings about the benefits of the tips provided by the app. Some found them helpful, while others reported that they were suitable for rather less experienced diabetics. Another raised concern was focused on the weaknesses and poor advancement of the data analytics and prediction functions. Nevertheless, this might be considered as a still developing sphere, since bringing valuable insights from the data requires substantial effort. Overall, the achieved results were found to indicate that the app brought noticeable benefits for diabetics in terms of managing their chronic disease.

In conclusion, identifying success factors for users of mHealth applications for supporting the self-management of their diabetes is a challenging affair. Satisfying all users' needs simultaneously seems rather unlikely. However, if the common success factors of such applications can be identified, then developing future applications, or updating existing ones in accordance could lead to significant health benefits and quality of life improvements for diabetics. The study sheds light on an important research topic that has not been well explored yet. Thus, further research in this area is required to hopefully understand the context more comprehensively.

## 7 Future research

During the conducted interviews users brought some concepts and ideas regarding the potential application improvements and enhancements of existing functions. Despite it not being the research's objective, findings were included in chapter 4.1.6 as "Other empirical findings". The direction of future studies could focus on the exploration of what is missing in existing solutions for diabetes self-management. The primary focus during the conversation with the participants was on advanced data analytics, as well as predictions based on the historical data that was entered into the system. The potential outcomes of further research could guide the development of such applications and constitute a step forward towards the advancement of the technology in healthcare.

Growing misinformation in the digital space of health is another area of concern. Therefore, it could be the subject for a future study in the field of IS and healthcare. The online sphere gives a lot of freedom yet without the right verification measures and reliability assessment it might generate dangers, especially taking into account the significance of health-related information. The misinformation was brought up as an existing issue by the interviewees and is also included in the "Other empirical findings" part (chapter 4.1.6). Bradway et al. (2017) raised this issue of lacking the right verification for the advice and information being provided, which further strengthens the reasoning behind the need for exploration of the field. Further study could focus on the ways to mitigate the phenomenon and their real effectiveness.

Further research that could also be done is a result of not examining two quality dimensions of the updated DeLone and McLean information systems success model in our study. Service quality was not included in our conceptual framework and the exploration of it has the potential to lead to new insights. Moreover, even though we did not include system quality in our research either, our findings highlighted the importance of factors such as ease of use on the satisfaction of users. A more in-depth examination of the user experience, user interface, and the layout of mHealth applications is required to determine their influence on the app usage and overall experience. The correlation between the successful implementation of the app and the user interface has already been the area of interest of researchers like Handayani et al. (2018) whose focus was more directed toward the application design. Therefore, it is highly likely that including the dimension of system quality in future research is worth exploring.

The possibility to conduct further study was also noticed in the area of mHealth applications that support the management of other chronic diseases. Identifying the success factors of those apps from the perspective of users would contribute to the knowledge about the real impact of the technology on patients. This is vital since even though the knowledge in the field is constantly growing, it is still not exhaustive enough.

Finally, perhaps the perspective of stakeholders other than users could lead to significant findings as well. The research gave the perspective of users with the exclusion of the medical professionals. Expanding the coverage of future studies on the healthcare specialists could bring valuable perspective to mHealth applications for managing diabetes and other chronic diseases. Furthermore, the perspectives of system developers could be considered, as they have the ability shed light on understanding the challenges involved in the making of such applications.

# Appendix 1 - Interview Guide

## Profiling Questions

1. How old are you?
2. What are your experiences with mobile applications?
3. What are typical ways you are looking for information about diabetes? (advice suggestions)
4. How did you discover the app?
5. Are you affiliated with Gendius, the company that made the app?
6. How long have you been using the app?
7. How often do you use the app?

## Intention to Use

1. Why did you start using the app?
2. What is your main objective in using the app? (You can mention more than one)
3. Have you used other diabetes management apps before?
  - a. If so, what made you switch to this app? How would you compare them to this app?
  - b. If not, why?

## Use

1. What functions of the app are you using?
2. What functions of the app are the most useful for you?
3. What problems are you encountering with using the app?
4. What kind of external appliances or software do you integrate with the app? Why?
5. How easy is the integration with external appliances and software?
6. How is the application engaged in the way you communicate with your diabetologist?

## Information Quality

1. How do you feel about entering your data into the app? Do you have any concerns or reservations? Please elaborate.
2. What is the way you enter the information in the app?
3. How do you feel about the information that you receive from the app? (Do you think that it is reliable? Do you trust it?)
4. Have you found all the relevant and crucial information to help you manage diabetes? Is there anything that the app is lacking considering the information?
5. How personalized is the information you receive from the app?
6. About the information you get from the app, how do you apply it in your daily life?

## User Satisfaction

1. What is your satisfaction level from using the app?
2. What appeals to you about the app, what not, and why?
3. How long does it take for you to engage with the app on a daily basis?
4. What were your expectations before downloading the app? How were they fulfilled?

**Net Benefits**

1. How has the app influenced your life with diabetes? What has changed in your daily behaviors?
2. What are the advantages of using the app?
3. What are the disadvantages of using the app?
4. How does the information from the app support the management of diabetes in your daily life?

**Debriefing Questions**

1. How likely is it that you will continue using this app in the future? Why or why not?
2. What would motivate you to further engage with the app?
3. Is there anything else you would like to say about the app?

## Appendix 2 - Survey Questions (English)

### Diabetes self-management app survey

Dear participant,

We are Kostas and Mike, master's students from Lund University in Sweden, who are conducting research in the area of applications for diabetes self-management. Overall, the aim is to examine what are the success factors of the apps from the perspective of users. The survey is a part of the study where we are looking for insights from the real-world use of the technology in mobile health.

The survey is anonymous, the responses will be used only for the master thesis purpose and will be stored in the archive in Google Drive.

You can find Polish version of the survey here: <https://forms.gle/uoZhTbedw64usQp49>

If you have any questions or comments regarding the survey, please contact:

Mike: [mi3670tr-s@student.lu.se](mailto:mi3670tr-s@student.lu.se)

Kostas: [ko1227ra-s@student.lu.se](mailto:ko1227ra-s@student.lu.se)

Logga in på Google för att spara förloppet. [Läs mer](#)

\*Obligatorisk

1. Please select your gender

- ☐ Male
- ☐ Female
- ☐ Prefer not to say

2. Please select your age group

- ☐ Under 20 years
- ☐ 20–30 years
- ☐ 31–40 years
- ☐ 41–50 years
- ☐ 51–60 years
- ☐ Above 60 years

3. Which app for diabetes self-management are you currently using?

Ditt svar \_\_\_\_\_

4. Is the app free? \*

- ☐ Yes
- ☐ Yes, but with limited features
- ☐ No

5. How long have you been using the app for diabetes self-management? \*

- ☐ Less than 6 months
- ☐ 6-12 months
- ☐ 1-3 years
- ☐ Over 3 years

6. How often do you use the app for diabetes self-management? \*

- ☐ Daily
- ☐ Every other day
- ☐ Less often

7. How much time per day are you using the app for diabetes self-management? \*

- ☐ Less than 5 minutes
- ☐ 5 to 10 minutes
- ☐ 10 to 20 minutes
- ☐ 20 to 30 minutes
- ☐ 30 to 60 minutes
- ☐ More than 1 hour
- ☐ I am not using the app for diabetes self-management daily

8. What functions of the app for diabetes self-management are you using?

- ☐ Blood glucose entry/reports
- ☐ Blood pressure entry/reports
- ☐ Last basal/bolus entry/reports
- ☐ Activity entry/reports
- ☐ Diet entry/reports
- ☐ Other

9. How did you find the app for diabetes self-management? \*

- ☐ Google play store/app store
- ☐ Healthcare professional
- ☐ Social circle
- ☐ Social media
- ☐ Internet search
- ☐ Diabetes forums
- ☐ Other

10. I have positive experiences with mobile applications for diabetes self-management \*

- |                   |                       |                       |                       |                       |                       |                       |                       |                |
|-------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------|
|                   | 1                     | 2                     | 3                     | 4                     | 5                     | 6                     | 7                     |                |
| Strongly disagree | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Strongly agree |



11. I am experienced in using mobile applications for diabetes self-management \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

12. I am frequently using the app to look for information about diabetes \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

### Information Quality in the app

13. What is the way you enter the information in the app?

- ☐ Manually
- ☐ Directly from my connected apps/ devices

14. The information which I receive from the app is reliable \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

15. The information which I receive from the app is valuable \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

16. The information which I receive from the app is complete \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

17. The information which I receive from the app is personalized \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

18. The information which I receive from the app improved my daily life \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

### Intention to use the app

19. Why did you start using the app?

- ☐ Necessity
- ☐ Recommendation
- ☐ Curiosity
- ☐ Convenience
- ☐ Övrigt: \_\_\_\_\_

20. How many different apps for diabetes self-management have you used? \*

- ☐ None
- ☐ 1
- ☐ 1-4
- ☐ 5 or more

21. The application is engaged in the way I communicate with my diabetologist/ doctor \*

- |                   |                       |                       |                       |                       |                       |                       |                       |                |
|-------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------|
|                   | 1                     | 2                     | 3                     | 4                     | 5                     | 6                     | 7                     |                |
| Strongly disagree | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Strongly agree |

22. I integrate/use external appliances or software with the app \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

23. I feel safe entering my sensitive data in the app \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

24. I find the integration with external appliances and software easy \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

#### Your satisfaction

25. I am satisfied from using the app \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

26. I encounter problems while using the app \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

27. It takes me too much time to use the app \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

28. My initial expectations about the app were fulfilled \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

29. I will keep using this app in the future \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

30. I would recommend the app for diabetes self-management to other people \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

### Your benefits

31. The app has positively influenced my life with diabetes \*

	1	2	3	4	5	6	7	
Strongly agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly disagree

32. The app has positively influenced my daily routine \*

	1	2	3	4	5	6	7	
Strongly agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly disagree

33. Using the app has helped me to manage diabetes \*

	1	2	3	4	5	6	7	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

34. What would motivate you to further engage with diabetes self-management apps?

- ☐ More information
- ☐ More features
- ☐ If they were faster to use
- ☐ If they were more visually appealing
- ☐ If they were less complicated to use

35. How likely is it that you will continue using this app in the future? \*

	1	2	3	4	5	6	7	
Highly unlikely	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Highly likely

36. Is there anything else you would like to say about the app?

Ditt svar

## Appendix 3 - Survey Questions (Polish)

### Ankieta dotycząca aplikacji dla diabetyków

Hej!

Mam na imię Michał i jestem studentem na Uniwersytecie w Lund w Szwecji. Wspólnie z Kostasem prowadzimy badania w obszarze zastosowań aplikacji mobilnych do wspierania osób z cukrzycą. Ogólnym celem jest zbadanie, jakie są czynniki sukcesu aplikacji z perspektywy użytkowników. Ankieta jest częścią badania, w której poszukujemy spostrzeżeń z rzeczywistego wykorzystania technologii w mobilnym zdrowiu.

Ankieta jest anonimowa, odpowiedzi zostaną wykorzystane wyłącznie do celów pracy magisterskiej i zostaną zapisane w archiwum na dysku Google.

W przypadku pytań lub uwag dotyczących ankiety proszę o kontakt:

[mi3670tr-s@student.lu.se](mailto:mi3670tr-s@student.lu.se)

#### 1. Wybierz swoją płeć

- ☐ Kobieta
- ☐ Mężczyzna
- ☐ Wolę nie odpowiadać

#### 2. Wybierz swoją grupę wiekową

- ☐ Poniżej 20 lat
- ☐ 20–30 lat
- ☐ 31-40 lat
- ☐ 41-50 lat
- ☐ 51-60 lat
- ☐ Powyżej 60 lat



3. Z jakiej aplikacji dla diabetyków obecnie korzystasz?

Your answer

---

4. Czy aplikacja jest darmowa? \*

- ☐ Tak
  - ☐ Tak, ale oferuje ograniczone funkcje
  - ☐ Nie
- 

5. Od jak dawna korzystasz z aplikacji wspomagającej diabetyków? \*

- ☐ Poniżej 6-ciu miesięcy
- ☐ 6-12 miesięcy
- ☐ 1-3 lat
- ☐ Ponad 3 lata

6. Jak często korzystasz z aplikacji dla diabetyków? \*

- ☐ Codziennie
- ☐ Co drugi dzień
- ☐ Rzadziej

7. Ile czasu dziennie używasz aplikacji dla diabetyków? \*

- ☐ Poniżej 5 minut
- ☐ Od 5 do 10 minut
- ☐ Od 10 do 20 minut
- ☐ od 20 do 30 minut
- ☐ od 30 do 60 minut
- ☐ Ponad godzinę
- ☐ Nie używam aplikacji dla diabetyków codziennie

8. Z jakich funkcji aplikacji dla diabetyków korzystasz?

- ☐ Wpisy/raporty dotyczące stężenia glukozy we krwi
- ☐ Wpis/raporty dotyczące ciśnienia krwi
- ☐ Wpisy o ostatnim basal i bolus
- ☐ Wpis/raporty o aktywności
- ☐ Wpis/raporty dietetyczne
- ☐ Inne

9. W jaki sposób dowiedziałas/dowiedziałeś się o aplikacji dla diabetyków? \*

- ☐ Google play store/app store
- ☐ Lekarz
- ☐ Znajomi
- ☐ Social media
- ☐ Wyszukiwarka internetowa
- ☐ Forum dla diabetyków
- ☐ Inne

10. Mam pozytywne doświadczenia z aplikacjami mobilnymi dla diabetyków \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

11. Mam doświadczenie w korzystaniu z aplikacji mobilnych dla diabetyków? \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

12. Często korzystam z aplikacji do wyszukiwania informacji o cukrzycy \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

## Jakość informacji w aplikacji

13. W jaki sposób wprowadzasz informacje w aplikacji?

- ☐ Manualnie
- ☐ Informacje są przesyłane bezpośrednio z moich podłączonych aplikacji/urządzeń

14. Informacje, które otrzymuję z aplikacji są wiarygodne \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

15. Informacje, które otrzymuję w aplikacji są wartościowe \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

16. Informacje, które otrzymuję z aplikacji są kompletne \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

17. Informacje, które otrzymuję z aplikacji są spersonalizowane \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

18. Informacje, które otrzymuję z aplikacji poprawiły moje codzienne życie \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

### Zamiar używania aplikacji

19. Dlaczego zacząłeś korzystać z aplikacji?

- ☐ Z konieczności
- ☐ Została mi zarekomendowana
- ☐ Z ciekawości
- ☐ Dla wygody
- ☐ Other: \_\_\_\_\_

20. Z ilu różnych aplikacji dla diabetyków korzystałeś? \*

- ☐ Żadnej
- ☐ 1
- ☐ 1-4
- ☐ 5 albo więcej

21. Aplikacja jest używana w trakcie komunikacji z moim diabetologiem/lekarzem \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

22. Integruję/korzystam z zewnętrznych urządzeń lub oprogramowania z aplikacją \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

23. Czuję się bezpiecznie wprowadzając moje wrażliwe dane do aplikacji \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

24. Integracja z zewnętrznymi urządzeniami i oprogramowaniem jest dla mnie łatwa \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

### Zadowolenie z użytkowania

25. Jestem zadowolona/zadowolony z korzystania z aplikacji \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

26. Mam problemy podczas korzystania z aplikacji \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

27. Korzystanie z aplikacji zajmuje mi zbyt dużo czasu \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

28. Moje początkowe oczekiwania dotyczące aplikacji zostały spełnione \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

29. Będę nadal korzystać z tej aplikacji w przyszłości \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

30. Poleciłbym aplikację dla diabetyków innym osobom z cukrzycą \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

### Twoje korzyści

31. Aplikacja pozytywnie wpłynęła na moje życie z cukrzycą \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak



32. Aplikacja pozytywnie wpłynęła na moją codzienną rutynę \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

33. Korzystanie z aplikacji pomogło mi lepiej zarządzać cukrzycą \*

	1	2	3	4	5	6	7	
Zdecydowanie nie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Zdecydowanie tak

34. Co zmotywowałoby Cię do dalszego angażowania się w aplikację do samodzielnego leczenia cukrzycy?

- ☐ Więcej informacji
- ☐ Więcej funkcji
- ☐ Gdyby były szybsze w użyciu
- ☐ Gdyby były bardziej atrakcyjne wizualnie
- ☐ Gdyby były mniej skomplikowane w użyciu

35. Jakie jest prawdopodobieństwo, że nadal będziesz korzystać z tej aplikacji w przyszłości? \*

	1	2	3	4	5	6	7	
Wyoce nieprawdopodobne	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Wyoce prawdopodobne

36. Czy jest coś jeszcze, co chciałbyś/chciałabyś powiedzieć o aplikacji?

Your answer

---

## Appendix 4 - Survey Questions (Greek)

### Έρευνα εφαρμογών αυτοδιαχείρισης διαβήτη

Αγαπητέ συμμετέχοντα,

Είμαστε ο Κώστας και ο Μιχάλης, μεταπτυχιακοί φοιτητές από το πανεπιστήμιο του Lund της Σουηδίας, που διεξάγουμε έρευνα στον τομέα των εφαρμογών για την αυτοδιαχείριση του διαβήτη. Ο στόχος μας είναι να εξετάσουμε παράγοντες επιτυχίας τέτοιων εφαρμογών από την οπτική γωνία των χρηστών. Η έρευνα είναι μέρος της μελέτης όπου αναζητούμε πληροφορίες από την πραγματική χρήση της τεχνολογίας.

Η έρευνα είναι ανώνυμη, οι απαντήσεις θα χρησιμοποιηθούν μόνο για τον σκοπό της μεταπτυχιακής διατριβής και θα αποθηκευτούν στο αρχείο του Google Drive.

Μπορείτε να βρείτε την αγγλική έκδοση της έρευνας εδώ:

<https://forms.gle/Erhq1NpwYf6e2EoZ7>

Μπορείτε να βρείτε την πολωνική έκδοση της έρευνας εδώ:

<https://forms.gle/uoZhTbedw64usQp49>

Εάν έχετε ερωτήσεις ή σχόλια σχετικά με την έρευνα, επικοινωνήστε με:

Μιχάλης: [mi3670tr-s@student.lu.se](mailto:mi3670tr-s@student.lu.se)

Κώστας: [ko1227ra-s@student.lu.se](mailto:ko1227ra-s@student.lu.se)

Συνδεθείτε στο Google, για να αποθηκεύσετε την πρόοδό σου. [Μάθετε περισσότερα](#)

**\* Απαιτείται**

1. Παρακαλώ επιλέξτε το φύλο σας

- ☐ Άντρας
- ☐ Γυναίκα
- ☐ Δεν επιθυμώ να δηλώσω

2. Επιλέξτε την ηλικιακή σας ομάδα

- ☐ Κάτω των 20 ετών
- ☐ 20–30 ετών
- ☐ 31–40 ετών
- ☐ 41–50 ετών
- ☐ 51–60 ετών
- ☐ Άνω των 60 ετών

3. Ποια εφαρμογή για την αυτοδιαχείριση του διαβήτη χρησιμοποιείτε αυτήν τη στιγμή;

Η απάντησή σας \_\_\_\_\_

4. Είναι η εφαρμογή δωρεάν; \*

- ☐ Ναι
- ☐ Ναί, αλλά με περιορισμούς
- ☐ Όχι

5. Πόσο καιρό χρησιμοποιείτε την εφαρμογή για την αυτοδιαχείριση διαβήτη; \*

- ☐ Λιγότερο από 6 μήνες
- ☐ 6-12 μήνες
- ☐ 1-3 χρόνια
- ☐ Περισσότερο από 3 χρόνια

6. Πόσο συχνά χρησιμοποιείτε την εφαρμογή για αυτοδιαχείριση διαβήτη; \*

- ☐ Καθημερινά
- ☐ Μέρα παρά μέρα
- ☐ Λιγότερο συχνά

7. Πόση ώρα την ημέρα χρησιμοποιείτε την εφαρμογή για αυτοδιαχείριση διαβήτη; \*

- ☐ Λιγότερο από 5 λεπτά
- ☐ 5 με 10 λεπτά
- ☐ 10 με 20 λεπτά
- ☐ 20 με 30 λεπτά
- ☐ 30 με 60 λεπτά
- ☐ Περισσότερο από 1 ώρα
- ☐ Δεν χρησιμοποιώ την εφαρμογή για αυτοδιαχείριση διαβήτη καθημερινά

8. Ποιες λειτουργίες της εφαρμογής για την αυτοδιαχείριση διαβήτη χρησιμοποιείτε;

- ☐ Εισαγωγή/αναφορές γλυκόζης αίματος
- ☐ Εισαγωγή/αναφορές αρτηριακής πίεσης
- ☐ Εισαγωγή/αναφορές τελευταίας basal/bolus
- ☐ Εισαγωγή/αναφορές δραστηριότητας
- ☐ Εισαγωγή/αναφορές διατροφής
- ☐ Άλλο

9. Πώς βρήκατε την εφαρμογή για την αυτοδιαχείριση του διαβήτη; \*

- ☐ Google play store/app store
- ☐ Επαγγελματίας υγείας (π.χ. γιατρό/νοσοκόμο)
- ☐ Κοινωνικός κύκλος
- ☐ Social media
- ☐ Αναζήτηση στο διαδίκτυο
- ☐ Φόρουμ για τον διαβήτη
- ☐ Άλλο

10. Έχω θετικές εμπειρίες με εφαρμογές αυτοδιαχείρισης διαβήτη \*

1    2    3    4    5    6    7

Διαφωνώ απολύτως   ☐   ☐   ☐   ☐   ☐   ☐   ☐   Συμφωνώ απολύτως

11. Έχω εμπειρία στη χρήση εφαρμογών για αυτοδιαχείριση διαβήτη \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

12. Χρησιμοποιώ συχνά την εφαρμογή για να αναζητήσω πληροφορίες σχετικά με τον διαβήτη \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

### Ποιότητα πληροφοριών στην εφαρμογή

13. Ποιος είναι ο τρόπος με τον οποίο εισάγετε πληροφορίες στην εφαρμογή;

- ☐ Με το χέρι
- ☐ Αυτόματα με συνδεδεμένες εφαρμογές/συσσκευές

14. Οι πληροφορίες που λαμβάνω από την εφαρμογή είναι αξιόπιστες \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

15. Οι πληροφορίες που λαμβάνω από την εφαρμογή είναι πολύτιμες/  
χρήσιμες \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

16. Οι πληροφορίες που λαμβάνω από την εφαρμογή είναι πλήρεις \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

