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Establishing requirements for a digital solution in the diabetes type II care

A qualitative study in the Region of Västra Götaland

Master's thesis in Biomedical engineering

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MASTER'S THESIS EX021/2018

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Abstract

It is estimated that 415 million people are living with diabetes worldwide, of which 90 % are diabetes type II (T2D). The prevalence is expected to increase over the coming years due to the ageing population, and thereby also the associated health expenditures. Evidence based guidelines of the T2D care emphasise self-care and lifestyle interventions to decrease the risk of complications, but national evaluations in Sweden show that adherence is low. A suggestion is to introduce digital solutions in the diabetes care as it has been proven effective to improve glycemic control among patients. The aim of this study is to describe the current T2D care process in the Region of Västra Götaland (VGR) in Sweden and outline the requirements for enhancing the care with digital solutions.

A qualitative study was performed in collaboration with four primary care centres in VGR. Semi-structured interviews were conducted with five diabetes nurses and five T2D patients to understand the current state of the T2D care process and the potential usefulness of digital interventions. The collected interview data, in conjunction with data from a literature study on T2D and eHealth, were analysed and transferred into software requirements and conceptualised as a low-fidelity prototype of a digital solution. As a final step, the requirements were compared with features in the Swedish national Support and Treatment (SoB) platform to assess its adequacy as a potential tool in the T2D care.

The current state analysis revealed a highly standardised T2D care process, despite patients being strikingly diverse in terms of capabilities, needs and motivations. The defined requirements resulted in a digital concept aiming to support self-care by enhancing the educational process for T2D patients. With the solution, knowledge required for successful diabetes management can be manifested in patients' everyday life by introducing personalised education with included reflective elements, and embedding recorded diabetes related data in an educational context. The technical architecture in VGR permit digital solutions to be incorporated either as external applications or through the SoB platform. However, neither of the two options enables integration with the clinical information systems.

The conducted study provides a basic theoretical and practical foundation for a future digital implementation in the T2D care. It is concluded that more work is required to promote semantic and technical interoperability, but VGR do have the means to introduce a digital solution to enhance the T2D care today.

Keywords: eHealth, diabetes type II, self-care, primary care, Region of Västra Götaland, chronic care model, requirements engineering

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“I am sure there is some universal foundation of what should be included in a good diabetes treatment, but it is a complex situation.”

Amelie Andersson & Josefin Erngren
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Abbreviations

1177	1177 Vårdguiden
ANSI	American National Standards Institute
API	Application Programming Interface
BMI	Body Mass Index
CBT	Cognitive Behavioural Therapy
CCM	Chronic Care Model
CE	Conformité Européenne
COPD	Chronic Obstructive Pulmonary Disease
eCCM	eHealth Enhanced Chronic Care Model
EHR	Electronic Health Record
ER	Entity-Relationship
EU	European Union
FaR	Referral to physical activity support
FHIR	Fast Health Care Interoperability Resources
FR	Functional Requirement
GDPR	General Data Protection Regulation
HbA_{1c}	Glycated Hemoglobin
HL7	Health Level Seven International
HSLF-FS	Joint constitution concerning health care, social services and more
ICT	Information and Communication Technology
IDF	International Diabetes Federation
ID	Identification
IEEE	Institute of Electrical and Electronics Engineers
IT	Information Technology
LDL	Low Density Lipoprotein
NAHW	National Agency of Health and Welfare
NDR	National Diabetes Register
NFR	Non-Functional Requirement
OS	Operating System
PROM	Patient Reported Outcome Measures
RCT	Randomised Controlled Trial
SITHS	Secure IT for Health Care Personnel
SNOMED CT	Systematised Nomenclature of Medicine Clinical Terms
SoB	Support and Treatment Platform
T1D	Type I Diabetes
T2D	Type II Diabetes
UCD	User Centred Design
VGR	The Region of Västra Götaland

1

Introduction

This chapter sets the context of the study and motivates the importance of the research topic. The purpose and objectives of the study are presented, and the delimitations are declared.