17. Οι πληροφορίες που λαμβάνω από την εφαρμογή είναι εξατομικευμένες \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

18. Οι πληροφορίες που λαμβάνω από την εφαρμογή βελτίωσαν την  
καθημερινότητά μου \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως



## Πρόθεση χρήσης της εφαρμογής

19. Γιατί ξεκινήσατε να χρησιμοποιείτε την εφαρμογή;

- ☐ Από ανάγκη
- ☐ Από σύσταση
- ☐ Από περιέργεια
- ☐ Για ευκολία
- ☐ Άλλο: \_\_\_\_\_

20. Πόσες διαφορετικές εφαρμογές για την αυτοδιαχείριση του διαβήτη έχετε χρησιμοποιήσει; \*

- ☐ Καμία
- ☐ 1
- ☐ 1-4
- ☐ 5 ή περισσότερες

21. Η εφαρμογή εμπλέκεται στον τρόπο επικοινωνίας με τον διαβητολόγο/γιατρό μου \*

- |                  |                       |                       |                       |                       |                       |                       |                       |                  |
|------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------|
|                  | 1                     | 2                     | 3                     | 4                     | 5                     | 6                     | 7                     |                  |
| Διαφωνώ απολύτως | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Συμφωνώ απολύτως |

22. Συνδέω/χρησιμοποιώ εξωτερικές συσκευές ή λογισμικό με την εφαρμογή \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

23. Αισθάνομαι ασφαλής όταν εισάγω τα ευαίσθητα δεδομένα μου στην εφαρμογή \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

24. Βρίσκω εύκολη την σύνδεση της εφαρμογής με εξωτερικές συσκευές και λογισμικό \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

### Η ικανοποίησή σας

25. Είμαι ικανοποιημένος από τη χρήση της εφαρμογής \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

26. Αντιμετωπίζω προβλήματα κατά τη χρήση της εφαρμογής \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

27. Μου παίρνει πολύ χρόνο για να χρησιμοποιήσω την εφαρμογή \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

28. Οι αρχικές μου προσδοκίες σχετικά με την εφαρμογή εκπληρώθηκαν \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

29. Θα συνεχίσω να χρησιμοποιώ αυτήν την εφαρμογή στο μέλλον \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

30. Θα συνιστούσα την εφαρμογή και σε άλλα άτομα \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

### Τα οφέλη σας

31. Η εφαρμογή έχει επηρεάσει θετικά τη ζωή μου με τον διαβήτη \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

32. Η εφαρμογή έχει επηρεάσει θετικά την καθημερινότητά μου \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

33. Η χρήση της εφαρμογής με βοήθησε να διαχειριστώ τον διαβήτη \*

	1	2	3	4	5	6	7	
Διαφωνώ απολύτως	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Συμφωνώ απολύτως

34. Τι θα σας παρακινούσε να ασχοληθείτε περαιτέρω με εφαρμογές αυτοδιαχείρισης του διαβήτη;

- ☐ Περισσότερες πληροφορίες
- ☐ Περισσότερες λειτουργικότητες
- ☐ Αν ήταν πιο γρήγορες στη χρήση
- ☐ Αν ήταν πιο οπτικά ελκυστικές
- ☐ Αν ήταν λιγότερο περίπλοκες στη χρήση

35. Πόσο πιθανό είναι να συνεχίσετε να χρησιμοποιείτε αυτήν την εφαρμογή \* στο μέλλον;

	1	2	3	4	5	6	7	
Απίθανο	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Πολύ πιθανόν

36. Υπάρχει κάτι άλλο που θα θέλατε να πείτε σχετικά με την εφαρμογή;

Η απάντησή σας

## Appendix 5 - Transcript of Interview 1

### Coding Scheme:

Dimension	Color	ID
Intention to Use	TURQUOISE	ItU
Use	YELLOW	U
Information Quality	ORANGE	IQ
User Satisfaction	GREEN	US
Net Benefits	MAGENTA	NB

### Interview 1 – Information:

General Information
<p>Actors:</p> <ul style="list-style-type: none"> <li>• Speaker 1: Diabetes self-management app user</li> <li>• Interviewer 1: Konstantinos Ratzos</li> <li>• Interviewer 2: Michal Piotr Trzpis</li> </ul> <p>Time: 13:00 CET</p> <p>Date: 13.04.2022</p> <p>Location: Google Meets</p> <p>Age: 22</p>

### Interview 1 – Transcript with codes:

Row #	Actor	Text	Code
1	Interviewer 1	Nice to meet you.	
2	Speaker 1	Nice to meet you.	
3	Interviewer 1	How are you doing?	
4	Speaker 1	Yeah. Good, yourself?	

5	<b>Interviewer 1</b>	Perfect. Thank you for taking your time. We really appreciate it. A quick introduction. I am Interviewer 1.	
6	<b>Interviewer 2</b>	Yep, I'm Interviewer 2. So, we are both Lund university students.	
7	<b>Interviewer 1</b>	Mm-Hmm. We're studying. We're doing our master's in information systems at Lund University. It's in Sweden, if you don't know.	
8	<b>Speaker 1</b>	Yeah, yeah.	
9	<b>Interviewer 1</b>	So, we reached out through Gendius with you. I think you've talked with someone from the company.	
10	<b>Speaker 1</b>	Yep.	
11	<b>Interviewer 1</b>	So, first of all, I would like to reinstate what we're doing. So, we try to identify success factors from the user's perspective for mobile applications that support diabetes self-management. One such application is Intellin, that I'm guessing you are a user of, right?	
12	<b>Speaker 1</b>	Yeah, I am, yeah.	
13	<b>Interviewer 1</b>	Perfect. Oh, before we start, I would like to inform you, the audio of the interview is being recorded.	
14	<b>Speaker 1</b>	Yeah, that's.	
15	<b>Interviewer 1</b>	as we said in the email. There you saw all the details about the recording.	
16	<b>Speaker 1</b>	Yeah. Yeah, there's a consent form, I saw it.	
17	<b>Interviewer 1</b>	So formally, and this is something we have to do. Do you consent to the interview audio being recorded and processed according to the description you received?	
18	<b>Speaker 1</b>	Yeah.	
19	<b>Interviewer 1</b>	Perfect. Great. We can. Do you have any questions before we start?	
20	<b>Speaker 1</b>	No, no.	
21	<b>Interviewer 1</b>	I'm trying to make it so that we don't take too much of your time as well. We really appreciate you.	
22	<b>Speaker 1</b>	Yeah, that's fine, I have the day off, anyway.	
23	<b>Interviewer 1</b>	Perfect. So, we can proceed with the interview then. We will ask you some general questions about yourself, as well as your experiences with using the application, Intellin Diabetes Management. So, to start with, how old are you?	
24	<b>Speaker 1</b>	I'm 22.	
25	<b>Interviewer 1</b>	So, what are your experiences with mobile applications? Are you a frequent user of your phone?	
26	<b>Speaker 1</b>	Yeah, I am, and I regularly use games, organizer, email, social media, obviously, and then I use some word applications for my university degree and whatnot. And yeah, I'm pretty clued up on using them.	

27	<b>Interviewer 1</b>	That's good. So, what are typical ways that you are looking for information about diabetes?	
28	<b>Speaker 1</b>	Do you mean information as though advice and suggestions or like that I use in or trying to use like an app for functionality? You know, what I mean?	
29	<b>Interviewer 1</b>	If you can answer both, that would be perfect.	
30	<b>Speaker 1</b>	In terms of information, I generally actually just email my doctors or my healthcare team. I'm also in a couple of online groups, so Facebook, Reddit one as well just to get other people's opinions who actually have diabetes rather than health cares, or just Google, sometimes. In terms of functionality, I'm on the pump and that has quite a lot of the features Intellin already has in terms of giving you a bolus calculations and whatnot. So, I don't tend to use apps like that, but I do use the LibreLink 2 app to get a bunch of readings from that. CGM.	ItU
31	<b>Interviewer 1</b>	Perfect. So next question, how did you find the Intellin diabetes management app?	
32	<b>Speaker 1</b>	Yeah, it was good. I liked. I like the layout. It's quite simplistic, but there's a lot of data there as well. It's easy to use as well, which is a bonus compared to some of the other ones I've tried in the past. I also like the healthcare stuff, so the activity and then the blood pressure and the BMI. I think that's quite impressive because I do quite a lot of running and stuff myself, so I like to be included in the app and I also like to priorities there as well, where it tells you, well, based off what you put in it and gives you sort of suggestions and whatnot. I think that was a good up to the app.	US
33	<b>Interviewer 1</b>	How did you come about using the application?	
34	<b>Speaker 1</b>	Do you mean, how did I start to use it?	
35	<b>Interviewer 1</b>	Yeah, yeah. How did you discover it?	
36	<b>Speaker 1</b>	My brother works with the company that created the app and then he asked, asked me if I wanted to get involved in doing some feedback for it because I'm always trying to look forward to making stuff a bit better and easy for everyone. And so that's how I got into it. That was about a month and a half ago now. So, I've been using it this time trying to get used to the app. But yeah, that's pretty much it.	ItU
37	<b>Interviewer 1</b>	How often do you use the app?	
38	<b>Speaker 1</b>	I try and do it a couple of times a day, but like I said it, because my pump, does most of the work for me. I sometimes forget, especially if I'm on the move. I can imagine if I was on daily injections, then I would use it a lot more frequently.	U
39	<b>Interviewer 1</b>	OK. How often do you do injections?	
40	<b>Speaker 1</b>	So, my pump is obviously always running about, probably three or four times a day. So, I do additional insulin those times.	



41	<b>Interviewer 1</b>	Mm hmm. So, you can't connect it with the app, your device, right?	
42	<b>Speaker 1</b>	No because I got a little, it's essentially a little phone, and that controls the pump itself, but I do think they're bringing out a phone app as well, so in the future, that might be a possibility. One of the things I will say about it, though, is I would like it to be linked to the LibreLink 2 app or like just general CGM, so that you can swap in between apps trying to test your blood sugar and then add it, it would just be nice if you scanned it in the Intellin app and it gave you the blood sugar there, just make it a bit quicker to do.	U,ItU
43	<b>Interviewer 1</b>	So, what would you say was your main objective of using the app?	
44	<b>Speaker 1</b>	Trying to just get a good average blood sugar. Trying to make injections and whatnot just simpler and quicker and just less inconvenient than it used to be. And obviously it is because this lets you just press the button and then it's there. I think that's really good. And I think as well the fitness part as well is a good object to it. I think maybe they can add a bit more. So maybe like a food diary thing so you can search up. Do you know MyFitnessPal?	ItU
45	<b>Interviewer 1</b>	No.	
46	<b>Speaker 1</b>	It's essentially that you scan a barcode, and it gives you the carbs or what the nutrients of what you eat and it would just be good, if you could do that quickly and then you don't need to do any calculations yourself.	
47	<b>Interviewer 1</b>	So, have you used other diabetes management apps before?	
48	<b>Speaker 1</b>	Yeah, I've used two. I have used mySugr. I didn't like that because it's a subscription service, I think that's a bit bad. And I used one called mylife. There are just not as much features there. It's really a basic little calculator, but it's got similar features, but I think Intellin just offers way more.	ItU
49	<b>Interviewer 1</b>	Was there anything you liked that those apps did that Intellin doesn't do, for example?	
50	<b>Speaker 1</b>	MySugr had like a graphing thing I thought was quite good. I'm not sure, I haven't gone over the graphs on this yet properly, but they had this graph thing of your blood sugar over time. And then it did like a predicted A1C, HB1C as well, which I thought was quite good, gives you a better idea of where you are in terms of your management.	
51	<b>Interviewer 1</b>	How about the other one?	
52	<b>Speaker 1</b>	Mylife? Not really. It was just a bit simple. It was easy to use simple but didn't offer a lot.	
53	<b>Interviewer 1</b>	So, what functions of the Intellin app are you using?	

54	<b>Speaker 1</b>	At the moment, mainly just the inputting carbohydrates and blood sugar and injection suggestion and also the body mass index one as well.	U
55	<b>Interviewer 1</b>	OK. And which ones do you think are most useful?	
56	<b>Speaker 1</b>	The carbohydrate one.	U
57	<b>Interviewer 1</b>	Have you encountered any problems while using the app?	
58	<b>Speaker 1</b>	I think it was on setup and while setting it up you obviously get all those questions you have to answer. And then it came to one called like triglycerides or whatnot, and I didn't really know what that was, and it would have been nice if there was like an explanation. How can I find this out or whatnot, but other than that I think that a lot of the questions that as well that it needs, it's not quite easy, but maybe just a bit more explaining on the way to what the readings are.	U
59	<b>Interviewer 1</b>	So, it was tough for you to set it up. Did you require external help?	
60	<b>Speaker 1</b>	I had to find out what triglycerides were and blah blah. Yeah, that's the only complain now.	U
61	<b>Interviewer 1</b>	So, do you use external appliances like a smartwatch or software that you can integrate with Intellin?	
62	<b>Speaker 1</b>	I've not used them no, but I do have a Garmin smartwatch that I use for running, but I don't wear it unless I'm running so. Yeah. I would like to see stuff like that way, you could just look at your watch and it tells you what's going on. If it was a link between the Libre app, the Intellin and then the Garmin software as well, I think that'd be really good. But at the moment, no, I'm not using any external stuff.	U,ItU
63	<b>Interviewer 1</b>	OK. Why would you say you're not using it? Because it is not supported?	
64	<b>Speaker 1</b>	I just don't think I really ever thought about doing it. To be honest. I've just not tried.	U
65	<b>Interviewer 1</b>	OK. Fair enough. So, have you ever used the application to engage when you're talking with your doctor or your diabetologist?	
66	<b>Speaker 1</b>	I've not talked to them about Intellin. I obviously use the Libre app with them, they check that data because they can get it off the cloud and then they check my pump data as well.	U
67	<b>Interviewer 1</b>	OK, so you don't need this app to communicate with your doctor, right?	
68	<b>Speaker 1</b>	Not right now. But I can imagine if I was on daily injections and it linked to the CGM application, that would be really useful because then they will not look at two sets of data. They could just correlate between each one.	U
69	<b>Interviewer 1</b>	OK, fair enough. Next question. So how do you feel about entering your data in the app? Do you have any concerns or reservations about it?	

70	Speaker 1	Oh no, not at all.	U
71	Interviewer 1	OK, that means you trust in them that the company follows regulations?	
72	Speaker 1	Yeah, definitely. I mean, I've done it with every other app, so I can't imagine why it would be different.	U
73	Interviewer 1	I'm asking because a lot of people may have concerns and because it's health data, it's personal.	
74	Speaker 1	Yeah. No, I'm not particularly bothered at all.	
75	Interviewer 1	Right. So, what is the way you enter information in the app? Manually, right?	
76	Speaker 1	Manually, yeah.	IQ
77	Interviewer 1	So, the app has a lot of tips and presents information. How do you feel about this information you get?	
78	Speaker 1	I've just been going through it now. I like the risk, I like the thumbs up, thumbs down thing it does that gets your data and tells you what you should look at. Generally, I know all this stuff anyway, just from having diabetes for so long. But I could imagine for a newer, newly diagnosed person, it'd be really helpful.	IQ, US
79	Interviewer 1	That's very good insight. Do you think it's reliable what you see? Does it confirm your previous knowledge?	
80	Speaker 1	Yeah, it confirms everything I know. Yeah, it's got everything that I've been told over the years anyway, so I think there's no problem there.	IQ
81	Interviewer 1	Perfect, that's good. So, you trust usually information you receive from the app?	
82	Speaker 1	Yeah, I do.	IQ
83	Interviewer 1	That's good. Do you think you have found all the relevant and crucial information to help you manage diabetes in the app? Is there something that is lacking in your opinion?	
84	Speaker 1	I don't think so, really. Obviously, it doesn't tell you everything from start to finish, but I'd imagine people would already know that from their doctors and whatnot and I don't think. I think they should trust that information over what an app says, obviously trust the healthcare professional, but I think in terms of tips on, say like eating healthy diet, watch healthy weight and stuff like that, I think that's really helpful.	IQ, NB, US
85	Interviewer 1	Great. A different question. About the information you received from the app. You've set it up, you enter some data, is it personalized to your case?	
86	Speaker 1	Yes. So, obviously, you can set up your different carb ratios and insulin sensitivity and whatnot. So yeah, that's the same as the other apps I've used as well. But yeah, it's just a standard like bolus calculator, and it works.	IQ
87	Interviewer 1	Yeah, I guess. So, nothing too tricky there.	

88	<b>Speaker 1</b>	No, no. I think when you know what you're doing anyway, it just makes sense because I have obviously done it before with previous apps and previous blood tests and monitors and what-not. So, it's quite intuitive in that way.	
89	<b>Interviewer 1</b>	Mm hmm. Great. So, about the information you get from the app. Do you apply it in your daily life?	
90	<b>Speaker 1</b>	Yes. So obviously, the bolus requirements I use those when I need it. In terms of the tips and stuff I don't generally use them that much. Unless there was an issue and I'd go back and try and see it. And then also the BMI one, obviously, I think that's quite good just to see where you're at and see if anything's changed.	IQ, NB
91	<b>Interviewer 1</b>	Perfect. So, a more general question that you've kind of answered already, but I'll ask it again, maybe you want to add something more as to what appeals to you about the app? Or is there something that doesn't appeal to you?	
92	<b>Speaker 1</b>	What appeals to me is the simplicity of it. It's just easy to navigate. And there's no, also there's no hidden costs or anything. There's no in-app purchases that sort of thing other people might try and do. But again, I think it should try and interface or that. No, that's the right word. Link with the CGM apps, just to make sure everything's all in one app, just to reduce the amount of time you spend on it and make it easy for everyone really.	US
93	<b>Interviewer 1</b>	That's fair enough. How long does it take you to interact with the app?	
94	<b>Speaker 1</b>	This app's really fast, but the Libre app itself is really slow. I don't know why. So. Well, I flip in between them, that's what takes the time and sometimes if you're in a rush, or you've got somewhere to go, it can be quite annoying having to change between the two apps.	US
95	<b>Interviewer 1</b>	So, it takes too long in your opinion.	
96	<b>Speaker 1</b>	Yeah.	
97	<b>Interviewer 1</b>	Fair enough. What were your expectations from the app before downloading it? Do you remember?	
98	<b>Speaker 1</b>	I don't really remember. I think it's surpassed what I thought it would be, I thought it would just be similar to the mylife one, which was a basic calculator. I didn't expect like the lifestyle tips and the additional data that you can put in. So yeah, in that sense it's done better than I thought it would do.	US
99	<b>Interviewer 1</b>	Oh, that's good. So, has the information you get changed anything in your daily behaviour?	
100	<b>Speaker 1</b>	Not really. No, it's just that it does help, though it does help. It makes life easier. And that's the entire goal of these things, I suppose. But it's what I was doing anyway. I just think it's all in one place, which is nice.	NB
101	<b>Interviewer 1</b>	Some closing questions. How likely do you think is it that you will continue using this app in the future?	

102	<b>Speaker 1</b>	Again, because I'm on the pump and it does itself, probably not. But I imagine if you did the integration with the Libre app, I probably would start using it more just as sort of a. Because it's good to tell about what your carbs are and whatnot. Yeah, it's just not. It'd be good if you could build it all together.	US
103	<b>Interviewer 1</b>	Perfect. So, you told us what would motivate you to further engage with the app. It's integrating with the other apps or maybe your smartwatch.	
104	<b>Speaker 1</b>	Yeah.	
105	<b>Interviewer 1</b>	Would you like to, for example, have an app in your smart-watch?	
106	<b>Speaker 1</b>	Yeah, I really don't use my smartwatch that much. So, but I imagine if it was there, I might start using it more.	
107	<b>Interviewer 1</b>	So, it would be more convenient than your phone, you think?	
108	<b>Speaker 1</b>	Yeah, especially if I'm doing exercise as well, because I generally tend to not take my phone out with me, if I'm doing a short run or something, and so it'd be nice just to have it on the watch.	ItU
109	<b>Interviewer 1</b>	So, is there anything else you would like to say about the app in general?	
110	<b>Speaker 1</b>	No. I think it's well designed, well put together and has all the right stuff in it. So yeah, very good.	US
111	<b>Interviewer 1</b>	Great. Well, that's basically all of the questions we had prepared for you, unless, Michael. Do you have any other ones?	
112	<b>Interviewer 2</b>	I only like that one of the last questions had an interesting answer that you've given. It's about that you are not planning to further use the app. And I was wondering about another benefit that you would be looking for in the app, apart from the integration. Is there anything that you would consider, let's say a life changer in the app that would convince you to engage with it?	
113	<b>Speaker 1</b>	Yeah, it would be the food diary thing I think I mentioned where you can scan the barcode of whatever foods that it tells you the carbs. Because I already use a separate app for that as well. So that's three apps, I use in general. If that was all in one place, I'd definitely continue using it.	
114	<b>Interviewer 2</b>	OK, good, thank you for your clarification.	
115	<b>Interviewer 1</b>	Great. So, uh, would you like us to share when we? Because as we told you, we're recording this and we're going to make the transcripts from the interview, what has been said. Obviously, there's not going to be your name on it anywhere. Don't worry about it. Um, so do you want, because we've got to proceed with that. It's our next step in our research. We're going to make the transcripts. Would you like access to those transcripts to verify that we have not misunderstood you? Or.	
116	<b>Speaker 1</b>	I'll have access to them, yeah. Just to have a look really. Can I ask you, what are you like writing a paper or something?	
117	<b>Interviewer 1</b>	Exactly.	

118	<b>Speaker 1</b>	What's the end goal of this?	
119	<b>Interviewer 1</b>	The end goal is our master thesis. And it's as we told you, it's about identifying success factors and from the user's perspective for mobile health applications that support diabetes self-management apps. We use. We're doing interviews about Intellin. This is part of the research, but we're also doing a more generalized questionnaire. And it's going to be, we're trying to contribute just a little bit to see what's, what people have to say about it. Yes, it's a bit under researched. I would say, it's an under researched area.	
120	<b>Speaker 1</b>	OK, go, yeah.	
121	<b>Interviewer 1</b>	So, we can also share the publication with you if you like.	
122	<b>Speaker 1</b>	Yeah, that'd be good, yeah. That's right then.	

## Appendix 6 - Transcript of Interview 2

### Coding Scheme:

Dimension	Color	ID
Intention to Use	TURQUOISE	ItU
Use	YELLOW	U
Information Quality	ORANGE	IQ
User Satisfaction	GREEN	US
Net Benefits	MAGENTA	NB

### Interview 2 – Information:

General Information
<p>Actors:</p> <ul style="list-style-type: none"> <li>• Speaker 2: Diabetes self-management app user</li> <li>• Interviewer 1: Konstantinos Ratzos</li> <li>• Interviewer 2: Michal Piotr Trzpis</li> </ul> <p>Time: 11:00 CET</p> <p>Date: 14.04.2022</p> <p>Location: Google Meets</p> <p>Age: 81</p>

### Interview 2 – Transcript with codes:

Row #	Actor	Text	Code
1	Interviewer 2	OK, that's the good news. It's nice to meeting you. So just to quickly introduce ourselves. I'm Michael and I'm working with Interviewer 1.	
2	Interviewer 1	Hello.	

3	<b>Speaker 2</b>	Yeah.	
4	<b>Interviewer 2</b>	So, we are Lund University students in Sweden, and we are doing our master's thesis about success factors from the user's perspective for mobile health applications that support diabetes self-management.	
5	<b>Speaker 2</b>	All right.	
6	<b>Interviewer 2</b>	Yeah. And I will just bring quickly the formalities because it's obligatory for us to have this here. So, I would like to inform you that the audio of the interview is being recorded and all the details about the recording were included in the PDF you received via email.	
7	<b>Speaker 2</b>	Which I've said OK to. Yes.	
8	<b>Interviewer 2</b>	Yeah, and I need to ask the question just for formalities. So, do you consent to the interview audio being recorded and processed, according to the description?	
9	<b>Speaker 2</b>	Yes.	
10	<b>Interviewer 2</b>	OK, thank you. So, we are done with formalities. And before we start, do you have any questions to ask?	
11	<b>Speaker 2</b>	Or can I introduce myself?	
12	<b>Interviewer 2</b>	Of course, yes.	
13	<b>Speaker 2</b>	I'm a knowledge transfer advisor. I'm very old, but I still work full time. I work 37 hours a week. I've been doing this job for 25 years or more.	
14	<b>Interviewer 2</b>	So, moving on to the questions, so we will start with some general questions. And you mentioned that you are pretty old. I'm just repeating you. So, I would like to ask, how old are you specifically?	
15	<b>Speaker 2</b>	I'm 81.	
16	<b>Interviewer 2</b>	OK, thank you.	
17	<b>Speaker 2</b>	1940.	
18	<b>Interviewer 2</b>	OK. OK, that's that's good. And what are your experiences with mobile applications in general?	
19	<b>Speaker 2</b>	Um, well, I spent a lot of my time with those mobile applications, I suppose, but um, the ones that I've had in the past were to do with diet, and I can't quite think of the name of it. It's a very well-known one. But it was all to do about diet and the psychology behind dieting and sticking to a diet. And I went through that programme for about four months or so, and I did lose some	ItU,U, NB,IQ, US



		<p>weight. I did lose some weight, all my numbers, all my medical numbers pretty well are in the right place. Blood pressure and that sort of thing, but about my weight and I'm somewhat overweight. And so, I tried that. I've been ever since I started to talk to Gendius and I knew they had an app. I registered and I pay to be a member of the club and I fill it in each day. But it seems like a one-way street. I'm putting data in. I'm getting hardly anything back. The app itself, I have to say, has a lot of information on it, but most of the information is not new to me. It may be new to other people, and I would say generally, as a diabetic, I've been a diabetic for nearly 20 years now. When I first was diagnosed, I felt pretty awful. And so, you know, my end had come. But the advice I got seemed to be contradictory. Some people were saying, take small meals many times a day. Other people were saying try and see if you can get one meal a day. In the end, my current situation is I have no breakfast. I don't eat until midday like a light lunch. My main meal in the evening round about seven o'clock and I finish eating around about eight o'clock, so I have nothing else to eat until one o'clock the following day. So, I have about a 16 hour fast. But going back to your question. I don't feel I'm getting very much back from the app to instruct me. All of the things I've worked on in my general KTP work because I'm very interested in personal medicine where we can actually have medicine, which is tailored to an individual. We're slowly moving in that direction, but it's not. It's not sharp enough or informative enough for me.</p>	
20	<b>Interviewer 2</b>	<p>OK. OK, thank you. You mentioned the interesting thing that, like different sources, are giving different information. How do you filter the information? What is your approach that you distinguish the good from the bad, let's say?</p>	
21	<b>Speaker 2</b>	<p>Well, of course, when you start, you don't know which is good or which is bad. And you see you see prestigious bodies, you know, you know, the American Diabetic Association or somebody like that, even the British Diabetic Association, you say, well, these people must know what they're talking about. But in fact, when you get back to it, a lot of these are regurgitated and copied from earlier stuff. That's not original thinking. And there're too original thinkers. There's a professor in Newcastle. There's a professor there who seems to be he's the one who does the advice on partial fasting. Two days with, you know, a low-calorie intake and the rest of the week, it doesn't matter. And that will in fact of affect your results. And he's also very keen to help diabetics. So, you start to find people who seem to know what they're talking about. And then you've got to make your own mind up. I talked to my GP, and I find my GP strangely ill informed. He knows a lot about on. It froze. We're all frozen. Yeah, are we?</p>	
22	<b>Interviewer 1</b>	<p>I think we're back.</p>	

23	<b>Speaker 2</b>	I'm frozen. Anyway, my GP. You can still hear me?	
24	<b>Interviewer 1</b>	We can see you; I can see you as well.	
25	<b>Interviewer 2</b>	Yeah, I can see you as well.	
26	<b>Speaker 2</b>	OK. Well, my GP, surprised me. He'd been really regurgitating the standard stuff. And not really looking at my individual case, but it's a good surgery where I go to and when I had my six months review with a diabetic nurse who is much more informed. And then I have to say, since I've been working with Gendius on a personal basis, there are people in Gendius, particularly their senior nurse who I find very helpful and very knowledgeable and very much up to date. So, I'm slowly finding sources that I can trust. But I had probably five years where, quite frankly, I was like a wind vane. I was just blowing around in different directions. I wasn't sure of what was good and what was bad. And in that time, I got a lot of fluctuations in my sugar readings. I said to you, I have no, I have no feeling in my feet. I have a little bit of trouble with my eyesight. I'm short sighted, as you can see. That's about it. But I worry about my kidneys, but so far, so good. Part of my six-monthly review. They did a check on my kidneys, and that's OK. That's okay. So, does that answer your question? I'm still frozen here, I can't.	IQ
27	<b>Interviewer 1</b>	Yeah, we see you perfectly. We're seeing you.	
28	<b>Speaker 2</b>	I'm moving, I'm moving my hands.	
29	<b>Interviewer 1</b>	Yeah, we can see.	
30	<b>Interviewer 2</b>	Yeah, we can see you. But if we were to run into like bigger issues, we will let you know for sure.	
31	<b>Speaker 2</b>	OK, OK.	
32	<b>Interviewer 2</b>	OK. And that was good. A good, comprehensive answer and another like, pretty short question. So how long, like combined have you been using the Intellin app?	
33	<b>Speaker 2</b>	I think about a year.	
34	<b>Interviewer 2</b>	OK. Yeah. And how often do you use the app?	
35	<b>Speaker 2</b>	Twice, or possibly three times a day.	U
36	<b>Interviewer 2</b>	And how long like time wise does it take you?	
37	<b>Speaker 2</b>	Well, I just have a in the morning I come down and I take my pills because I take about eight and then I take a finger prick. Then look at what the score is, decide what insulin to take. I then inject myself that all takes probably no more than three or four minutes, five minutes max.	
38	<b>Interviewer 2</b>	OK, thank you. And why did you start using the app?	

39	<b>Speaker 2</b>	Mainly because, the university, came to me and said we found this company that just got a problem, and they need our help. And it's Nottingham University. And I thought, well, I said, I'm a diabetic. Yes, I'm very keen. So, I went to see them. I supported them. We raised the grant, which is around about 200000 pounds, and then we recruited the associates. But of course, by then I was talking to them. We had to get, I had to get a lot of information from Gendius in order to do the application and the app came up. So, I investigated the app and found there were two levels. You could use it sort of for free or you could use it by becoming a paid member. So, I just had become a paid member. So that's then all. That's probably 12 months.	ItU
40	<b>Interviewer 2</b>	OK. You mentioned about the paid membership. Is it like, how does that work with the paid membership?	
41	<b>Speaker 2</b>	Well, I pay them. I think about forty-nine pounds a year. And I'm a little bit disgruntled because I don't, as I said earlier, I don't think I'm getting very much back, but then I'm a patient man and I'm saying it's all very new and I'm hoping that as time goes on, things will start to improve. I'm very fortunate in the sense I can talk to the authors of the app and I meet them every four months and I had one face to face meeting with them about two months ago, which was a bit tricky because when I came back from that meeting and my iPhone started to vibrate to tell me I had been in contact with the COVID-19, and two people at that meeting tested positive. Luckily, I tested negative, but so we stopped doing face to face meetings, but possibly in two months. I may feel like going back. So, in a sense, I have a relationship with Gendius and the ability to ask questions. I know I already raised my fears and my disappointment at the first meeting, but I'm just now holding back, giving them the chance to get involved because in a sense, I will be seeing him much more regularly and I can ask him to ask questions on my behalf. And hopefully, because I've given him a lot of data, hopefully they will start to give me some something back, some direction, which is what I'm expecting.	US
42	<b>Interviewer 2</b>	OK. This is interesting insight, actually, because this is like a unique objective of using the app and another question is, have you used other diabetes management apps before?	
43	<b>Speaker 2</b>	I've used the British Diabetic Association app or the website I've got that is quite comprehensive in terms of talking about diet. Talking about injection. Talking about how to make an injection. I'm talking about what to look for in terms of loss of sense in your feet and your legs. So, I use that, but I use it in a sense as an information source.	
44	<b>Interviewer 2</b>	OK. And any more or only this one and Intellin?	
45	<b>Speaker 2</b>	In the earlier days, I was looking all over the place, but I got a feeling a lot of them were regurgitated from other earlier ones and I was looking for the ones that were moving forward. That I	ItU

		felt there was good science behind it and that's when I came across Gendius who are genuinely trying to give feedback to diabetics on a personal basis. So that really struck me as the right one. So, the other ones are informative, but by now, I've been a diabetic long enough. I know the kind of diet I need to eat and the range of foods that I need to eat. And I try to cut down the quantities of food I need to eat, and I have lost. I have lost at least probably 10 kilograms over the last two years. So, there's been some success in the remark.	
46	<b>Interviewer 2</b>	Yeah. OK. Good. And so, considering the use of the app, what functions of the Intellin are you using?	
47	<b>Speaker 2</b>	I'm using. I record my insulin level on each time I know records. The amount of insulin I take every time, sometimes at zero, if my sugar level is five or six or seven, I may decide not to take insulin. This morning at eight point five. What I usually do, I normally double the sugar reading and add a bit. I've got this mind. This graph in my mind which sets out that. And that's what I've worked out. If I take the double insulin is too much. I then start to go to a hypo. So, I got to be a bit careful. But I don't know whether it's possible if I could just. If my thing will work. So that's my oh, you can see that. But that's my insulin levels over a year.	U
48	<b>Interviewer 2</b>	OK.	
49	<b>Speaker 2</b>	And I don't know how clearly you can see that, but you can see I'm. I got two hypos. The blue circles are hypos.	
50	<b>Interviewer 2</b>	Oh, yeah. Mm hmm.	
51	<b>Speaker 2</b>	There's my input. If I look back at the front. So, on the front side, you can see that I filled in my blood glucose each day, my activity. I put that in about every two or three months. Um, my blood pressure, I change. I take that roughly on a weekly basis. So, under 19, I was 70 to 120, over 75. Sort of thing. My body mass, twenty-nine point six, that doesn't get changed very often. And the last bolus. But the only problem I have, when I go into that part of the app, I'm not sure what to do because if I. When I go into the insulin part, it says: What is your latest bolus, short-acting? What is your latest basal, long acting? And Gendius have never explained that to me. So, I put all my readings into the short-term one. So, I got all the, and the other thing it took me some time to find, there is a way of actually plotting or looking at the plot of the insulin. But it's not easy, it's not easy to find. I find. OK. So, that took me some time to find, and I wasn't. I discovered that one day because the real number one question I have with this app is given a sugar level reading, what is the appropriate amount of insulin to take?	U, ItU
52	<b>Interviewer 1</b>	Hmm.	

53	<b>Speaker 2</b>	And I say, I have got this little formula. Double the insulin level, plus a bit. So typically, with eight, I would say 16 plus four, 20, I would take 20. And that's where most of those readings are.	
54	<b>Interviewer 1</b>	Mm-Hmm.	
55	<b>Interviewer 2</b>	Okay. Yeah, we can see that. And considering like problems, are there any other problems you encounter while using the app?	
56	<b>Speaker 2</b>	Not really. No, <b>in the respect of other apps, it's very good, it's very good.</b> Yeah.	US
57	<b>Interviewer 2</b>	OK. And going back a little. So, you said what functions of the app you use in general and what functions or function do you find the most useful?	
58	<b>Speaker 2</b>	<b>Only the graph, I think, OK, when I'm always. That's the one I use most because that's a year.</b> That's the months.	U
59	<b>Interviewer 2</b>	Yeah.	
60	<b>Speaker 2</b>	Well, again, I had a hypo on April the seventh. I'm fortunate I get plenty of. When I'm starting to get a hypo. I certainly think something's wrong. I'm a bit hot and perhaps sometimes I feel a little woozy. And I know if I keep a small bottle of Lucozade in the fridge, if I go and swig half a bottle of Lucozade and chew a sweet, I'm, I'm OK within 30 minutes.	
61	<b>Interviewer 2</b>	OK.	
62	<b>Speaker 2</b>	That's that's really very useful to me. And one thing I've been thinking about and again, Gendius are encouraging me, is to go to continuous recording of my sugar levels. You know. What's the one that goes into the arm?	
63	<b>Interviewer 2</b>	Libre? Is it Libre? I think.	
64	<b>Speaker 2</b>	Libre. There's another one. There's two of them.	
65	<b>Interviewer 2</b>	Oh, OK.	
66	<b>Speaker 2</b>	There's two of them and then you then pick up. You don't have to finger prick. You can read and see your sugar level on a fairly constant basis and also, I think that way, you can also take into account the amount of food or the kind of food you're eating and see how that affects. Because once a guy I take a reading, shall we say before tea, before dinner, as it were. And that may be, shall we say, eight or nine. So, I decide on the basis of that, nine plus nine and 18 plus a bit, I'll probably take 22 units of insulin then I have my dinner.	
67	<b>Interviewer 1</b>	Mm-Hmm.	
68	<b>Speaker 2</b>	Now I know that my sugar level is now spiking, but I don't test that. I leave it for a couple of hours. That's just before I go to bed and see what it is. And I may decide, depending on the reading, to take more insulin then. So, if you have it on a continuous reading would be useful.	

69	<b>Interviewer 2</b>	Yeah, OK. Thank you for answering this question. And the following one is about the external appliances or software. So, do you integrate any external devices or software with the Intellin app?	
70	<b>Speaker 2</b>	No, I don't and perhaps I should. You know, for example I was looking at it this morning. I might add that I shall have to go in about 15 minutes, max.	U
71	<b>Interviewer 1</b>	OK.	
72	<b>Interviewer 2</b>	OK. So yeah, we can. We can just speed up to fit with the deadline. Yeah. So moving on. How is the application engaged in the way you communicate with your diabetologist?	
73	<b>Speaker 2</b>	We share it, we share my screen. They find that very useful. My diabetic nurse finds that very useful. And seeing basically the highest levels I spiked to and also the number of hypos that I have and also the running average, which is around about eight to ten. And I found that more comfortable. I mean, by taking more risk, by taking more insulin, I can run more at five to seven. But then the chances of hypo is quite high. And I think if I had the continuous reading, I would like to run my reading at a lower, near to five, between the five to seven region. So, it's a bit too risky. So, I tend to be in the seven to ten region.	U
74	<b>Interviewer 2</b>	OK. So, moving on now, how do you feel about entering your data into the app? Do you have any concerns or reservations while doing so?	
75	<b>Speaker 2</b>	No, I don't.	U
76	<b>Interviewer 2</b>	OK, thank you. You mentioned a little bit, because right now we are going to move into information quality of the app that you are receiving. And but I will ask some questions once again. So just we can go through it. So how do you feel about information that you receive from the app? I mean, the advice or the information about diabetes.	
77	<b>Speaker 2</b>	Not much. Whatever is there, I know of it from other sources. And I think it would be very useful as an app for other people, especially new diabetics. But for me, it doesn't. It doesn't inform me very much.	IQ
78	<b>Interviewer 2</b>	OK, thank you.	
79	<b>Speaker 2</b>	I don't rely on it in that way.	
80	<b>Interviewer 1</b>	Mm-Hmm.	
81	<b>Interviewer 2</b>	Yup, yup. OK, so here I see we covered some questions about information quality. So, let's jump right into user satisfaction. So, what is your satisfaction level from using the app?	
82	<b>Speaker 2</b>	It's no more than mid-range in the sense that it's useful to me for me to see the graph, for me to record my sugar level and bear in mind the kind of diet that I'm eating. Because of COVID, I've	US



		<p>been in this room for the last two years. I believe. But normally I would drive probably 500 kilometers a month to see the various clients I have, which means when you're on the road, you can't always get precisely the right kind of food. And so, you either starve or you over, you take something, you know, like fish and chips. So, the fish is good for you. The chips just really raise your sugar level. So, I don't eat very many, but sometimes you're forced into eating stuff, which is not as good as you would hope. So, in that sense, that's the only information I get. Information from Gendius at the moment is zero. And I'm very dissatisfied with that and I rather hope that, and I believe from what I've been talking to them, they also recognise the delinquents there. And as soon as possible, they want to get into a relationship where they are actually feeding information to me. But we're not there yet.</p>	
83	<b>Interviewer 2</b>	OK, gotcha. And what were your expectations before downloading the app?	
84	<b>Speaker 2</b>	<p>I thought I was going to have very regular input from Gendius. I mean not necessarily sort of talking to me, but perhaps some diagram or something that was interpreting the data I was putting in and perhaps making suggestions of the level of insulin I should be taking or perhaps suggesting that the I was eating too much, or I was eating too much of the wrong stuff, which was indicating a higher sugar level than I should have. I mean, I still don't know to this day whether running. I was in the hospital about a year ago and I've been reading a twelve, which horrified me. That was high for me. And the nurse said, Oh, that's OK, that's OK. So, is my running at eight to ten in terms of long, long term exposure to diabetes. Is that, OK? I know a lot of people who just don't bother. And so, they must be running insulin levels, so sugar levels in the 20s or even higher. And they undoubtedly will suffer in terms of more rapidly than I am.</p>	US
85	<b>Interviewer 2</b>	OK, thank you, thank you for this extended answer, actually. And how has the app influenced your life with diabetes?	
86	<b>Speaker 2</b>	<p>It's brought a regime to my life in that before I do anything in the morning, I take a pint of water with gelatin, fiber gel, to aid my digestion. At the same time, I do my finger prik and I take an appropriate amount of insulin at the same time before lunch. I take my sugar level and the appropriate amount of insulin before dinner. I do the same thing. So, the app has given me a way of recording my results, and the graph informs me of any trends that I'm on. So, in that sense, it's good.</p>	NB,US
87	<b>Interviewer 2</b>	OK. And moving on. What are the overall advantages of using the app?	
88	<b>Speaker 2</b>	<p>Well, I suppose the advantage in the first place is that you are able to record your insulin levels. So, your sugar levels the insulin you're taking. To sometimes look back and see if you can</p>	NB

		correlate any trends with any trends in your health. But the downside is very little coming through from Gendius.	
89	<b>Interviewer 2</b>	OK. And. So how likely is it that you will continue using this app in the future?	
90	<b>Speaker 2</b>	There's every likelihood and I think it's a good thing. I think it's a good thing. It brings you, the regime of doing the tests and also it records the test. So, there is a sort of record there that can be interpreted and there is a record there that I can show to people like you or my diabetic nurse or my GP. What I do, I can prove that I am keeping or attempting to keep my levels in control. Otherwise, I just turn up and sit on the desk and they say, do I believe it? I can prove that I do it daily, weekly, monthly.	US,NB
91	<b>Interviewer 2</b>	Yeah. So, moving on. What would motivate you to further engage with the app?	
92	<b>Speaker 2</b>	To have more feedback.	ItU
93	<b>Interviewer 2</b>	OK, so this is confirmed with what we were talking before. That's good. So, basically, I have the last question for you now. Is there anything else you would like to say about the app?	
94	<b>Speaker 2</b>	Not really. I accept that I feel that. The recording of the amount of insulin I'm taking was hidden. It's not on the main dashboard. And perhaps that's where it should be. And I would like some sort of correlation, if I can, between sugar level and a suggested level of insulin to take. That's what I was expecting. And I'm still a bit sore that I have to make that decision myself. And again, using this kind of crazy mapping or graph in my head because I kind of feel that at low sugar levels, if I take double the amount of insulin, it would be too much. When I say low, if my insulin was, so shall we say, 5.5, I wouldn't take any insulin or if I did, I'll take only perhaps 10 units when it's seven, strictly, seven times two is 14 plus a bit is 16. It feels a bit too high. Somehow, I feel the graph in my head and says, no, just take take seven times two, 14. When it gets up to 12. 12 times two was 24 and a little bit more is 25. Again, I've done that, and I've gone to hypo. So, I'm taking in anywhere above 25 if I take 30. I can pretty well almost indicate I'll have a hypo.	U,US
95	<b>Interviewer 2</b>	OK.	
96	<b>Speaker 2</b>	But I need more guidance.	
97	<b>Interviewer 1</b>	Hmm.	
98	<b>Interviewer 2</b>	Yeah.	
99	<b>Speaker 2</b>	More guidance and more feedback, and I feel that I'm left to my own devices. And I know, you know, as a scientist, I have that sort of approach to it. There must be some relationship, but I don't know what that relationship is, and I've got it in my head, but I can't prove it to you. I can only prove it to myself by	US



		experience. And there must be, I feel, externally people who can tell me when you get to an eight. This is the right amount of insulin to take. If you want to be running that sort of five and a half to six, six and a half.	
100	<b>Interviewer 1</b>	It makes sense.	
101	<b>Interviewer 2</b>	Yeah. Thank you for answering the question. And before we conclude, Interviewer 1, do you have any any questions?	
102	<b>Interviewer 1</b>	No, we thank you a lot for your insight. It was very helpful.	
103	<b>Interviewer 2</b>	Yeah. So just to close everything, and I would like to ask you, do you want to receive the transcript of our interview when it's done?	
104	<b>Speaker 2</b>	I'd be interested. Yes. Yes. It just I mean, anything we could. No, I'm just interested in this kind of work. I think there are an awful lot of diabetics out there. And I think the vast majority are not well advised, and I worry some of them just ignore the fact that their diabetic control and they don't realize the problems that they're giving themselves into amputations or blindness. And I've had friends who've gone blind. Friends who have hypos, but they have 30 seconds warning. Before they go unconscious, and they're on the high street, and they suddenly get the warning, going to the nearest building and say	
105	<b>Interviewer 2</b>	Absolutely. So, we will share the transcripts and then the paper with you when it's published.	
106	<b>Speaker 2</b>	I'll be delighted to receive it. So, I wish you all the best. And with your degree and in your careers. All the best.	
107	<b>Interviewer 1</b>	Thank you for your time.	
108	<b>Interviewer 2</b>	Thank you for your time. All right. Bye bye.	

## Appendix 7 - Transcript of Interview 3

### Coding Scheme:

Dimension	Color	ID
Intention to Use	TURQUOISE	ItU
Use	YELLOW	U
Information Quality	ORANGE	IQ
User Satisfaction	GREEN	US
Net Benefits	MAGENTA	NB

### Interview 3 – Information:

General Information
<p>Actors:</p> <ul style="list-style-type: none"> <li>• Speaker 3: Diabetes self-management app user</li> <li>• Interviewer 1: Konstantinos Ratzos</li> <li>• Interviewer 2: Michal Piotr Trzpis</li> </ul> <p>Time: 19:00 CET</p> <p>Date: 20.04.2022</p> <p>Location: Google Meets</p> <p>Age: 49</p>

### Interview 3 – Transcript with codes:

Row #	Actor	Text	Code
1	Interviewer 1	Thank you for taking your time today for this interview.	
2	Speaker 3	No problem.	
3	Interviewer 1	But let me introduce myself. I'm Interviewer 1 and.	
4	Interviewer 2	I'm Interviewer 2.	

5	<b>Interviewer 1</b>	We're both Lund University. It's in Sweden. If you don't know. Lund university students, we're studying information systems. And we're doing our masters. Now it's the part where we're doing our thesis. So, our study is about identifying success factors from the users' perspective for mobile health applications that support diabetes self-management, such as is Intellin that you. You have used, I'm guessing. So, to get the formalities out of the way, like, I don't know if you remember in the first email. We sent you an informed consent form, that the audio of the interview is being recorded and it will be processed for creating the transcripts and creating, and it will be included in the final master thesis. So.	
6	<b>Speaker 3</b>	That's fine.	
7	<b>Interviewer 1</b>	Yeah, to be. I have to repeat myself and ask that question for formalities. So, do you consent to the interview audio being recorded and processed according to the description you received?	
8	<b>Speaker 3</b>	I do.	
9	<b>Interviewer 1</b>	Perfect. Thanks a lot. Before we begin, do you have any questions for us?	
10	<b>Speaker 3</b>	No. Far away, I will have questions as we go through, but at this stage, I'm just happy to help.	
11	<b>Interviewer 1</b>	Perfect, feel free to stop or ask for clarifications if we ask something that is not clear, although I think they're pretty simple questions. Yeah. So, I don't think you.	
12	<b>Speaker 3</b>	Just just a very quick one so as to understand is this is this is the stuff you're doing. Is it is it predominantly based around supporting the research that the Intellin team want or the Gendius team? Or is it multiple applications?	
13	<b>Interviewer 1</b>	It. At this stage, this is part of the study. We are planning to do also a survey with questionnaires to. Because we're doing a limited amount of interviews with users of Intellin, yeah, mainly because the company was kind enough to offer us assistance in finding people.	
14	<b>Speaker 3</b>	Yeah. Perfect.	
15	<b>Interviewer 1</b>	We are also combining. We're doing, we're trying to do a survey as well and reaching out to the general public to get a bit of a better picture. But it's a two-month thesis, so our scope is very limited as you can.	
16	<b>Speaker 3</b>	Fair enough. Yeah, I can imagine you've got limited time. So, OK.	
17	<b>Interviewer 1</b>	So, we're doing the best we can in the time we have, but we are not affiliated with a company in that sort of way.	

18	<b>Speaker 3</b>	That's OK.	
19	<b>Interviewer 1</b>	They're just helping us do our research.	
20	<b>Speaker 3</b>	That works. Yeah, it's all good. I mean, a lot of these as well. I think a lot of the a lot of the the mobile app companies that use them without knowing how people use and why they use and what's good, what's not good, they develop. And the developers are often techies rather than user experience focussed, and they build their own thing. So I get it.	
21	<b>Interviewer 1</b>	It's not. It's not just about user experience. They may include information that is not correct. They might.	
22	<b>Speaker 3</b>	True, it's very true.	
23	<b>Interviewer 1</b>	And to the reason we're doing this study is because we found looking through literature that there is now not enough research done for especially diabetes or in general about managing chronic diseases. These applications, there are a lot of them out there and they're not sufficiently evaluated. There are no guidelines that someone can that there are, for instance, guidelines for social media applications. They say you design them like this. You do this. For these kind of applications there are no guidelines.	
24	<b>Speaker 3</b>	So, which means the which means the people that develop the questionnaires, the data points, they don't think how the data could be utilized and hence whether the average is the aggregation, etcetera, etcetera, is actually going to give a valid result. Right?	IQ
25	<b>Interviewer 1</b>	Exactly, it's tough.	
26	<b>Speaker 3</b>	Yeah.	
27	<b>Interviewer 1</b>	That's why we're trying to contribute just a bit.	
28	<b>Speaker 3</b>	Yeah. That's good. I think that we challenging all this, it helps. Just so you've got a bit of background on me just so that you know where it comes from. So I've had my diabetes now for 40 years, nearly 40 years, probably thirty eight, thirty nine years. And I currently work in a company, which is a safety quality sustainability organisation.	
29	<b>Interviewer 1</b>	So, to continue with the interview, I will ask some general questions about yourself. Some of them, I think you've covered them, as well as about your experience with using the Intellin diabetes management application.	
30	<b>Speaker 3</b>	Mm hmm.	
31	<b>Interviewer 1</b>	So, to begin with, how old are you?	

32	<b>Speaker 3</b>	Uh, forty-nine.	
33	<b>Interviewer 1</b>	Forty-nine. And you had diabetes for most of your life?	
34	<b>Speaker 3</b>	Since I was eleven, yeah.	
35	<b>Interviewer 1</b>	So, what are your experiences with mobile applications? Are you a frequent user of your phone?	
36	<b>Speaker 3</b>	Yep. Yeah. I mean, I I use mobile apps for work, for home, all sorts. So, and I would use mobile apps for things like Facebook. I don't I'm not a mad Facebook, but I use it. I use it sometimes for news. I'll use it occasionally for entertainment like Netflix, but not often, usually I use the TV. But I use it a lot for work. So, emails and Microsoft Teams and stuff like that. And then I use things like FreeStyle Libre and the apps that come with that one. Blood testing, and I use that a lot. And then my son who's got diabetes as well, who's only six, he uses Dexcom and those apps as well, which is similar to FreeStyle Libre, but it's just a US based company that you're probably aware of.	
37	<b>Interviewer 1</b>	We are not aware of it. At least I am not so.	
38	<b>Speaker 3</b>	So, Dexcom is. So FreeStyle Libre is produced by Abbott, that you probably were right? And and Dexcom is similar to it, but it's more expensive, but it's instead of with with the FreeStyle Libre, you have to swipe. And with the Dexcom, you don't. So, there's a Bluetooth sense between the phone. And then once it's on the phone or the mobile device, that then immediately means that I can see my son's blood sugars even when he's at school, you know?	
39	<b>Interviewer 2</b>	OK, really good one.	
40	<b>Speaker 3</b>	Well, that is fantastic. It's really good because that just means you can't monitor it too much. You can also over worry about everything, but that's a different thing altogether.	
41	<b>Interviewer 1</b>	But it's good. We can definitely check it out and look it up afterwards.	
42	<b>Speaker 3</b>	Yeah, D E X C O M.	
43	<b>Interviewer 2</b>	Noted.	
44	<b>Interviewer 1</b>	So, in general, what are typical of ways that you are looking for information about diabetes?	
45	<b>Speaker 3</b>	So, and for me, I I probably don't use the data as much as I should. I mean, my role in the company, I'm in, it's all about data. So, I'm probably a bad user to do as I say, rather than as I do, but I use it. I use the app to check my blood sugar, you know, 10, 15 times a day, at least. So, I will check it constantly. See where my blood sugar is so that I know where I am against that. And I also use the I did use the Intellin app to track my blood pressure. So, at one point, my my GP said, look after, you	U,ItU,US

	<p>know, check your blood sugar, rate your blood pressure regularly. And because I didn't have an app to do it on, I put it in there because it stored it. So, I did that. So, I could then see the trend and see where it is. Typically for the for medical stuff, I would use an app one to capture what I'm on. So, I know what it is if it's complex or I can't remember, but there's not many things that you need that. But I would love it if all of my blood test results that I have when I go to my regular GP. When I go to my regular hospital appointment, I get blood test results, right? Which, you know, same as everyone does. They do your HBA one plus a whole bunch of other things, and I don't like the fact that I don't get those electronically. So, for me, and that's something I would like to see, just so that I can see the history of what's my HBA one done? What is what's my cholesterol? What's my, you know, all those and there's about 30 of them that get taken every time I have my bloods done. I would like to be able to see the trend of those, and I've never been able to see that. Now, once you've got the trend, the next thing I would want from an app, it is an explanation of what does it mean? Right? And for me, what do I want out of an app? I want an app that or I want a tool that tells me what I am and what the trending is. And then typically what the trending means. So, I think with a lot of tools nowadays, there's a blend of things. One is to track, but the other is actually to inform about what you need to do, which is where I think the Intellin idea is good, but I haven't. I'll be honest, I haven't found the execution very good, right? So, it doesn't tell me enough. So, there's suggestions that Intellin gives me is useful. But having had diabetes for that long, it says you must look after your feet. Right? That's a bit obvious. And so, what I'm looking for is a little bit of a richer insight. And then the other bit that I would want an app to be able to do in this sort of space is also just inform me about new evolutions in this space. So, for me, as a diabetic, there are all sorts of things that you can do to influence the way your health is, is is managed. And so, the obvious ones of blood pressure and weight and blood sugars, whatever it might be. And insulins. They're good. But then there's also other stuff which is less frequent that you don't track every day, but it's still quite informative. And so, if if through an app, I was also able to scroll like it would on social media information and news about diabetes and about things that were interesting, that I could tag and select topics that I was interested in and then read articles by doctors, physicians, scientists, research students about the topic. I would find that interesting. Now how much I would actually use it, I don't know. Right? It would be sporadic as opposed to frequent. And the other thing that I would, I would I would. I don't use the app for it, but I probably should is repeat prescriptions. Whereby in the UK with my GP, I can get my repeat prescription through the app. I tend to just ring up the the pharmacy and say, Can I</p>	
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		<p>have this? And I know the pharmacist, and she then plugs it into a system directly. Job done. But I should probably do that a little bit more, as well as to get the medicines reordered via the app also, so it then would prompt me when I should be reordering it right, where sometimes I have to check the fridge to say is my insulin to run out? Whereas actually with an app, if I ordered it through the app, it tracked it through the app. It would then say, by the way, do you want to reorder this because it looks like you're about to run out? Oh, yes, thank you very much. Click. Right? So, I think that's a that's a good one. And that is also one where I think for managing health like ours, the other area where I think there's a lot of stuff that could be done is there are associated nonprescription things which you can buy or utilize, which could be packaged up to either reduce the cost to me because I'm doing it as a package, a bundle or just allows some other service provider to make it visible to me when I didn't even know it existed. So, for example, when my son gets his patches, so for me with my my Libre patch, if I take that off, I just rip it off and my my arms are old and tough enough that it doesn't really matter. Whereas when my son pulls his off, a lot of kids and some people have sensitive skin, and it leaves a mark. So, you can get these sprays which let you rip it off and it comes off easily. And so, there's things like that where, especially for new diabetics who aren't used to it, there can be little prompts to say, oh, did you know that there's this? Then some of those helps with that, right? So, there's an opportunity to tap into diabetes management, including products, as well as including the hard-core medical science.</p>	
46	<b>Interviewer 1</b>	That's great insights. Thank you for that.	
47	<b>Speaker 3</b>	You say that to everyone but thank you.	
48	<b>Interviewer 1</b>	Oh, I do say that to everyone because everyone's opinion matters, right?	
49	<b>Speaker 3</b>	Yeah, that's very true. That's very true.	
50	<b>Interviewer 1</b>	That's why we're doing this whole thing, because we do value your opinion. It matters to us more than ours, because you're actual users. You guys know what's up. Not us.	
51	<b>Speaker 3</b>	Yeah, yeah.	
52	<b>Interviewer 1</b>	So, we're trying to understand the whole thing. So.	
53	<b>Speaker 3</b>	<p>One of the things I think about it is that that I know the app has, but I don't use and or the Intellin app has, but I haven't really used, is the ability to link exercise and stuff like that in as well. Now, that is something which is very difficult to and. To correlate, i.e., how much does my blood sugar drop when I do a certain amount of exercise. Right? Now, over years, you get used</p>	U,US,ItU



		<p>to it and it changes as you get older as well. So, you know, when you've had a period of time, when you're sat stationary, like working from home, like we do now, the amount of steps I do a day, there is a lot less than I used to, which of course, probably has an impact on my diabetes. Right? And now that sort of stuff I don't track because it's just not easy enough to link to the apps that I've got into the Intellin app where I consolidate it. So, the aggregation of some of those data points, I think, is something which the Intellin team have been trying to do, but I don't yet think they've achieved. So that, again, would be one whereby, OK, what's the correlation between the amount of exercise, the amount of alcohol, the amount of food, the amount of blah blah blah with what my blood sugar does so that I can be predictive on it and make the change before I do something rather than correct it after. That's the bit that would be real value to me. Now that is the holy grail. How you achieve that is difficult because you then need some AI that understands how heavy am I? How old am I? How does it really impact me? So, it's going to use my data, as well as benchmark data to give me a prediction of what's going to happen if I do A, B and C. But linking those data points together correctly is the bit that I haven't yet worked out, so it comes through.</p>	
54	<b>Interviewer 1</b>	nI think it's very difficult as well, because a number of issues arise from linking and giving suggestions as far as your health is concerned. For example, liability issues.	
55	<b>Speaker 3</b>	Yes, correct.	
56	<b>Interviewer 1</b>	If they tell you to take an action and it's the wrong action.	
57	<b>Speaker 3</b>	<p>Yeah. So, so this is something that we do in my work, right? We have the same sort of thing whereby I'll give you an example. We're working with a company, which is there to help brands sell themselves. Right? So, you might get a brand like Gymshark, and there's all sorts of companies around that are new brands, and they want to scale and grow into new markets. To scale into new markets. They need investment. Therefore, they're looking for investors to buy them. They then sell out, make lots of money, which is great, but it grows. We as a company. Are there that we can give some assurance on the company that wants to sell the brand. Right? As well as the supply chain. So, we will go and do social audits, quality audits of the suppliers that provide the brand to to make sure there's no social issues, there's no child labour. There is sustainability as they claim all this sort of stuff, which then means that when a buyer looks at the brand, they've got some sort of assurance that the brand meets certain standards, right? So that's where we sit. Now, of course, what we don't want to do is have any liability that, by saying, it meets a standard, it doesn't mean that they're actually going to make any money. Right? Because we're not</p>	IQ



		verifying that they make money. We're just verifying that we've tested something, and it was X. So, in the same same issue exist for us whereby we can't we don't want to say A therefore B, but we do want to say A because it is informative and it is useful, but we don't want the liability of how you interpret the data. So, we make sure that it's part of a contractual bit, you're very clear about that, which is easier when it's B to B than maybe when it is B to C, right? But and for me, I think having. Having the ability to give correlations and let the user decide what they do with that correlation is where the value sits. Now, whether most users can do that correlation analysis, I don't know. And it may be just because I work in data, it seems logical to me and everyone else would say, well, it predicted this, therefore I should do that and therefore you got a problem, right? But for me, that's what I would want. And I, you know, we should be we should be aware enough that it is an app and it's not a it's not a doctor, and therefore there is going to be a flaw within it.	
58	<b>Interviewer 1</b>	Yeah, I mean, there're even flaws with doctors, right?	
59	<b>Speaker 3</b>	Well, yeah, because the apps often get it better than the doctors, right? Percentage wise. Yeah.	
60	<b>Interviewer 1</b>	So very interesting stuff. We're looking through because we've already covered a lot of things we wanted to ask, I think. Oh, so how did you discover Intellin diabetes management?	
61	<b>Speaker 3</b>	So, I went to school with one of the guys who set it up.	
62	<b>Interviewer 1</b>	Mm hmm. Interesting. So, they suggested it?	
63	<b>Speaker 3</b>	No, I saw it. I saw it online and I saw that he was starting something up with diabetes. So, I pinged him and said, well, actually, I downloaded it, had a look at it first and then pinged him and gave him some feedback. And then I've just connected with him as he's gone through. And then what I like about it is it's it's it supports diabetes, which is important to me. It's in the data space, which I find enjoyable from work point of view and it's a friend who's trying to grow a business which if I can help him, I will.	US
64	<b>Interviewer 1</b>	Very nice. How long have you been using it?	
65	<b>Speaker 3</b>	I don't use it very much. So, if you want to ask me, how do I use it, I used it for a bit, but I don't use it much. I don't use it predominantly because I can't sync my blood sugars into it. And the the outputs I get, so the predominant use I have for any diabetes tool is blood sugar management. And it doesn't do blood sugar management in any decent way. It's rubbish if I'm brutally honest. I like the intent; I just don't like the execution.	ItU,NB
66	<b>Interviewer 1</b>	That's respectable. When when did you download it? Do you remember how long you've had the app?	

67	<b>Speaker 3</b>	I've had it for about. And let me have a look. Reports. Yeah. I've had it for several years.	
68	<b>Interviewer 1</b>	OK.	
69	<b>Speaker 3</b>	And you can can you see my data?	
70	<b>Interviewer 1</b>	Your data?	
71	<b>Speaker 3</b>	Do you have access to the app or not at all? So, you won't see any of this stuff?	
72	<b>Interviewer 1</b>	No, no. We're not affiliated with the company. We're university students.	
73	<b>Speaker 3</b>	OK, so yeah, well, you might have had access to some of it, so you can actually start see, you know, anonymized. But um, so I mean, I've got the. She's going to blur out, isn't it? And I've got the app. Will it focus? No. And I've got the app there. So, I've got inputs in there for blood glucose, but I haven't used it for and for blood glucose entry. I think the last time I used it was a few years ago, at least a year ago. But when I go on the home page, it shows me something for it and it shows me it was good for May the 18th. But when I go into the detail reports, it doesn't show me any data because I haven't entered in for at least a year, right? So, against the blood glucose, the activity, the basal, the bolus, the body mass, I've not entered in any of those in for well over a year, but I did do the blood pressure because my doctor asked me to do something with the blood pressure. So, I use it as a simple capture and I did do it for a while, but not enough.	U
74	<b>Interviewer 1</b>	OK. So, what was your main objective when using the app?	
75	<b>Speaker 3</b>	My main objective when I got it was literally to see what it did and how it worked, and to see whether it added anything. And the bit I found is the effort to enter the data in manually was too great. For me to warrant doing it, I already have to enter it into one place, I'm not going to then enter it into somewhere else for them to give me a graph which isn't as good as the app that I use in the first place. So, until they get that blood sugar link with FreeStyle Libre, I won't use it really. And now I might use it for blood pressure and things like that. So, if there were other things that I could do on it, that would be good. But but really, for me, the real value of it is only going to be when they get the blood sugar linkage.	ItU,US
76	<b>Interviewer 1</b>	Right. So, have you used other diabetes management apps before?	
77	<b>Speaker 3</b>	No. The only the only other app that I use is a carbs and cal. So, there's an app called Carbs & Cals, I think it is. Yeah, Carbs & Cals. It's a it's an app that tells you how much carbohydrates and calories there are in food. And in that one, you can log what you eat, how much you eat, all the rest of it. But I use it purely	

		to tell me how much carbohydrate is there in something. So, if we're cooking something like a pancake, I weigh the flour, put it in, tells me how much carbs there is, right? So, it's just an easy way to make sure that we're counting our carbohydrates properly.	
78	<b>Interviewer 1</b>	Mm-Hmm.	
79	<b>Speaker 3</b>	So that again, is is another good one, which probably if you have the blood sugars and then the food. So, when you counted it, it went straight in. That would be good. Again, I find I don't I don't track the amount of carbohydrate I eat on a tool every day because it's just too much effort.	ItU
80	<b>Interviewer 1</b>	Yeah, I guess there's another area where we could improve on.	
81	<b>Speaker 3</b>	But but but but I do think the carbohydrate tracking is for a diabetic is quite important because it does two things. So, for those that are done in the UK, there's a thing called the DAFNE course dose adjustment for normal eating. Have you come across that one?	ItU
82	<b>Interviewer 1</b>	No.	
83	<b>Speaker 3</b>	So DAFNE, as in D A F N E. Dose Adjustment For Normal Eating and and that course is all about teaching people how to count their carbohydrates and adjust their insulin for it, right? So common sense stuff. And now my diabetes is type one, so I do injections, and which is where it's more relevant. Type two, I don't know much about if I'm brutally honest, but having to consciously think about how many carbs you've got is important for getting your diabetes managed properly. So, if there's an easy way to be able to type it in or even speak it in, then you'd probably do it more often. Right? So that's the other thing. Just thinking about it, I would probably do it more often if I could just say lunchtime carbs 43. Done. Right? That simple. Whereas if I've got to open the app and type it in, I don't, because that extra two seconds I don't do for whatever reason.	US
84	<b>Interviewer 1</b>	Not not just you. Everyone is the same.	
85	<b>Speaker 3</b>	Yeah.	
86	<b>Interviewer 1</b>	That's why we try to use technology, I guess, to make everything more easily.	
87	<b>Speaker 3</b>	Yes. And and that that also is something which I think when I when I look at some of my son's diabetes management on his stuff and you see a lot of these apps like Diasend. So Diasend is, do you know Diasend?	
88	<b>Interviewer 1</b>	No.	
89	<b>Speaker 3</b>	So, Google that one. D I A S E N D. Diasend is a tool that aggregates data and shares it with hospitals. So, we link my Free-Style Libre, my son's Dexcom, etcetera, etcetera, and all the different things. We link it to Diasend, which then means that we	

		can allow the hospital access to the data. Now, I'm sure Intellin does something similar. I don't know how and if it does, but it should do if it doesn't. And and I would like that flow to be both ways, not just me to the hospital, but also the hospital back to me. But that that linkage, that means they can see it all. Now, what I'm aware when I look at it is it's only as good as the consistency of the data that I put in. So, if I forget to put in food at certain times of the day, it'll show that I did an injection, but they won't show my average bolus to insulin or bolus to carbohydrate ratio is Y. Whereas actually, you know, it's not because I didn't put the carbohydrates in. So that is where I think there's some risk on using the averages and stuff like that because it means that it's it's only, you know, it's only useful if you're really precise on capturing the data.	
90	<b>Interviewer 1</b>	Mm-Hmm. Certainly. But next question I have. So, you have not. In Intellin the app, you can use external appliances to connect it or?	
91	<b>Speaker 3</b>	I linked in I linked in my Strava, or I think it was or no, my Fitbit linked my Fitbit into it once just to see what happened. But I did it because it was interesting to see how it worked. Out of the Intellin app I didn't get any insight.	U,NB
92	<b>Interviewer 1</b>	So, you are not satisfied with that experience?	
93	<b>Speaker 3</b>	No, it costs me money. It didn't seem to give me anything. Actually, I did it when it was free and then they made it chargeable. I thought, OK, I'll pay it because it helps the company. It helps my friend, but hopefully I've canceled it. But for me, it didn't it didn't give me enough, right? So, if it's if you're going to consolidate the data, it's then going to do something with it. And and and again, the challenge you've got here with an aggregator of the data from multiple sources is that the individual sources are focused on that function and therefore they tend to do it much better than the data aggregator does.	US,ItU
94	<b>Interviewer 1</b>	Mm-Hmm. So, a different question. How do you feel about entering your data in the app? Do you have any concerns or reservations?	
95	<b>Speaker 3</b>	I do more and more as time goes on, because and you don't know who it is going to be used by. So, and you see it more and more, especially as social media becomes more exposed, and risk based is. You know one person makes one comment in context, but it's then presented out of context and then it impacts stuff. So, my biggest fear with entering my any data in anywhere is that some corporate will plug into the data set and then will tell me I can't do something because of the data and the data may not be correct. So, I do worry about that.	U
96	<b>Interviewer 1</b>	That's perfectly reasonable. So how do you feel about the information you received from the application, do you think it's reliable? Do you trust it?	

97	<b>Speaker 3</b>	So, the information you get from the app, the primary information, you get are some suggestions of things that we could do. And generally, yes, I would say it's useful. I always take it as the data that's been put in there is has been created by medical or my assumption is is being created by a medical expert in whatever field it is, and it's being presented as a discussion point rather than as a fact or action for me. But I could see that some people could take it as an instruction and then it could be slightly dangerous because it's. There's often not enough data to be precise about the action. But but I do think based off data, it can suggest things that could be worth considering. And so, I take it as a almost like a guided, you know, it's almost like a, you know, you brought this on the internet. Have you thought about this? Because other people that bought that also bought this? Right? It's that sort of thing is. Oh, that's interesting. Oh yeah, I would like that. Rather than, you bought that, therefore you must buy this, right? And so, I take it as as per the way that social media prompts things because users that bought it liked it. So, I think that is quite useful as you go forward with it. But on the flip side, with with a lot of these is. When when my son became diabetic, my wife then started, and even though she had known me for, 15, 20 years, she then, of course, felt like she had to learn about diabetes and where did she go to learn? She went on social media and to the chat groups where you've got people, and therefore she started hearing stuff from people that I didn't trust. Because they were just other mums and dads. Right? And, you know, knowing my wife's perception of what was right and knowing how I didn't always agree with her. Being a diabetic, I knew that it was the right intent, but she didn't understand it because it was still relatively new for her. And then she was listening to someone else who had even less experience. That scared the hell out of me because she started saying, well, we must do this because and so that social bit where you get non educated people presenting a view, I think is quite dangerous.	IQ
98	<b>Interviewer 2</b>	Agreed.	
99	<b>Interviewer 1</b>	I would 100 percent agree with that.	
100	<b>Speaker 3</b>	Yeah, but it's a social community which can sometimes be quite supportive or perceived to be supportive so that they don't feel alone. But I do think that that sort of content has to be curated.	
101	<b>Interviewer 1</b>	Mm hmm. Yeah, healthcare related in general.	
102	<b>Speaker 3</b>	Yeah, yeah.	
103	<b>Interviewer 1</b>	We saw it also with the case of COVID, I guess. The misinformation that has spread.	
104	<b>Speaker 3</b>	Yes, it's it's it's huge, right? And unfortunately, it's it's very difficult to filter through what is right and what is wrong. And you go for whatever sounds right and that's dangerous, right? Or	

		whatever resonates with whatever you thought it might be right? It just reinforces the wrong behaviour. So, for me, that's something that I think we all have to be very careful of.	
105	<b>Interviewer 1</b>	Certainly.	
106	<b>Speaker 3</b>	But this is where I think there are. There are various ways that data can be used and you can you can present information and then put a percentage reliability next to it. So, I don't know how you would apply it to this scenario, but I'm sure you've come across it that, you know, especially on the predictive that you're saying, look, according to these data points, there's a there's a probability that this might happen next, but there's only a 60 percent probability that this is accurate. Right? And then you go in there, but that then gets into a much more dangerous spot about liability.	IQ
107	<b>Interviewer 1</b>	Yeah, I guess. But I like the idea of percentage of certainty.	
108	<b>Speaker 3</b>	Yeah, that's right. And you use it in different spaces. There are certain places in financial risk, for example, where it's applied. And so I see that sort of thing could cross over pretty easily. And then it means that for educated users of the app, they can start to take it as an input, not as a not as a guidance.	
109	<b>Interviewer 1</b>	I like that perspective. So, in your opinion, is there anything that the app is lacking considering information that you would like to see?	
110	<b>Speaker 3</b>	So, in terms of stuff that I think is useful to have in there, let me just open it up again and. So, I think the the main data points that collects insulin, weights, activity, blood pressure, blood glucose, they're logical ones. It doesn't collect food. I don't think. And. Or if it does, I can't remember if it does. That's a while back since I did it, but it it would be logical if it's also tracked food because it's tracking exercise. So why wouldn't it track food? And and of course, within food, you'd also want to include alcohol. Because that has an impact. So, I would take the major contributions to what impacts your short-term blood sugars as one element. The activity is good and then really just beginning to trend those so you can see. So, you can start to see when one goes up, how does the other one interact. And that's something I have not seen anywhere. Whereby a classic trend graph that shows you do that, OK, 50 percent of the time when you do that, this is what happens afterwards. Right? So those sorts of things are quite useful. And whether that is something which goes into the app for the user to consume or whether the data from the app is used to give the healthcare advisors data to help them interpret it, I think that probably is where I would start if I was extending the service. So, you basically take that the analytics element, which is complex to understand and give that to the medical experts to then help them be more informed when they when they discuss with the patient. So, I think that's where the value kicks in and then it can be used. You know,	IQ



		then you can decide what you share with the users and you you have a light analytics touch with the users, and you have a heavy analytics touch with the medical professionals. But I think on those those six things which fit nicely on the page when you look at it and food would be the other big one that I think is missing. And let me just have a quick look on my. Does it does it have the HBA one on it?	
111	<b>Interviewer 1</b>	Mm hmm. Good question. I don't remember.	
112	<b>Interviewer 2</b>	I don't remember either.	
113	<b>Speaker 3</b>	But if you look at if you look at things like FreeStyle Libre and all the others, they've got daily patterns, time in target, all that sort of stuff, which I think the Intellin app will struggle to beat. So, what you've then got to decide is what's the value that the Intellin app has? And for me, it's about bringing together the multiple data points pressure, heart, blood pressure, exercise, food and showing how those trend together is where it can add the value. But it's only going to be useful if it sucks the data in rather than gets it manually entered.	ItU
114	<b>Interviewer 1</b>	Mm-Hmm. So, more automatic data entry?	
115	<b>Speaker 3</b>	Yeah.	
116	<b>Interviewer 1</b>	And from what I understand you're saying that it would be nice to be more personalized to your case.	
117	<b>Speaker 3</b>	Yeah, I would. Yeah, I think I would go that as well because there's certain things that I'd want to be able to compare. But that's very difficult because to build to build a BI tool on the app isn't easy. Right? Because everyone's got their own want. So, I think on that sort of stuff as they go down it, they have to think, OK, well, you'd have to have a semi customizable approach whereby you can say, OK, you want to see this first is that this is how you do it so you can pick what you see. But that's I mean, we don't even do that, and we turn over three billion. I don't think Gendius turns over that volume yet.	ItU
118	<b>Interviewer 1</b>	We don't know, either. So, um, so would you say that at the moment, the tips and the recommendations you receive from the app, they're not personalized to what you've entered, right?	
119	<b>Speaker 3</b>	Yeah, they're not personalized, which or they might be, but I didn't notice that they were. And I have to be honest, I haven't used it enough to really be able to tell you whether I did anything with it. And let me just go in there.	IQ,U
120	<b>Interviewer 1</b>	But that's fine.	
121	<b>Speaker 3</b>	Yeah, there was there wasn't there wasn't enough on there. I mean, you've seen some of the tips on that. So, if I if I look at feet risk, having diabetes means you're at much greater risk of developing foot problems. It says this is big, blah blah. It could also affect your circulation and you have a high risk of problems	IQ

		with your feet. Check out the tips to see. How you can improve things for yourself. So, the tips. I can't remember where those came. And I'm back in it now, but I don't know.	
122	<b>Interviewer 1</b>	You receive some notifications as well as from the app from time to time.	
123	<b>Speaker 3</b>	Yeah. No, I've got some of them here, I guess. And. But the the the advice. It's OK, it's OK. I think it's more useful when you're new than when you've had it for a while, because most of it you already know so. And I think I think where you can use the tips and stuff is when you should be doing things periodically. So, I think the tips and advice can be for things where you know you should do it, but you just need a prompt.	IQ
124	<b>Interviewer 1</b>	Mm-Hmm.	
125	<b>Speaker 3</b>	So, think of social media apps when you haven't logged on for a while. You often get a little email saying, oh, we see you haven't logged in for three weeks. You know. And have you thought about blah blah blah. Or, you know, comes we've seen that you've not been here for two weeks. Have you had have you seen this? Right? So, I think there's an element of. Of socially engaging the user but reminding them of the stuff they ought to be doing.	ItU
126	<b>Interviewer 1</b>	Mm-Hmm. I get what you're saying. So what would you say is your satisfaction level from using the app?	
127	<b>Speaker 3</b>	Intellin? Yeah. And one, two out of 10. Yeah, I didn't I didn't get enough from it. My my my view of what it could be is quite exciting. My view of what it actually does and helps me with. I don't use it.	US
128	<b>Interviewer 1</b>	That would be another question I would ask. How much of your expectation when downloading it has it fulfilled? I'm guessing not enough?	
129	<b>Speaker 3</b>	No. It doesn't. It. It's the main thing it's done for me is to say. It reminds me that all these things contribute, so it's a nice summary that brings it all together. But the frequency with which the data goes in and the updates on it means that I don't look at it every day. So, the challenge I have with it is unless you're going to type in your input every day, I don't open it up and therefore the prompts I get are a too infrequent. Therefore, it's not really valuable. So, for me, it needs it needs to either be something which I have to do once a week. And when I do it once a week, I then look at it and check it. It gives me some stuff. So, it becomes a structured thing, or it needs to be something. Every time I go in, it pops out. Oh, don't forget you got this and this today. Right? So, and that's where potentially linking in with some of the routine bits that we as diabetic diabetics should be doing. So, if there's stuff that you should do once a week, once a month, once or whatever else, then having the app remind you of those things so you use it almost as a diabetic diary or a diabetic prompt, then that gets you into the app. And at that point,	NB,U,US



		the user experience is OK. Oh, let me look at my trend. OK, what does that mean? Do I need to adjust anything this month? OK, what am I going to do? Right, that's. But I didn't quite get that. The interactivity of it didn't work for me as a person.	
130	Interviewer 1	Mm-Hmm. Were there any other expectations you had before downloading the app on what it was supposed to do?	
131	Speaker 3	I was interested to see what it suggested and what the suggest the suggestions were, but I didn't. I didn't get enough out of them, and I think I would have rather that the suggestions came with a link to, you know, an article or something else, which I could have explored deeper. The tips are this big. So, it's like. Yeah. And and and so there wasn't enough to it. There was there wasn't enough substance to make it valuable.	US
132	Interviewer 1	Mm-hmm.	
133	Speaker 3	But that's where I think they've got to build a website or a click through to something else, which then takes them through.	
134	Interviewer 1	To so you would like more information, for example?	
135	Speaker 3	If yeah, if you if they're going to use the app to suggest stuff, then I would want it to click through to a richer set of data and information, which then will take me through rather than just a two second read. Which is useful, right? I'm not saying it doesn't have its place, but you might click through in the show. And what's that mean? And often it's like the five whys, you know, when you do a root cause analysis, well, why did that happen? And then why did that happen and why did that happen? You often have different questions and answers, which takes you down different routes, whereas a single app suggestion only answers the first question. Doesn't give you the next why? Why? Why, why? So, you never really get to the bit of what you're actually meant to do.	IQ
136	Interviewer 1	So, you might not understand why you're getting this recommendation, for example?	
137	Speaker 3	Yeah, that's right. Yeah, I mean, so when when a recommend is prompted I I, you know, with a more of a science background would like to understand, look we're prompting this because of this and this, because then what it does is it reinforces, oh, I hadn't thought of that. Oh, that affects this? Oh, I better do something about that, right? So that feedback loop and understanding loop is, I think, quite an important one.	
138	Interviewer 1	Is there something that appeals to you about the app, something you liked in particular?	
139	Speaker 3	Visually, it worked nicely. The consolidation of the data I liked and the output from it, I didn't.	US
140	Interviewer 1	Yeah, that's the worst offense. The output?	

141	<b>Speaker 3</b>	Yeah, it doesn't. It doesn't give me. The report in the analytics isn't particularly good. It's a bit. It's a bit dated. It's a bit clunky. It doesn't flow. And when I look at it, what's it telling me?	US,NB
142	<b>Interviewer 1</b>	Mm-Hmm.	
143	<b>Speaker 3</b>	I think I think with the analytics it needs, it needs to come from the analytics it then needs to be the ability to take the analytics and to click to suggestions rather than analytics on its own, suggestions on its own. There needs to be connectivity between them.	
144	<b>Interviewer 1</b>	Mm-Hmm. So, a more general question, coming to the end, we're wrapping up. So, what would motivate you to further engage with the app?	
145	<b>Speaker 3</b>	It would. I'd have to have the blood sugar synced. And then I'd want to be able to see the blood sugar synced and then some of the correlations between the different data points. And then I would also, I would like it if it was more of an information source than just a data capture. Because on just data capture, the individual apps do it better.	ItU,US
146	<b>Interviewer 1</b>	Mm hmm.	
147	<b>Speaker 3</b>	Whereas as a consolidated point which I can navigate through and to, it then gives me a different perspective, which means I might sit and look at it periodically and actually explore. I'm having. Yeah, I've looked at my phone, let me go and look at insulin, OK? And again, where does it link me through to something that's useful to help inform?	
148	<b>Interviewer 1</b>	Mm-Hmm.	
149	<b>Speaker 3</b>	The other thing that I think. But potentially I'd be keen to keep it would be as if if things like my blood glucose that I get taken by the hospital, whether that got fed back in now, I can do that manually myself as well. So maybe that's what we just need to do. But. But all those standard tests that you can do is part of a standard blood sugar thing. I think those should be added in there as well. So, you can see those trend over several years. Because, again, I think that's where the value will come is when you start to see, you know, the average blood sugar is X and when the average blood sugar is X, you see the downward trend on Y right now that's more than medical teams want. But that's what I would be interested in saying. OK, well, your average is this over a period of time. Therefore, normally we see this thing dropping, when this thing drops. It doesn't look like it's diabetes, but it's being caused by your diabetes. Therefore, fix your diabetes. Otherwise, you're going to have a problem with your toenails or whatever it might be.	ItU
150	<b>Interviewer 1</b>	Mm-Hmm. Great. Final question, is there anything else you would like to say about the app in general?	
151	<b>Speaker 3</b>	At this stage, probably not, I mean, the only bit I would say is that the approach for diabetes is one market, but there are there	

		are loads of them that are similar. So, I think the opportunity in this space is pretty big and in whatever it is, whether it's taking your tablets as a dementia patient or whatever it might be. You know, there's all sorts of stuff like that that that could be done whereby it would make it easy. So. And you know, there's that's where there's there's probably the opportunity to start seeing and helping the and as. As I think about it more, the real value is getting the data back to the medical professionals who can then manage the patients better, rather than giving the patient something. But the challenge with that is if you focus just on the medical team, then the users are going to do all the work, but get no benefit or no, no immediate feel of a benefit. So, the balance is how do we get the balance between providing the data for the medical to be able to do a better job, but give the user some reward for the effort they're making, capturing the data in the first place?	
152	<b>Interviewer 1</b>	Mm-Hmm.	
153	<b>Speaker 3</b>	And the reward bit. I'm struggling with it a little bit for me, that will be the sort of thing whereby, you know, if <b>if it clicks back</b> where it makes it easier to do your repeat prescriptions, if it clicks back what it reminds you to do things better than you would otherwise. If it clicks back and gives you discounts on things you have to order, then you get some user benefit. But if it doesn't, then it's data capture for not enough benefit for the individual or not enough perceived. But even though it does give the medical teams all that rich data and insight that they can do benchmarking and comparison and predictive stuff off.	ItU
154	<b>Interviewer 2</b>	Right. It sounds like it sounds like a topic for another master thesis. Like gamification in mobile health applications.	
155	<b>Speaker 3</b>	No, no, but this is it right? With all of these is is <b>people don't like changing what they do. They don't move away from doing it the way they do it.</b> The fact that I still order my prescriptions by ringing the GP up, rather than by ordering on the app. And I'm a technology guy, right? And I don't even use it for that. I mean, Jesus. So, if I don't do it, how are we going to get the mass that costs the health services millions and millions and millions? So, the money for the government and the saving for the government is enormous. But you're not going to get that, unless you give something to the user. And that's the bit that's why I was saying to the Gendius team before, how would you give something to the user that social? Without, to your point, Konstantinos, the risk of the liability?	U
156	<b>Interviewer 1</b>	Mm-Hmm.	
157	<b>Speaker 3</b>	But I think I think it's I think it's and I think, you know this this sort of stuff that you guys are doing is fantastic, so good luck with it. I hope you enjoy it.	
158	<b>Interviewer 1</b>	We appreciate it.	

159	<b>Speaker 3</b>	And and if at any stage, so open offer, if at any stage you're doing this and you need more feedback and you're more than welcome, just email me. Call me direct and not a problem at all. And I'll be more than happy to help contribute further if you need it.	
160	<b>Interviewer 1</b>	Thank you. We really appreciate it. So, yeah, we're pretty much done with the interview. Just another thing I would like to say is what I mentioned a bit in the beginning, but we're going to produce the transcripts. What about what has been said here in that interview? Would you like us to send them to you so that you can verify them?	
161	<b>Speaker 3</b>	Yes.	
162	<b>Interviewer 1</b>	Yeah. OK. We'll send. We'll send you a follow up email when we're done with it, and we can also share the publication if you like when we're done.	
163	<b>Speaker 3</b>	Yeah, I'd love to. I'd love to see that.	

## Appendix 8 - Transcript of Interview 4

### Coding Scheme:

Dimension	Color	ID
Intention to Use	TURQUOISE	ItU
Use	YELLOW	U
Information Quality	ORANGE	IQ
User Satisfaction	GREEN	US
Net Benefits	MAGENTA	NB

### Interview 4 – Information:

General Information
<p>Actors:</p> <ul style="list-style-type: none"> <li>• Speaker 4: Diabetes self-management app user</li> <li>• Interviewer 1: Konstantinos Ratzos</li> <li>• Interviewer 2: Michal Piotr Trzpis</li> </ul> <p>Time: 18:00 CET</p> <p>Date: 23.04.2022</p> <p>Location: Google Meets</p> <p>Age: 58</p>

### Interview 4 – Transcript with codes:

Row #	Actor	Text	Code
1	Interviewer 1	We're doing our thesis in identifying success factors from the users' perspective for mobile health applications that support diabetes self-management. Such an application is Intellin diabetes management. I imagine you're familiar with it.	
2	Speaker 4	Yeah, yeah.	

3	<b>Interviewer 1</b>	OK. Yeah. Perfect. So I don't know if you remember the email that we sent the initial one. It had an informed consent form. It was talking about that the audio of the interview is being recorded It has some details in it. And did you perhaps see it?	
4	<b>Speaker 4</b>	Oh, to be honest, unfortunately, I've been working away from home all week, so that's why I've not been able to do the initial interview and I've just looked at the email. I'm on a different computer and I've seen it. I haven't. I haven't signed or agreed to anything yet, but I'm more than happy to do so. And that's	
5	<b>Interviewer 1</b>	That that's fine. We can do it like orally, but just to if you want you can look at it. But I can also let you know, in short, what's in it.	
6	<b>Speaker 4</b>	Just far away cause the other computer is downstairs?	
7	<b>Interviewer 1</b>	Yeah, yeah, yeah. So basically what we're doing is we're recording this interview we're doing this to make the transcripts basically text from what we've talked in this interview. This text, then if you want, we can send it to you and you can approve of it if we have not misunderstood what you were saying or something like that and then these transcripts, not the audio of the interview will be used in our final thesis to make some to draw some conclusions. The Interview audio we will keep it in our computers until the submission deadline for our thesis, then we will delete it. We don't need it. So that's basically it. So formally, I have to ask this. So do you consent to the interview audio being recorded and processed according to the description?	
8	<b>Speaker 4</b>	Yes.	
9	<b>Interviewer 1</b>	Perfect. Thanks. So before we start, would you like to ask if you have any questions for us?	
10	<b>Speaker 4</b>	No, no. Far away	
11	<b>Interviewer 1</b>	Far away. OK, we don't want to keep you here forever.	
12	<b>Speaker 4</b>	That's why I said far away.	
13	<b>Interviewer 1</b>	Perfect. So let's begin the interview. How old are you?	
14	<b>Speaker 4</b>	58. I just think that. Yeah, 58	
15	<b>Interviewer 1</b>	So what are your experiences with using mobile applications?	
16	<b>Speaker 4</b>	I use mobile applications for day to day stuff, you know, just like, you know, everybody else does.	
17	<b>Interviewer 1</b>	So you would call yourself, you're familiar with using the applications?	

18	<b>Speaker 4</b>	Yes, Yeah, yeah, yeah. No problem.	
19	<b>Interviewer 1</b>	So what are typical ways that you are looking for information about diabetes?	
20	<b>Speaker 4</b>	I think I think what would I look for is I use the app to to try and for instance, if I want to know what my my blood results were last time, because I go for my annual check my diabetes review and then I, I update the app with what the blood results were. So, you know, if for whatever reason, I want to think, what was it last year, I can always go to the app and have a look at what that was, and you know, again, it's it's a case of you could quite easily store that information on a simple note. But obviously, the app gives you a place to put it, and it tells you the right sort of components that you're looking for, you know, the various different results you get from a blood review. OK.	U,NB
21	<b>Interviewer 1</b>	OK. OK. A similar question in general, when you want to learn something about diabetes, let's say to find out something new. Where do you look for? Do you ask your doctor, Do you look online?	
22	<b>Speaker 4</b>	I look online. And I also, I suppose, fortunate that I have a really, really good doctor's practice and I'm able to email the nurse who does my diabetic review. So if I have any questions, even for the day to day viewpoint, I'm very lucky that I have a relationship where I can send the nurse a quick e-mail and she would generally get back to me within a short space of time so we do have an extremely. And I realize that not everybody has got that sort of response, but it's it's a good doctor's practice and they're very good at that sort of thing.	
23	<b>Interviewer 1</b>	Of course, and I guess that's the most trusted source for you.	
24	<b>Speaker 4</b>	Yes, yes, the doctors, definitely. Yeah. But I do go online and look alone as well.	
25	<b>Interviewer 1</b>	When you go online, where do you usually look?	
26	<b>Speaker 4</b>	Google	
27	<b>Interviewer 1</b>	Fair enough. Is there any way you distinguish your sources? Is there some sources you trust?	
28	<b>Speaker 4</b>	Yeah, yeah. Yeah. I mean, generally, I look at the website and decide, you know, if it's some website I've generally never heard of. So for instance, if I Google it and then the the NHS website comes up with information and I obviously prefer to use that information. I wouldn't just go to someone known website and trust what they say. Yeah, it's it's generally the NHS website that you end up with.	
29	<b>Interviewer 1</b>	I think you have a nice approach about it. Do you trust Facebook groups or things like that?	

30	<b>Speaker 4</b>	No. No.	
31	<b>Interviewer 1</b>	Fair enough. So how did you discover the application? How did you find it?	
32	<b>Speaker 4</b>	My wife works for Gendius, so when she started to work for Gendius and she obviously became, you know, exposed to to the app, the first thing I did was download the app.	ItU
33	<b>Interviewer 1</b>	Fair enough, that's great. How long have you been using the app?	
34	<b>Speaker 4</b>	About two years now. Yeah.	
35	<b>Interviewer 1</b>	Long time.	
36	<b>Speaker 4</b>	I mean, I don't I don't use it very often. I have the app on my phone and you know, when I get new blood results, I update the app, you know, but it's it's it's not something I look at daily.	U
37	<b>Interviewer 1</b>	OK, that was my next question, but you covered me thanks for that. So what is your main objective of using the app? You can mention more than one if you like.	
38	<b>Speaker 4</b>	I guess it's good that if you've got the app that if you put your blood results in, it's great to sort of well, you know, what's the national average or what it should be. So being in a position where if you insert your blood results into the app and it simply says, Oh, this is, you know, this is higher than average or lower than average. It's great to be able to to see that is a good feature for me. You know that, you know, and the other thing is that obviously you can see the trend, you know, every year is your blood results going the right way or the wrong way, you know, and and I find that useful.	ItU,NB, US
39	<b>Interviewer 1</b>	So have you used other diabetes management apps before?	
40	<b>Speaker 4</b>	I've I've downloaded a couple and then pretty much deleted them straight away once you get bombarded with advertisements, you know, so you know, the free, the free diabetes apps and then it's just constant advertisements where you know, you just think, Oh, you know, I don't really want to spend my life waiting for an advertisement to finish.	US
41	<b>Interviewer 1</b>	So is that what made you delete that they had the advertisement in it?	
42	<b>Speaker 4</b>	Yeah, yeah. Advertising is, you know, it kind of worries me that, you know, if if the apps there just so that you, you know, somebody can, you know, use it to advertise to the right marketplace, then I question the validity of the information in the app.	IQ
43	<b>Interviewer 1</b>	That's fair enough. So you told us a bit about the functions you're using from the app, you use the graphs and your input data. Do you use any other of the functions.	



44	<b>Speaker 4</b>	Not really, no. I just tend to use it mainly as a as a record for my blood results and yes, tips. Yeah, I'm just I was going. I was going to bring my phone on but unfortunately, the battery has just gone flat for me. So I've got I've got to pull a copy on the Apple. So the things like the tips and stuff like that I look at as well, you know, so so it's good, you know, because sometimes maybe, you know maybe when you sorting that you're putting your toenails and things like that and you notice something on your foot and you're not sure you can, you know, I can go to go to this and basically just see if there's anything there that suggests, you know, this is some custom matter, you know, or something more serious I need to be aware of. So sometimes I use it as a bit of a reference.	U,NB
45	<b>Interviewer 1</b>	So is that what, what would you say is the most useful function? The tips?	
46	<b>Speaker 4</b>	The tips. Yeah, the tips. Yeah.	
47	<b>Interviewer 1</b>	OK. So have you encountered any problems while using the app?	
48	<b>Speaker 4</b>	The only the only thing that I don't think it was really a problem, but I could see it being an issue for some people is when you first start using the app and it's asking you to input the data. I can imagine, I'm quite lucky that I got a copy of some of my blood results so I could immediately put them in. But I can imagine if you're not quite as familiar with the blood results, people could get very confused about what information they were putting in. And, you know, the units and and sometimes there are different units for the same thing, and you may get quoted from your doctor one type of unit, you know, and there's a different kind of usually being quoted somewhere else. So it's that initial. And as I say, I was quite lucky because all I did was email my diabetic nurse and just say, I'm just filling this app, and it's asking me for this, this, this and this and two minutes later, I got an email with all the results that I needed to be able to do that and of course, you can also go on the the the other app I do use is that we we can go on the NHS app where we can get our medical records, you know, which again, I go on, you know, if I if I want to check my blood results, I can go in there and check if any updated results have been put on there.	U
49	<b>Interviewer 1</b>	OK. So the setup is where you found it more challenging.	
50	<b>Speaker 4</b>	I didn't find it challenging, I just noticed that because because my my wife is a nurse and I could ask her a question about are these units, the right kind of units and you know, she could say, oh no, it should be this, this or this. I don't think if you had that access to somebody who's perhaps, you know, got that medical background, you might find it challenging.	U

51	<b>Interviewer 1</b>	Yes, that's understandable. I get what you're saying. So do you integrate any kind of external appliances or software with the app?	
52	<b>Speaker 4</b>	No, no. I just use the app at the moment. I've talked, I'm type two but the one thing that I am seriously thinking about and because of COVID, I've not had my diabetic review for two years. But I think one thing that I would seriously consider even being type two is is potentially to look at the the the is it the Dexcom, Yeah, the Dexcom system. Yeah. And which, you know, I would think would be quite interesting because, you know, to get those results when putting something in your mouth can say what the results are to your system and getting that immediate reaction, I think will be quite quite good.	U,ItU
53	<b>Interviewer 1</b>	That could potentially be a good idea. We've heard other people using it and they're satisfied if that helps.	
54	<b>Speaker 4</b>	I think I think it would make you think twice about maybe eating some of the things that you eat, you know, and then you realize, you know, that pot of yogurt or that piece of chocolate has quite a significant effect. You know, and I think I think that for me is something that I think as I get older I think it will be worth looking at.	ItU
55	<b>Interviewer 1</b>	Potentially, yes. So you like the idea of having instant feedback?	
56	<b>Speaker 4</b>	Yeah. Yeah.	
57	<b>Interviewer 1</b>	It makes sense.	
58	<b>Speaker 4</b>	I mean, it's not just the instant feedback, it's it's it's the also it's the it's a constant record of, you know, you you know what, you know what, what, what my records for the last month. You know, which way is this going? Is it going in the right direction? Is it going in the wrong direction over a longer period of time? And the only way you can do that is by monitoring it all the time purely.	NB
59	<b>Interviewer 1</b>	A different question. So you told us a bit about it, but I'll ask it again in case you want to elaborate more. So how is the application engaged in the way you communicate with your diabetologist?	
60	<b>Speaker 4</b>	It's not yeah, it's not really, because obviously from from their viewpoint, from the doctors' viewpoint, they have their own internal systems and they can't, obviously, and they can't cope with every, you know, every patient, I mean, a different system. So I wouldn't expect them to to, you know, all they can do is provide me with the information that I then can manipulate in the app that I use.	U
61	<b>Interviewer 1</b>	So you don't use it usually.	
62	<b>Speaker 4</b>	No, no. I just, as I said, predominantly just use it to keep a record and again, if something develops where I have a certain	U

		symptom, I'll have a look at the tips to see whether there's anything in there that says, Oh, actually, you know, constant headaches mean less or, you know, cramp in your legs means this or whatever, you know,	
63	<b>Interviewer 1</b>	Yeah, it makes sense. So how do you feel about entering your data in the app? Do you have any concerns or reservations about it?	
64	<b>Speaker 4</b>	No, no, no. I don't. There's enough data for for all of us out there that it's not going to really make much difference, is it?	U
65	<b>Interviewer 1</b>	I share your viewpoint	
66	<b>Speaker 4</b>	If I was worried about what data was out there I'd never sleep.	
67	<b>Interviewer 1</b>	Yeah, exactly. So what is the way you enter information in the app manually, right?	
68	<b>Speaker 4</b>	Yes. Just manually.	U
69	<b>Interviewer 1</b>	Okay. Yeah. Um, how do you feel about the information that you received from the app? Do you think it's reliable, you trusted the tips and everything?	
70	<b>Speaker 4</b>	Yeah, yeah. I don't. I don't see a problem with that. No. I mean, you know, I wouldn't I would only use it as guidance and if I felt I was gonna change something, I would speak to the doctors anyway. So, so it's it's it's it's good to get that guidance to decide whether you think it's worth taking further to, you know, to a professional.	IQ
71	<b>Interviewer 1</b>	Yeah, fair enough. But you trust the tips. They're useful to you, right?	
72	<b>Speaker 4</b>	Yeah, yeah, yeah.	
73	<b>Interviewer 1</b>	OK. And a different question, is there something that you find the app is lacking considering the information that it should have possibly?	
74	<b>Speaker 4</b>	I don't. I don't think so. But then, as I say, I don't I don't use the app on a daily basis, on a weekly basis, maybe once a month, you know. So it's not something that I would, I would say, is something I'm constantly looking at and feeling that it's lacking anything, you know, it serves the function that I want it to do.	U,US
75	<b>Interviewer 1</b>	Fair enough, I was asking more in terms of if there was something that you would like to see as additional information in the way that you use it, it covers your use case completely?	
76	<b>Speaker 4</b>	Yeah. I don't think there's anything that I would sit there and say this, you know, there's some function that I would like to see. You know, it does what I want it to do.	US
77	<b>Interviewer 1</b>	Fair enough. So how personalized would you say that information you receive from the app is? The tips, for example?	

78	<b>Speaker 4</b>	I think I think I think the fairly general and I wouldn't know how you will get anything more, you know, to be very personal. I wouldn't trust something that was purporting to be very personal, to be honest. You know, for an app telling me something that's unique to me, I will question this, it's its viability.	IQ
79	<b>Interviewer 2</b>	Can you please elaborate about it because this is interesting?	
80	<b>Speaker 4</b>	Well, well, yeah, OK. Well, you know, it's why, why are they and how are they giving the information that's personal to me without knowing all the circumstances from the inputting my basic data that would make me think. Why are they doing this? Because, you know, why do you really try to get that personal and the credibility of the information, I don't have an issue with, to be honest, because why are you trying to make it personal on very, very basic information, you'd have to put a lot more information in there to make it personal. You know, so I then start to question the motives of why they're trying to say it's personal.	IQ
81	<b>Interviewer 2</b>	OK, thank you.	
82	<b>Speaker 4</b>	Makes sense?	
83	<b>Interviewer 1</b>	Yeah, it makes sense, absolutely. OK, next question. So what would you say is your satisfaction level from using the app?	
84	<b>Speaker 4</b>	Measured in what?,	
85	<b>Interviewer 1</b>	Whatever. Do you like it? Do you dislike it?	
86	<b>Speaker 4</b>	Oh yeah, I think it's OK. I think it's yeah, you know. You know, it's it's it's great. It's OK. Yeah.	US
87	<b>Interviewer 1</b>	Is there something in particular that appeals to you about the app?	
88	<b>Speaker 4</b>	I like the fact that I don't get bombarded with advertisements. I like the fact that it does what it says it does. You know, that's fine. Yeah, I think the tips are good and it, you know, it's fine. It doesn't, it doesn't try to do anything, you know. I mean, the personal thing is a classic. You know, if I've got an app telling me it's giving me a personal recommendation, my view is so you just trying to push me in a certain direction by telling me it's personal to me and I wouldn't believe it then.	US,IQ
89	<b>Interviewer 1</b>	That makes sense. So is there something that doesn't appeal to you about the app?	
90	<b>Speaker 4</b>	Not really, no. I think, it's, you know, it's it's fine. Yeah.	
91	<b>Interviewer 1</b>	OK. A different question. Do you think the time you spent when entering the data in the app, do you think it takes too long? Or.	

92	<b>Speaker 4</b>	No, no. It takes a few minutes, that's all,	US
93	<b>Interviewer 1</b>	I'm asking because a lot of people might they don't like interacting and taking extra time. Yeah, yeah. You feel fine with it as I understood.	
94	<b>Speaker 4</b>	Yeah, yeah, yeah. I think I think you know it, it doesn't want a lot of information. And if you can't afford to spend the few minutes once a month or once, every couple of months or whatever, and then I think it says more about the people than it does about the app.	
95	<b>Interviewer 1</b>	So what were your do you remember what your expectations were before downloading the app?	
96	<b>Speaker 4</b>	Not really, because it was probably the first diabetic app that I downloaded, and I would say I didn't go looking for the app. It was because, my wife works for Gendius, that I did it. It has it has stimulated me to think, as I say, about looking at the devices. And I think that would would be something that I think is is something that I think, you know, getting that information into the app via devices such as the Dexcom, you know, I mean, the apps made me think that that is a fantastic way to do it, you know, and I know friends and colleagues and people who've got Dexcom and, you know, the start saying what they got from it is that instant, you know, we can say, you know, you, you know, you literally eat something and you can see what effect that's having. Being able to go on the app and look at the history of that. That, to me, is is fantastic.	ItU,NB
97	<b>Interviewer 1</b>	It certainly adds, I guess, a lot of value, right?	
98	<b>Speaker 4</b>	I think it makes you think twice about what you're doing. I think, you know, because we all go away and forget and eat things, we shouldn't eat and eat too much. And perhaps when you start off, I mean, even things like portion size, when you're eating food with the with the ability to look at that and say, I'm just eating a typical portion size and the effect it's having on me is that I'm eating twice as much as I needed, you know, to to maintain my blood levels, you know. So the app getting that feedback through different devices, whether it be Dexcom or a set of scales that you weigh yourself on that gives you, you know, I think where where if it could all go to that app where you get all that information in one place is great because, you know, none of us want 15 apps on our phones that are all doing different things, you want it all in one place, don't you?	ItU
99	<b>Interviewer 1</b>	Of course. So you talked a bit about this, but has this changed anything else in your daily behaviors?	
100	<b>Speaker 4</b>	It's made me. I don't think it's possibly changed my daily behaviors, but it's made me aware of the types of things that are being measured when I get my blood still I'm understanding things a little bit more, I'm understanding what the level should	NB

		be, because again, you know, you go to the app and you say, Oh, you know what what was this level or what was that level and what should it be? You know, so it makes you more aware of, you know, if you don't control your diabetes, you can see what the effects are.	
101	<b>Interviewer 1</b>	So awareness is something you would say was really important.	
102	<b>Speaker 4</b>	Yeah, definitely.	
103	<b>Interviewer 1</b>	Are there any more advantages that you would say at using the app you experienced?	
104	<b>Speaker 4</b>	As I say, the the tips are good, so that if you've got, you know, something starts to occur, you know, recently I kept getting cramp, so you know, you might go and have a look and see if there's anything about cramp, you know, things like that. So, you know, maybe it's not. Maybe it's something completely different, but it's always good to see if you can go check that and see if there is anything about certain conditions.	NB
105	<b>Interviewer 1</b>	And, would you say that there are any disadvantages of using the app?	
106	<b>Speaker 4</b>	No	
107	<b>Interviewer 1</b>	Fair enough. So how likely would you say is it that you would continue using this up in the future?	
108	<b>Speaker 4</b>	Yeah, I'll just carry on using it as I have been doing.	US
109	<b>Interviewer 1</b>	Because it serves the purpose you want?	
110	<b>Speaker 4</b>	Yes, yeah. And I think I think if I decided to do certain things, I think those functions all those features in the app as well, you know, like being able to to, you know, interlink with all the other devices.	ItU
111	<b>Interviewer 1</b>	So. This connection with other devices is it something that would motivate you to further engage with the application?	
112	<b>Speaker 4</b>	Yeah, yeah, yeah, I think so.	
113	<b>Interviewer 1</b>	Is there anything else that you would that you can think of that would further motivate you to engage with the app?	
114	<b>Speaker 4</b>	To be honest, I think I think the app is fine. I like the app. There's nothing that I see and I could honestly say, I'm lucky. I've got an opportunity when I want to talk about something specific because otherwise isn't.	US
115	<b>Interviewer 1</b>	OK, so the final question from you is if there is anything else that you would like to say about the app in general?	
116	<b>Speaker 4</b>	I think I've just said it, and I think, you know, the app is great, and I think it would be good if perhaps, as I say, there were things in the app that so I said what the advantages of doing	



		other things, for instance, you know, as I say, if there was an instant tips about the advantages of using the Dexcom or other devices, you know, or I don't know, maybe there's a there's a section that that takes you to articles about diabetes, you know, but I think it's something that you tend to want to go and look for something specific. So I think search criteria is pretty important. That you know, you've got a specific thing here. If I get cramp in my leg, you know, can you go search something about cramping diabetes. Will the app take you there? You know, so it's your place to go to. But you know, and I know it can't cover everything, but maybe it's able to direct you to the to a different website.	
117	<b>Interviewer 1</b>	For example, to some trusted source?	
118	<b>Speaker 4</b>	Yeah, to a trusted source, yeah, yeah, exactly. Such as the, you know, the the NHS website. You know, we all trust the NHS. So you know, and I would go to the NHS website and check that as well, to be honest. So yeah.	
119	<b>Interviewer 1</b>	Yeah, but you're so you're saying it would be nice if it had more in terms of search options to offer.	
120	<b>Speaker 4</b>	Yeah, yeah. I mean, if you go to Diabetes UK, which is a website I'm registered on, and they send through emails, various emails and you know, I I would go on the Diabetes UK website and so, you know, search for a particular thing on there. So maybe the app could, you know, if you've got a specific thing that the app doesn't actually have information on, there's a list of trusted websites to go to, you know, go to Diabetes UK, go to the NHS website. You know, that would that would be useful.	ItU
121	<b>Interviewer 1</b>	I think it's a good idea. But yeah, that's all the questions we have for you. This concludes the interview. Thanks a lot for your time.	
122	<b>Speaker 4</b>	Yeah, no problem.	
123	<b>Interviewer 1</b>	It's very much appreciated. Thank you for taking part. As I said in the beginning, from the recording of the interview we will produce some transcripts. Do you want us to email them to you so that you can have a look at them?	
124	<b>Speaker 4</b>	No, I'm OK, no, I'll save you that trouble.	
125	<b>Interviewer 1</b>	OK, but that's fine. We wanted to ask. In case you know, you wanna take a look at them. But yeah, we will use this transcripts in the final publication. And there's not gonna be any names or anything that will compromise your identity. So don't worry about it.	
126	<b>Speaker 4</b>	Yeah, I'm not worried	

127	<b>Interviewer 1</b>	Also, we can share the final publication if you like when we're done. We can send it to you.	
128	<b>Speaker 4</b>	Yeah, yeah. I hope it has been useful for you guys.	
129	<b>Interviewer 1</b>	Yes, very much useful. Thanks a lot for your time. We really appreciate it.	
130	<b>Speaker 4</b>	OK, thank you.	



## Appendix 9 - Transcript of Interview 5

### Coding Scheme:

Dimension	Color	ID
Intention to Use	TURQUOISE	ItU
Use	YELLOW	U
Information Quality	ORANGE	IQ
User Satisfaction	GREEN	US
Net Benefits	MAGENTA	NB

### Interview 5 – Information:

General Information
<p>Actors:</p> <ul style="list-style-type: none"> <li>• Speaker 5: Diabetes self-management app user/ Co-founder</li> <li>• Interviewer 1: Konstantinos Ratzos</li> <li>• Interviewer 2: Michal Piotr Trzpis</li> </ul> <p>Time: 11:00 CET</p> <p>Date: 29.04.2022</p> <p>Location: Google Meets</p> <p>Age: 67</p>

### Interview 5 – Transcript with codes:

Row #	Actor	Text	Code
1	Interviewer 2	Yeah. And I will just take a quick note about the formalities. So this is like formal thing. I need to ask this. And at the start I would like to inform you that the audio of the interview is being recorded and all the details about the recording are included in the pdf you received in the email. So do consent to	

		the interview audio being recorded and processed according to the description?	
2	<b>Speaker 5</b>	That's fine. Yeah, that's absolutely fine. Yeah, no problem.	
3	<b>Interviewer 2</b>	Okay. Thank you. Thank you very much. So. Oh, before we start, do you have any questions to us.	
4	<b>Speaker 5</b>	No, not really, no. I think we should get stuck into it and then see where we go, see where we end up with it. So, no. All good.	
5	<b>Interviewer 2</b>	Okay, perfect. I like the attitude. So today you will you will take part in the interview in two different roles. So right now, we will ask you a few questions where you are answering as the company's co-founder.	
6	<b>Speaker 5</b>	Yeah.	
7	<b>Interviewer 2</b>	Okay. So what is your role in the company?	
8	<b>Speaker 5</b>	Yeah, well, I guess the it started quite a long time ago and back in 2005 I was working for a Japanese pharmaceutical company called Takeda selling a drug for diabetes. And my 50th birthday present was a diagnosis of type two diabetes, which was a bit of a shock. And because I worked in diabetes, I knew all the data I thought was going to be really easy to control it. And actually, you quickly realized it's an extremely complex metabolic disease that's coming coming at you from many different directions and it's probably been present for quite a long time pre diagnosis. So suddenly you're into a whole completely different world. And as I said, I thought I'd find it really easy and I really struggled with it. So I got to a point where I thought that if I was struggling, there's going to be a lot of other people struggling. So I just had this sort of crazy idea about trying to help people. I wanted to do something to help people, and it took a long time. And the CEO of the company that and I had worked together in pharma on and off for many years, and we talked about it. And it wasn't actually until 2013 that we had a chance to do something about it and the sort of stars aligned. We thought, Right, we'll give it a go, see where we end up. So yeah, so the app, I guess was my sort of concept arrangement. Although at the time I must admit we didn't know was going to be an app that it was still a very immature market back in 2016. It was quite primitive. There were basically electronic diaries with a little bit more in some of them. So yeah, that's where we started. So I did the CEO role for a while. And I still am still very passionate about the diabetes side and the and the app. But as you'll know from conversations with Gendius, we're very much into the data and big data sets now and doing really bright things with those. So yeah, so it started really with my diagnosis of diabetes back in 2005 and now I'm just sort of	

		the old man who tells tales and he's writing a book about the business. So that's yeah. And as I said, a off for the year effectively having the major surgeries and. I'll probably just go back to the board next year and probably not take an operational role, but that's to be decided. So, yeah.	
9	<b>Interviewer 2</b>	Okay. Okay. Thank you. So would you say that the story that you've told us is also the motivation for developing Intellin.	
10	<b>Speaker 5</b>	Yeah, definitely. Yeah, absolutely. And I think you'll find with a lot of people who do startups or the entrepreneurial thing, there is there is some grit in the world that makes people grow. There's a reason for it. And the thing that's always surprised me is how powerfully the the fact that we have a personal story plays with investors. And as you can, you'll know from talking to the guys, we do a lot of work with AstraZeneca. And when we met with our senior management team, their global team, I thought that me telling my story would be a little interest to them, but actually they find it very compelling. They find it really powerful. And so, yeah, I think the personal involvement so it's not we've seen a gap in the market. We want to exploit it. We want to lots of the money for the company and buy an island in the Caribbean. That doesn't work. But the fact that you, I live with it every day and I take, what, six or seven different drugs, two types of insulin and yeah, I know quite a lot about diabetes and what it's actually like to live with. So it's a powerful story. There's no question about it.	
11	<b>Interviewer 2</b>	Okay, perfect. And how did you come up with functions that are in the app right now?	
12	<b>Speaker 5</b>	Well, the functions in the app. So, yeah, I guess when we first started, um, the, the challenge that I had with diabetes was that even, what if you Google just put diabetes into Google now, you'll probably get about 520 million pages of information back, so there is a huge amount of information and you can't, you've got no idea if you've done the mass on it and if you actually print that out the stack of paper will be 22 miles high. So the world is awash with information on diabetes the NHS in England the brilliant but time poor so I probably get a maximum of 60 minutes a year with a consultant or a nurse to talk about my condition. So the original idea of the app was not to make it intrusive but to make it supportive. So and that's really important. It's a chronic disease. It's not like a broken leg and it's going to be better. I'm going to be playing football that season. I've got this for the rest of my life, so it can't be something that dominates my life. It has to be a supportive, supportive place. It puts me in the right direction. And more importantly, my diabetes is different from everybody else's. And that something specific special about me diabetes runs in different courses with everybody and with some people. It's a very sort of passive thing of they don't really notice it. Other people, it's	

		<p>literally if they get it wrong, it's sort of life and death stuff because, you know, comas, diabetic ketoacidosis, all sorts of things could go horribly wrong. So we wish to try and individualize it. So that was the original concept. So let's try and put a clinical basis on this. And we talked to a professor of diabetes very early on and he talks how he consults with patients when he sees them so effectively. We took that as a model and said we will then ask a suite of questions and we're trying to personalize the information we give back to people with diabetes to make it relevant to them as an individual is at the moment, it was certainly back then that and even to a degree now it's a sort of one size fits all treatment regime. And again, just to give you a personal example, I was very, very lucky in a way, because normally if you type two and I was 50 when I was diagnosed and then you go through a standard stepwise progression of diet and exercise, then you might go to metformin, then you might go to some form urea, and then you got something else, and then eventually you might have an insulin. So people follow that. And in that period between diet and exercise, the first pharmacological intervention can be several years. And in the meantime, your pancreas is just getting beaten to death. It's just getting worse and worse. As microvascular disease has started. There's all sorts of stuff going on in your body. And I was fortunate again because my industry connections I got, I got adopted by a visiting Italian professor who was at Midlands Big Midlands Teaching Hospital, and he put me on to insulin three months after diagnosis. So I've been on insulin for, for 15, 16, 17 years now I guess, and that's unusual. But this is what I mean. It's not so much what's happened to me, but that was very different. But everybody's journey is different, so everybody needs a different level of support and a different level of understanding. So the concept was to try and personalize it, and it's a very slow, iterative process. You have to learn as you go along. And obviously if you're on insulin, then you did a lot of blood sugars every day. If you're not on insulin, then more of that is around lifestyle, advice, diet, exercise, all that sort of stuff. Because if you're a type two or metformin, even if you've got high blood sugars, you can't do anything about it. You've just got to keep taking the metformin and hopefully over a period it will settle down. So yeah, so personalization and individualization is absolutely key to what we try to do with it.</p>	
13	<b>Interviewer 2</b>	Okay. So and what is the future goal that you want to reach with Intellin?	
14	<b>Speaker 5</b>	I think I guess that there is a huge number of people out there with diabetes. It was always important to us that we made it free. We didn't want to, we didn't want to charge people to pay, you know, individuals to pay for it. If companies pay for it, that's fine. If healthcare systems or providers pay for it, that's	

		fine. But as an individual, we wanted to make it available. So we want to try to make reach as many people as we can. And again, you probably know this already, but I think we've been picked up by about 150 countries across the world, and we're getting close to a million downloads, which takes us into the upper echelons of diabetes apps. So it's reaching as many people as we can and really just trying to make a difference. And it sounds a bit cliched. It sounds a little bit cheesy in a way that, but that's effectively what we want to do and try help people. Not only this, this generation of people with diabetes, but to learn from this generation of diabetes to help the next generation. So we are constantly, as I say, iterative process with constantly trying to move it and make it better and more integrated, I think, is the thing the tech the whole tech world is moved on massively since 2016. Now, we talked about 150 different devices with insulin and it's having a passive it's someone just sitting on your shoulder saying, yeah, do that, that's great or don't do so much of that. So it's supportive, it's not invasive. So it's trying to get to that point where it's seen as a as an adjunct to diabetes rather than I don't want my diabetes to rule my life. It does to a degree, but I don't want that to be all I do. You think oh, I've got to inject more insulin now or I'm going to do the blood sugar reading or whatever? So it's to try and make it passive smart but make a difference to the individual.	
15	<b>Interviewer 2</b>	Okay, that was a great answer. So now we will do a little of a transition. So please forget that you are the company's co-founder and imagine that you are only the user of the application. And we will ask right now more questions regarding the day to day use, starting with some general questions. So how old are you?	
16	<b>Speaker 5</b>	I am now 67.	
17	<b>Interviewer 2</b>	Okay.	
18	<b>Speaker 5</b>	Yes, 67. Yeah. Yeah.	
19	<b>Interviewer 2</b>	And what are your experiences with mobile applications.	
20	<b>Speaker 5</b>	What, before Intellin you mean. Oh what do I.	
21	<b>Mik</b>	Yeah. So to, to specify what are your experiences with mobile applications in general? Are you a frequent user of different applications like not only diabetes apps but in general?	
22	<b>Speaker 5</b>	No, I use quite many apps, the only thing I don't use is the sort of social media stuff I don't do Facebook I don't do WhatsApp, I don't do any of that, Instagram, any of it. But yeah, I tend to use apps. So so you use Google Maps a lot. I've got an app that's connect, which tells me that the charge station I just	

		have. So yeah. So I use a lot. I also have a Dexcom, I don't know if you know what a Dexcom is, but yeah, so I'm connected to Dexcom. So I get blood readings every 5 minutes. So in terms of which app do I use most? It's Dexcom, no question about it. I probably look at it 20 times a day to see what my blood sugar is. And so yeah, like a lot of people I've got a lot of apps on my phone that I downloaded, never used, but I have a hard core of things that I do tend to stick with and use quite a lot. Yeah.	
23	<b>Interviewer 2</b>	Okay. And what are typical ways you are looking for information about diabetes?	
24	<b>Speaker 5</b>	Um, I, I take a lot of notice of my consultants and my general practitioner is very good. I have an experience with the NHS workers across healthcare professionals who are not so good. So I think there's variation in standard and I read quite a lot on the subject because I think I've just got a natural curiosity about life and and what's going on. And obviously the tech interface with diabetes always interests me as well. But I'm I've spoken as a patient advocate for AstraZeneca on several occasions, so I tend to take the patient centric view and it sounds very selfish, but it's about my diabetes. I'm not really interested in anybody else's per say. I want me to be the best version of me that I can be with my diabetes. So that's a that's a real passion of mine. And I also have a big thing about being treated as an algorithm. So I go in and I see somebody and they say, Right, you've done this. So the next step is this. But it might be on the protocol, but it might not be the best next step for me. So let's have a conversation. So again, I think it's all around patient at the center rather than as an ancillary sort of, you know, accessory to the fact. So patient centric care is really important to me. So I'm very passionate about it.	
25	<b>Interviewer 2</b>	Okay, perfect. And how often do you use the Intellin app?	
26	<b>Speaker 5</b>	Well, I use it every day because my Dexcom data goes through to it and I've got a blood pressure cuff which is behind me somewhere, which is Bluetooth. So that data goes into it, it picks up my activity from Apple health, from step counts and stuff. So all the primary stuff goes with BMI. So I'm in there quite a lot yeah and it's just useful and it will flag things as well, you know, to sort of tell what's going on. So I think it's still work in progress. And I think if we have this conversation in 20 years time. It would still be a work in progress. It's always going to be a moving feast. But the level of connectivity that we have now and the integration. Intellin is now a hub app so it sits at the center of an ecosystem and pulls in other stuff from different apps.	U
27	<b>Interviewer 2</b>	Okay. And why did you start using the app?	
28	<b>Speaker 5</b>	Because I invented it. I don't know. No, seriously. It's to thrive to put the information that's relevant. That's. That's the whole	ItU,US

		point of it. I want to cut down on the background noise of all the other stuff that's going on in the diabetes world and just look at stuff that's relevant to me. So again, I think we're part of the way down there to personalizing it, and it's better than most things out there, but we can do more with it. So it was really neat to try and have a tool that is specific and supportive to my daily needs in terms of managing my diabetes.	
29	<b>Interviewer 2</b>	Okay. And okay, so I'm just looking because you answered some questions before. Okay. So what functions of the app are you using?	
30	<b>Speaker 5</b>	Most of it is the stuff that I can influence. So it's looking at my blood glucose because obviously being on insulin, I can change that. And obviously I'm sort of post-surgery. I've had the knee replacement and I'm gonna have another one done. So my activity is really important at the moment. My weight's got up like a lot of people through COVID and obviously having needs that didn't work. Then I've become quite sedentary. So, you know, the whole weight BMI thing is really important to me as well. So there is a bunch of stuff I look at and obviously blood pressure is important as well. So I would track probably those four key things. So it would be exercise, blood glucose, activity and blood pressure. But yeah.	U
31	<b>Interviewer 2</b>	Okay. So are these mentioned functions are also the ones most useful for you?	
32	<b>Speaker 5</b>	Well, those four those functions.	
33	<b>Interviewer 2</b>	Yeah, yeah.	
34	<b>Speaker 5</b>	Yeah.	
35	<b>Interviewer 2</b>	Yeah. OK. Perfect. And what problems are you encountering with using the app?	
36	<b>Speaker 5</b>	I don't think there's any problem as such. I mean, the actual platform is being built on is really very stable. So it tends not to crash. It doesn't sort of lose data. And I think one of the challenges we have with it is that we're getting so much data pulled through from Dexcom because you're getting at about 240 data points a day of it. So this is a big is and is one of the challenges are diabetes, you may do one kidney function reading a year or two, maybe max, but then if you've got sort of two data points of the year as opposed to 240 in a day, then the actual sort of how that's displayed and how would be how you move that into a chart that's relevant, and usable. So I think that's the challenge. It's just disparity of the size of the data that we pulling down. So it could be just a single annual data point. Dexcom is every 5 minutes 24 seven. So yeah, that's a challenge and I think we need to do better on that in terms on how we manipulate that so that it would make it make it easier.	U



37	<b>Interviewer 2</b>	Okay. Perfect. And what kind of external appliance or software do you integrate with the app?	
38	<b>Speaker 5</b>	At the moment I have a smartwatch, which I don't wear very often, but that that integrates the app is a Garmin smart watch. So I've used that I have my scale's on Bluetooth into the app as well, so I can basically jump on it in the morning when I come down, by the time I'm downstairs it syncs with the app and pull my latest, you're too fat reading on it. I will wait. So the blood pressure cuff is the other one and obviously Dexcom. So those are the four key pieces of kit. So it's the scale it's the cuff, the blood pressure cuff, Dexcom and the smartwatch as well. So so that picks up the vast majority of what I need on a day to day basis, to be honest and I don't have to do anything is the other thing. Obviously I have to put the pressure cuff on, but I don't then have to type of reading it, so it just seems straight back to the app.	U
39	<b>Interviewer 2</b>	Okay. And how easy is the integration with external appliances and software?	
40	<b>Speaker 5</b>	It works really well. We actually have a we use a company in Berlin because obviously the danger is that if you connect to a device that if there's any changes in their software or the API interface, then you have to be all over it. We can't do that. We haven't got the capacity. So they effectively manage the whole interface for us. So all the all the tech that is connected to it. If there's any changes or updates, that is automatically done. So again, we find it pretty seamless. We don't tend to have issues where either a warm connection will fall over. They did really well for us. So there's a couple of companies. I mean, there's the one in Berlin and there's one based in the States who do the same sort of thing. And it costs us yeah, it costs us a little bit of money a month, but it's fantastic because it gives us a really big reach in terms of connectivity.	US,NB
41	<b>Interviewer 2</b>	Good. So how is the application engaged in the way you communicate with your diabetologist?	
42	<b>Speaker 5</b>	They love it. I'll give you an example. When I went to have my knee replaced a few weeks ago, they said, We want to do a blood test. And I went, It's on the phone. And. So little things like that. And the hospital can see my real time data. So they can follow my bloods 24/7 they don't but they can do. And they can. When we have a consultation and obviously a lot of consultations are done by phone these days, because of you know COVID and post-COVID, they can actually see my blood pressure history. They can see my blood glucose history and they can see what my weight stand over time. So having that turns it from a an advisory conversation in terms of what's been going on with say right we can see that your BMI be increased by the 2% over the last six months. Your blood pressure has actually slowed down or your HBA1C your blood	NB



		glucose is doing X. So you can actually have a relevant conversation about what my next six months needs to look like in terms of adjustments to medications or lifestyle or whatever else.	
43	<b>Interviewer 2</b>	Okay. And how do you feel about entering your data in the app? Do you have any concerns or reservations?	
44	<b>Speaker 5</b>	It's a it's a really important question, because one of the big issues is if you have to manually enter data, there's one main reason why people don't like it's because of the fat finger thing. That it's easy for somebody to put a wrong reading in. And secondly, just the the intensity of having to put data in all the time is a real it's a real pain. And you lose a will after a while. You know, you just go, I don't want to do this anymore. But because all I need to do is be synced with my Dexcom or my scale or my Bluetooth or my blood pressure cup, I don't have to do that. It's doing it for me. I just have to step on the scale or take a blood pressure reading with the cuff on, you know, sit there for 2 minutes and it will sync it back to the phone. If we were doing manual entry, it wouldn't work. People do it for a while and then they'll get bored with it. And if you're looking at a look at chronic disease and you're asking somebody to do something for 20 years, 25 years, it ain't gonna happen. So the reality is, if you don't connected, people might do it as while for a novelty and think, Oh, this is really cool. And then you go, I can't be bothered. So yeah, automated uploaded data is massively important.	U,NB, ItU
45	<b>Interviewer 2</b>	Okay. And moving on. How do you feel about the information that you receive from the app?	
46	<b>Speaker 5</b>	I think it's good. I think we built the content more and more. And again, I think if you look at the health guide app, you'll see there's a huge amount of content on there. I think a lot of it's quite relevant in terms of things that you can do to, you know, your heart health or kidney health or eye health. There's a lot of good stuff on there. But again, we need to constantly refresh it. And I think the one thing I would do is I think we do a lot of stuff in plain text at the moment, which is people are used to seeing short video clips. Now it has to be short, punchy, relevant, sexy, interesting. We need to do more of that. I think the actual content of it is really good because it's all been validated and signed up by clinician. So one of my big concerns when we started was that you go into Google, it's a Wild West that they've got no idea whether or not it is actually clinically sound. Everything that we do, every notification that goes out is referenced clinically. There's a reference on it. So if we, you know, for the American Journal of Diabetes or whatever, and it will tell you the actual references that that piece of advice is coming from. So it's validation of clinically validated products, I guess.	IQ

47	<b>Interviewer 2</b>	Okay. And have you found all the relevant and crucial information to help you manage diabetes, or is there anything that the app is lacking considering the information?	
48	<b>Speaker 5</b>	I think you can just get smarter. I think the problem with diabetes, you don't know what you don't know. Donald Rumsfeld quote the known unknowns and unknown unknowns. But I'm confident in it because obviously I've been there since it was born effectively. So I think we just need to make it smarter, more relevant. And as I said to you at the start of the conversation, it's all about personalization. So the more relevant it can be, so the more data it gets about me. And this is one of the things that we're doing now is going back in historical datasets to try and work out. What's happened over the past three, five, ten years, which then give you a really good idea of what the trajectory is going to look like. And we just need to keep on moving down that road. We're on the road, but we just need to keep on pushing it and make it more and more personal and more and more relevant and more more dynamic in a way. So, you know, my car is Tesla, it's smart. It can tell me if I'm going to hit something, and it'll break if it's needed. And we need to do that, if you know what I mean. With diabetes to say, okay, if you carry on in three months time, you've got a really high chance of having a stroke or a heart attack. So you've got to be careful. And so, yeah, that's what we need to do. We just need to make it that bit smarter. So forward looking is better, better and better. So.	IQ
49	<b>Interviewer 2</b>	And how the information is personalized right now.	
50	<b>Speaker 5</b>	Well, it's personalized because it's got all of my history and all my clinical markers in there. And that's a big step I mean no other app on the market as far as I know does that. So it's got my kidney function and it's got my last HBA1C once the ratings. And obviously speaking of data on a day to day basis. So it is getting quite cute and smart but it just it as I said before, it just needs to move along. So it is relevant to me. So it's not saying I'm a 67 year old we talk to a dependent is actually saying, right, you've got a BMI of X, you've got that, you know, your activity level is Y, your blood pressure has been in you know Z over this period of time and your HBA1C has been similar over a period of time. And on that basis, what we want to look at is that we need to, you know, make sure that you're doing good things around protecting your heart or cardiovascular system. And we're not too worried about fatal ulcers that moment because you're you know, we deal with vascular disease. So it's that sort of stuff. So it is starting to make it individualized and personalized in terms of what's going on.	IQ,US, NB
51	<b>Interviewer 2</b>	Okay. And about the information you get from the app, how do you apply it in your daily life?	

52	<b>Speaker 5</b>	I think most of it the biggest change that I can make on a daily basis is my insulin. So obviously controlling and staying in range is the biggest and the most important thing for me to do. So obviously the information I'm getting back from Dexcom through the app then allows me to adjust my insulin doses as I have much you know I did it after breakfast, I did it after lunch and I'll do it again when I have dinner and and it's also in terms of my activity again because I've just had a knee surgery, I had a knee replacement that obviously my activity been really low. So just see my activity kick up on a daily basis. Something about 2000 to 3000 steps a day when I was doing a 100, or a couple 100 that exerting too much. So being able to track and stuff like that. So certainly my daily activity is becoming really important to me as well. So yeah, so it's this whole suite of things going on that make a difference.	NB
53	<b>Interviewer 2</b>	Okay, moving on, what is your satisfaction level from using the app?	
54	<b>Speaker 5</b>	As a user, or as a co-founder.	
55	<b>Interviewer 2</b>	As a user, only a user right now.	
56	<b>Speaker 5</b>	Yeah I know, I know, I think I'll probably give it about a seven and a half out of ten. I think it could do more. As a co-founder, I'll be a little harder than that. And I would really push it on. But as a user, I think it's out there with some of the best right now. That it's slightly different. It's a bit more you have to commit to it early on to put your clinical data in. But once you've done that, then the rewards that you get off it are just well worth doing so. Yeah.	US
57	<b>Interviewer 2</b>	Okay. So what appeals to you about the app and what not and why?	
58	<b>Speaker 5</b>	I think the fact that it's free, I think is really important. It's free. There's no adverts on it. So it's a completely clean platform. I think the the actual user interfaces is good. I think it's, um, it's, it looks smart. We're going to reskin it. I mean, there's work goes on in the background so we're gonna to completely reskin it again. But I think it looks very efficient, it looks clinically. It looks like a serious piece of kit. So I think those things are important. Um, I think, as I said in it's present state, I think it's pretty good. It can get better, but it doesn't mean to say that this is bad. What it does, it does well. But there are still the bits that can make it smarter. So we go further forward. But yeah, I think it's. Yeah, I'm. I'm proud to be attached to it.	US
59	<b>Interviewer 2</b>	Okay, perfect. I have a tricky question here to you as the founder, but let's let's give it a try. So were your expectations fulfilled comparing like what you were imagining before start of the development of the up till today? I mean, how many of your expectations are so far fulfilled to this day?	

60	<b>Speaker 5</b>	<p>I think it's in a lot of ways it's completely blown me out of the water. And I think if you look at the data on the net, just on app downloads, I know it's a very crude measure, but the vast majority of apps never get more than 5000 downloads. And we were slow to start up. We had quite a soft launch and then we started to do some work on social media and it started to kick up and then suddenly we'd gone through 5000, 10,000 and 50,000, 100,000 then the 250,000 then 500,000. And there are very, very few apps out there I mean, obviously, you know, the mega apps, the giant apps go to, you know, tens of millions, hundreds of millions of Facebooks. But generally in this sector, there are very few. And the biggest app prior to us was an app called My Sugar, which was backed by Roshe, and it took them 12 years to get a million downloads. And we I'm pretty confident we'll go through a million this year. So that's probably, what, three and a half years post-launch. So in terms of the growth trajectory, it's been fantastic. So I guess my I wanted to make a difference. And you say you want to make a difference to one person and it's the app that we started all those years ago has touched a million people across the world. Then you think we've probably done something right? So yeah, I think in terms of expectations, yeah, it's been pretty good.</p>	US
61	<b>Interviewer 2</b>	<p>Okay, perfect. So now going back to you as a user of the app only, how has the app influenced your life with diabetes? What has changed in your daily behaviors? For example.</p>	
62	<b>Speaker 5</b>	<p>I think the most important thing is it de-stress it because if you don't have, if you don't have the app and you don't have the connectivity, you're effectively you run blind between consultations with your nurse or with your doctor. So for six months, you just you don't know what's going on. I know every day what's going on with me and whether I'm doing more activity, whether my blood pressure's creeping up, going down, if my blood sugar was good or bad. So it takes the stress away and it makes me get on with the rest of my life. So I don't have to worry about it. I don't have to think I'm going to have to do something really drastic in the next six months. So that's the biggest difference it makes, is having a wingman sit on your shoulder. Yeah, I'm looking after you. And and he does all the work. I don't have to. All I have to do is make sure that the printer is working and that all the information is coming through I'm getting all the advice I need from it. But I don't manually have to put, which we talk about a few minutes ago. I don't manually have to put in a load of data every day. But it's doing the work in the background so I can be completely passive right here as a user, but it's still looking after me and that's exactly what I want. So my diabetes is second to none. I don't you know, there's a billion things I want to do rather than worry about the to do with diabetes.</p>	NB

63	<b>Interviewer 2</b>	Okay. Perfect. And now to summarize, what are the advantages of using the app?	
64	<b>Speaker 5</b>	I think for me, the biggest difference it makes is it is the security. And knowing that there is a bunch of technology working in the background, that looking after you. So that's to me, that's the biggest single difference. And the fact that it's it's a low level of intrusion into my life. But I'm getting quality data. We know it's been validated by medics. It's been signed up by clinicians. So I don't have to worry about the validity of what it's telling me to do. It's all there. So those are the big things that as long as you use on a day to day basis. Yeah, there's somebody looking after me, that is very important to me.	NB,IQ
65	<b>Interviewer 2</b>	Okay, perfect. And to summarize on the other side, so what are the disadvantages of using the app?	
66	<b>Speaker 5</b>	The disadvantage is, I guess because you're getting so much information that you can look at, you tend to be you you can potentially start to micromanage your condition that you think a blood pressure. Let's talk about blood glucose. So I see over the last hour it's crept up and actually that's probably just part of the normal cycle of what's going on in your body. What you then start to do, do I need to stick to more fast acting insulin to try and bring my levels down and then I'm going to have a hypo, I'm going to have a wobble. And so the downside potentially is you can get. Yeah. Micromanaging. And you certainly see that not with insulin because we don't recommended it for kids under 18. But if I say an 11 year old child is connected to Dexcom or something and mom and dad can see what's going on. Parents can get really like that we need to get them off the swing back into the house and give them something because of the blood sugar start to change. So micromanagement is the downside potentially, but you've got to be pragmatic about it and say, well, this is a long day, but that's that's the one thing that you can get a bit obsessive about potentially is yeah, information can be. Yeah, make you too nosy. Too curious, though.	NB
67	<b>Interviewer 2</b>	Yeah. This is important remark here. Good. And what would motivate you to further engage with the app?	
68	<b>Speaker 5</b>	What would motivate me? I would just like to see the new developments. I like to see. I'd like as I said earlier, a lot of the stuff that we do at the moment is in plain text. I would like to see more sort of funky stuff happening. Sure. Just really punchy video clips, 50 seconds, 15, 30 seconds, stuff like that. Link sites, where are the websites. What's going on is there's sort of some new data breaking of diabetes or some new, you know, just trending in the medical community. Let's flag it. Let's you know, let me have a look at it. And I think you're probably just making the interface because we've had that interface now probably for three years. It's time for a refresh. So	

		I think just to, you know, repaint the house would be great and have a different color on it. So yeah, stuff like that. But I just move it on in terms of the functionality and make it smarter. That's the that's the interesting thing for me.	
69	<b>Interviewer 2</b>	Okay. And the last question. Is there anything else you would like to say about the app?	
70	<b>Speaker 5</b>	No, I think. I guess, you know, if you sort of take the co-founder piece. I think we saw the really vague concept and had no idea what was going to happen with it. It's attracted a lot of attention. We've got a lot of investment that's came into the company. I think we started to make a difference. So I just I just wanted to become a sort of a standard for people with diabetes. Not only do they download it, but they use it and they find the value in it and it makes their life better. I think it's as simple as that. If we can, you know, learn from this generation, as I said to you before, and the next generation, we know more about it by how you manage it over a long time. In terms of long period of time. It's usually what teachers talk about academic things, but if you're living with it on a day-to-day basis it's gonna be liveable with. Otherwise it just really just becomes your life. And I don't want diabetes to be my life. I want it to be something I've got. But hey, I could just get on with it and manage it. So, yeah.	
71	<b>Interviewer 2</b>	Okay. Perfect. Thank you. Thank you for the interview and taking this challenge to answer questions from co-founder and user perspective, because that that was challenging, I can imagine. So you did a really good Chris. So thanks.	
72	<b>Speaker 5</b>	No, thank you. So what about you guys? What happens now? What do you do? You do doctors or masters or what's the plan?	
73	<b>Interviewer 2</b>	Masters The plan is masters. Now, we have about 20 days to finish our Master thesis, and right now we are going to transcript our today's interview. So if you want to receive the text, you are more than welcome to to receive it if you want. So do you want to receive it?	
74	<b>Speaker 5</b>	Yeah, out of curiosity I'd love to.	
75	<b>Interviewer 2</b>	Okay. So we will send you the transcript and then if you want, we can send you the whole thesis, the whole work.	
76	<b>Speaker 5</b>	That would be brilliant, Yeah. And equally, if there's anything else you want me for, you know, you know, to get hold of me. So if there's anything else you want to pick up on later, then drop me a line and we can arrange another call if you want. So I don't think it's going to be a one off, but obviously you have to go forward.	
77	<b>Interviewer 2</b>	Perfect. Yeah. If necessary, we will do so and we will send you the transcript and the work when it's done. So right now, it's	



		only our our time to just, you know, do the analysis and all this stuff. And hopefully it will be. Also interesting to read for you about what the remaining four people said about.	
78	<b>Speaker 5</b>	Yeah, I'd love to see it. Yeah, I really would. So, yeah, fantastic. So, hey, good stuff, guys. Enjoyed that. That was great.	
79	<b>Interviewer 1</b>	Okay, well, thanks a lot for your time. Very good input. I think you gave us a good understanding of what your motives were, what the goal is, and what you value as a diabetic in an application. And that's actually what we're trying to find out what people value in such applications. But due to the sort short time span, we we're just going through your application Intel-lin to just as a baseline.	
80	<b>Speaker 5</b>	Okay, brilliant. Okay. Well, yeah, look to see your outputs, that would be fantastic. So yeah. But like I say, if you need me again, just. Just give me a shot.	
81	<b>Interviewer 1</b>	OK. Thanks a lot. Have a good day.	
82	<b>Speaker 5</b>	You too. See you guys. Bye-bye.	
83	<b>Interviewer 2</b>	Bye-bye	

# Appendix 10 - Informed Consent Form

Page 1 of 2:



LUNDS  
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Date: 08/04/2022

Reg. no: 001

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## Consent for personal data processing

I consent to my personal data in the form of e-mail, name, surname, and audio recordings of the interview being processed by Lund University for the following purpose: Creating the transcripts for the conduction of master's thesis research that aims at identifying success factors of mobile health applications for diabetes self-management, from the user's perspective. The consent is given by agreeing to grant the interviews.

### Information

The personal data will be processed in the following way:

- The data will be stored in the personal computer of Konstantinos Ratzos, an uncompromised Windows 10 system that is protected by McAfee LiveSafe (paid version).
- Access to the data is available only to the people involved in conducting the research: Michal Piotr Trzpis and Konstantinos Ratzos.
- The data will be used to create the transcripts that will be included in the final master's thesis, which will be published by Lund University. The transcripts will contain anonymous data. Answers that could compromise anonymity will be anonymized as well. Data anonymization is a type of information sanitization whose intent is privacy protection. It is the process of removing personally identifiable information from data sets, so that the people whom the data describe remain anonymous.
- The data will be removed from the system on the 8th of June 2022, which is the graduation date from the master's program.

The data will be used for the above purpose and in accordance with this form. The legal basis for the processing of your personal data is that you have given your voluntary consent written or verbally. We do not share your personal data with third parties.

The consent is valid up to and including 08/06/2022. You have the right to withdraw your consent at any time. You do this by contacting the people involved in conducting the research: Konstantinos Ratzos at [ko1227ra-s@student.lu.se](mailto:ko1227ra-s@student.lu.se) or Michal Piotr Trzpis



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at [mi3670tr-s@student.lu.se](mailto:mi3670tr-s@student.lu.se). We will in this case cease to process personal data that we have collected based on this consent.

You have the right of access to information about the personal data we process about you. You also have the right to have incorrect personal data about you corrected. If you have a complaint about our processing of your personal data, you can contact our data protection officer via [dataskyddsbud@lu.se](mailto:dataskyddsbud@lu.se). You also have the right to submit a complaint to the supervisory authority (Swedish Data Protection Agency) if you think that we process your personal data incorrectly.

## Appendix 11 - Collected Survey Data

The collected survey data can be found in this section in the form of print screens from the excel document we used. The first 7 rows are the replies to the English questionnaire, the next 6 rows are the translated replies from the Greek questionnaire, and the last 12 rows are the translated replies from the Polish questionnaire.

Timestamp	1. Please select your gender	2. Please select your age group	3. Which app for diabetes self-management are you currently using?	4. Is the app free?	5. How long have you been using the app for diabetes self-management?	6. How often do you use the app for diabetes self-management?
4/25/2022 19:31:46	Female	51-60 years	Diabetes:M	Yes, but with limited features	Less than 6 months	Daily
4/25/2022 20:18:44	Female	41-50 years	Sugarmate	Yes	Over 3 years	Daily
4/26/2022 6:51:44	Female	41-50 years	Medtronic sensor	Yes	1-3 years	Daily
4/26/2022 15:28:25	Female	41-50 years	Clarity	Yes	Over 3 years	Daily
4/29/2022 0:04:17	Female	51-60 years	FreeStyle Libre	Yes	1-3 years	Daily
4/29/2022 6:14:01	Female	41-50 years	The updated loop freeAPSx	Yes	1-3 years	Daily
4/30/2022 23:46:02	Female	31-40 years	mySugr	Yes	Less than 6 months	Daily
4/25/2022 15:03:58	Male	Under 20 years	FreeStyle Libre	Yes	1-3 years	Daily
4/25/2022 15:09:57	Female	31-40 years	FreeStyle Libre	Yes	Less than 6 months	Daily
4/25/2022 17:17:59	Male	20-30 years	FreeStyle Libre	Yes	Over 3 years	Daily
4/25/2022 18:17:14	Female	20-30 years	FreeStyle Libre	Yes	1-3 years	Daily
4/25/2022 23:11:28	Female	20-30 years	FreeStyleLibre	Yes	Less than 6 months	Daily
4/27/2022 0:09:46	Female	Under 20 years	FreeStyle Libre	Yes	Less than 6 months	Daily
4/23/2022 18:56:25	Prefer not to say	Under 20 years	VitaScale	Yes	Less than 6 months	Daily
4/26/2022 8:57:56	Female	20-30 years	Contour	Yes	Less than 6 months	Every other day
4/27/2022 13:55:39	Male	Under 20 years	FreeStyle Libre, XDRIP	Yes	Over 3 years	Daily
4/27/2022 15:59:43	Female	31-40 years	FreeStyle Libre, VitaScale	Yes	Over 3 years	Daily
4/27/2022 17:28:00	Female	Under 20 years	FreeStyle Libre	Yes	Less than 6 months	Daily
4/27/2022 18:27:43	Female	31-40 years	Dexcom	Yes, but with limited features	Less than 6 months	Daily
4/27/2022 18:49:04	Female	41-50 years	Dexcom	Yes	6-12 months	Daily
4/27/2022 20:57:56	Female	51-60 years	mySugr	Yes, but with limited features	1-3 years	Daily
4/28/2022 7:13:14	Female	20-30 years	FreeStyle Libre	Yes	1-3 years	Daily
4/28/2022 9:30:56	Female	20-30 years	One Touch	Yes	Over 3 years	Less often
4/28/2022 20:16:07	Female	20-30 years	mySugr	Yes	Less than 6 months	Daily
4/30/2022 13:51:25	Male	51-60 years	Contour Diabetes	Yes	Over 3 years	Less often

7. How much time per day are you using the app for diabetes self-management?	8. What functions of the app for diabetes self-management are you using?
20 to 30 minutes	Blood glucose entry/reports, Last basal/bolus entry/reports, Other
More than 1 hour	Blood glucose entry/reports, Last basal/bolus entry/reports, Activity entry/reports
More than 1 hour	Blood glucose entry/reports
10 to 20 minutes	Blood glucose entry/reports
10 to 20 minutes	Blood glucose entry/reports
More than 1 hour	Blood glucose entry/reports, Last basal/bolus entry/reports, Diet entry/reports
5 to 10 minutes	Blood glucose entry/reports
More than 1 hour	Blood glucose entry/reports
30 to 60 minutes	Blood glucose entry/reports, Activity entry/reports, Diet entry/reports
30 to 60 minutes	Blood glucose entry/reports, Activity entry/reports, Diet entry/reports
5 to 10 minutes	Blood glucose entry/reports, Activity entry/reports
Less than 5 minutes	Blood glucose entry/reports
Less than 5 minutes	Blood glucose entry/reports
5 to 10 minutes	Diet entry/reports
5 to 10 minutes	Blood glucose entry/reports
More than 1 hour	Blood glucose entry/reports
5 to 10 minutes	Blood glucose entry/reports, Activity entry/reports, Diet entry/reports
5 to 10 minutes	Other
More than 1 hour	Blood glucose entry/reports, Last basal/bolus entry/reports, Activity entry/reports
More than 1 hour	Blood glucose entry/reports
10 to 20 minutes	Blood glucose entry/reports, Last basal/bolus entry/reports, Other
5 to 10 minutes	Diet entry/reports, Other
10 to 20 minutes	Blood glucose entry/reports
30 to 60 minutes	Blood glucose entry/reports, Last basal/bolus entry/reports, Activity entry/reports, Diet entry/reports, Other
I am not using the app for diabetes self- management daily	Blood glucose entry/reports

9. How did you find the app for diabetes self-management?	10. I have positive experiences with mobile applications for diabetes self-management	11. I am experienced in using mobile applications for diabetes self-management	12. I am frequently using the app to look for information about diabetes	13. What is the way you enter the information in the app?
Diabetes forums	5	7	5	Manually
Social media	6	5	6	Directly from my connected apps/ devices
Healthcare professional	6	6	6	Directly from my connected apps/ devices
Healthcare professional	7	7	6	Directly from my connected apps/ devices
Diabetes forums	7	7	2	Manually, Directly from my connected apps/ devices
Healthcare professional	7	7	4	Directly from my connected apps/ devices
Internet search	6	5	3	Directly from my connected apps/ devices
Healthcare professional	5	7	7	Directly from my connected apps/ devices
Healthcare professional	6	5	6	Manually, Directly from my connected apps/ devices
Healthcare professional	6	7	7	Manually, Directly from my connected apps/ devices
Social circle	7	5	4	Directly from my connected apps/ devices
Social media	6	7	6	Manually
Google play store/app store	5	5	3	Manually
Healthcare professional	7	7	7	Manually
Other	6	5	2	Manually, Directly from my connected apps/devices
Diabetes forums	7	7	1	Manually, Directly from my connected apps/ devices
Social circle	6	7	6	Manually, Directly from my connected apps/ devices
Internet search	4	4	7	Directly from my connected apps/ devices
Other	4	5	4	Directly from my connected apps/ devices
Social media	4	5	6	Directly from my connected apps/ devices
Healthcare professional	7	6	7	Manually
Other	3	6	3	Manually, Directly from my connected apps/ devices
Healthcare professional	7	7	4	Directly from my connected apps/ devices
Diabetes forums	7	7	1	Manually, Directly from my connected apps/ devices
Social circle	7	6	3	Directly from my connected apps/ devices

14. The information which I receive from the app is reliable	15. The information which I receive from the app is valuable	16. The information which I receive from the app is complete	17. The information which I receive from the app is personalized	18. The information which I receive from the app improved my daily life	19. Why did you start using the app?	20. How many different apps for diabetes self-management have you used?
6	7	4	6	5	Necessity	1
5	6	6	6	6	Necessity	1-4
6	6	6	6	5	Necessity	1-4
7	7	7	7	7	Necessity	1-4
7	7	6	7	7	Necessity	1-4
6	6	5	7	7	Recommendation	None
6	6	6	6	5	Convenience	1
4	7	7	5	7	Necessity	1-4
5	7	5	7	7	Recommendation	None
5	7	5	7	7	Recommendation	1-4
6	7	6	7	7	Convenience	1
5	5	5	6	6	Convenience	1
6	6	4	5	6	Convenience	1
6	7	7	1	7	Convenience	1-4
7	7	7	7	5	Curiosity	1-4
6	7	5	7	7	Convenience	1-4
7	7	5	6	7	Convenience	1-4
6	6	6	6	7	Convenience	1-4
6	6	6	6	7	Necessity	1-4
6	6	6	6	6	Convenience	5 or more
5	6	3	6	3	Convenience	1-4
5	6	4	2	6	Convenience	1
6	7	7	7	7	Recommendation	1
7	7	7	7	7	Necessity	1-4
7	7	6	7	6	Convenience	1-4

21. The application is engaged in the way I communicate with my diabetologist/ doctor	22. I integrate/use external appliances or software with the app	23. I feel safe entering my sensitive data in the app	24. I find the integration with external appliances and software easy	25. I am satisfied from using the app	26. I encounter problems while using the app	27. It takes me too much time to use the app	28. My initial expectations about the app were fulfilled	29. I will keep using this app in the future
4	1	6	1	5	4	2	6	7
4	7	5	5	5	6	5	4	6
3	2	5	4	5	2	4	5	5
7	7	7	7	7	1	1	7	7
7	6	7	7	7	1	2	7	7
7	1	7	4	7	5	2	7	7
6	7	4	6	6	6	2	6	5
7	7	7	7	7	2	1	6	5
6	6	4	6	6	3	3	6	7
7	7	6	2	5	3	3	5	7
7	5	7	6	7	1	1	7	7
5	3	1	2	6	6	3	5	6
6	5	5	5	6	5	1	5	6
2	1	7	7	7	1	3	7	7
2	3	5	6	6	2	1	7	7
7	7	7	7	7	3	3	7	7
6	1	5	6	7	1	1	7	7
6	2	5	5	5	2	1	6	5
5	6	2	6	4	5	2	3	6
7	6	5	4	5	4	4	6	7
1	1	7	2	7	1	1	7	7
7	7	5	6	5	3	1	3	5
7	5	7	5	7	3	2	7	7
7	7	3	7	7	5	3	5	7
7	5	6	7	7	1	7	7	7

30. I would recommend the app for diabetes self-management to other people	31. The app has positively influenced my life with diabetes	32. The app has positively influenced my daily routine	33. Using the app has helped me to manage diabetes	34. What would motivate you to further engage with diabetes self-management apps?
6	6	7	7	More features
5	7	7	7	More information, More features, If they were faster to use, If they were more visually appealing, If they were less complicated to use
5	5	5	5	More features, If they were more visually appealing
7	7	7	7	More features
7	7	7	7	If they were faster to use
7	1	1	7	More information, More features
5	6	6	6	If they were faster to use
6	7	7	7	
7	7	7	7	More features
7	7	7	7	More information, More features, If they were less complicated to use
7	7	7	7	More information, More features
6	7	7	7	More features
7	6	6	7	More features
7	7	6	7	More features
7	6	5	3	More information, More features, If they were faster to use, If they were more visually appealing
7	7	7	7	More information, More features, If they were faster to use, If they were more visually appealing
7	7	7	7	More information, More features
5	5	5	5	More information, More features, If they were faster to use, If they were more visually appealing, If they were less complicated to use
6	7	7	7	More information, More features
7	7	7	7	More features
7	7	7	7	
5	7	6	6	More features, If they were more visually appealing
7	7	4	7	More features
7	7	7	7	More information, More features
7	7	7	7	More features, If they were faster to use, If they were more visually appealing

35. How likely is it that you will continue using this app in the future?	36. Is there anything else you would like to say about the app?
6	Integration with different meters or cgm would be nice
6	Wish my doctor would integrate his office and use this app
5	I would like to see the info from my smartguard at my mobile phone and smartwatch
7	Easy to use and quick to get info
7	
7	
5	
5	
7	No
7	
7	
6	
5	
7	
7	
7	
7	
5	
6	Dexcom cannot generate a report in xls / csv format, only pdf is possible. For this reason, it is not possible to integrate reports from e.g. insulin pump and dexcom
7	
7	It definitely helps to control diabetes
6	
7	
7	
7	It is helpful in controlling diabetes.

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