1.1 Background

In 2015, the International Diabetes Federation (IDF) [1] estimated that 415 million people were living with diabetes, which corresponded to 8.8 % of the global population. This number is expected to increase to 10.4 % in the future, reaching 642 million in 2040 [1]. The rising trend is mainly related to the ageing population, but also the increase of obesity and decreased physical activity [2, p. 44].

Diabetes is a metabolic disease identified by elevated blood glucose levels. There are several different types of the condition, with two prominent ones; type I and II [3]. In short, type I diabetes (T1D) is an autoimmune condition often diagnosed at young age, whereas type II diabetes (T2D) develops gradually and is related to old age and lifestyle choices. However, reports and estimates of prevalence rarely separate the two [1], but it is believed that 90 % are T2D [1], [2, p. 4].

Due to the large number of affected people, but also the accompanying economical burden, the condition is a global concern. The IDF [1] estimated that diabetes alone accounted for 12 % of the global health expenditure in 2015. Furthermore, a study in the United Kingdom [4] reported that 80 % of its diabetes costs can be related to the associated complications, and a study in the United States [5] concluded that 43 % of their expenditures related to diabetes are due to hospitalisation. Lifestyle interventions has the possibility to prevent further onsets, and reduce progression and complications for already diagnosed T2D patients [1]. Since most diabetics are of type II, the IDF therefore concludes that lifestyle interventions would be the most effective strategy to address these issues and significantly decrease the associated costs [1].

Comparing to T1D, the management of T2D is primarily based on intangible factors such as physical activity, nutrition and psychosocial care [6]. The self-care and lifestyle interventions are important to obtain a more healthy lifestyle, but the support for patients regarding these issues have shown to be sparse as the patients normally only visit their primary care centre once per year with minimal support for the self-care in between [7]. It

has furthermore been shown that the compliance to lifestyle interventions is low, where evaluations show that only 50 % of the patients fulfil the minimum recommendations regarding physical activity [7].

The term commonly used for digital solutions in the health care is eHealth, which is an interdisciplinary field that spans over technology, medicine and social science. There is a growing body of literature [8]–[10] suggesting that eHealth may be an effective tool in supporting T2D patients in their self-care. A meta study [10] of 55 randomised controlled trials investigated the effect of telemedicine on long term blood glucose levels in diabetics. They showed that eHealth interventions was in general more effective to improve treatment outcomes for T2D patients, as compared to conventional care.

In the last years, the amount of digital tools available for the health care has increased rapidly and so also the internet access in Sweden. The access to internet at home has increased from 27 % in 2011 to 68 % in 2017 in the age group 75+ years [11]. In other age groups, the access is close to 100 % [11]. Due to the technical development in the sector, the Swedish Government has released a vision statement called *Vision for eHealth 2025* [12] which declares that Sweden should be world leading in utilising eHealth by 2025. Additionally, the Region of Västra Götaland (VGR) has set up a strategic plan to develop digital care units and services [13]. Several successful projects using eHealth have been carried out in Sweden, but mainly in the management of Chronic Obstructive Pulmonary Disease (COPD) [14], [15] and psychiatry [16]. There is thus a possibility to investigate the applicability of incorporating digital solutions in the treatment of other chronic diseases, such as T2D.

1.2 Purpose

The introduction above can be summarised by the acknowledgement of a large prevalence of T2D and an expected increase in prevalence and costs over the coming years, but also a recognised possibility to improve the treatment of T2D with eHealth solutions, as well as an existence of national and regional incentives to incorporate more technology in the health care. The purpose of the thesis project is to contribute to the understanding of how eHealth solutions can be incorporated in the primary care by studying the case of T2D in VGR. The specific research questions (RQ) to be investigated are:

RQ1: How can the management of T2D in the primary care be supported with digital solutions?

RQ2: Which technical and organisational aspects should be considered before implementation of eHealth solutions in the T2D care?

1.3 Objectives

This project aims to suggest how digital solutions may be incorporated to enhance the T2D care. To understand the current state and challenges of the T2D care, the care process is mapped from the patient's point of view. Based on the mapped care process, requirements and suggestions of an eHealth solution are presented. To conceptualise the gathered requirements, a low-fidelity digital solution is created. Additionally, a discussion

regarding the technical and organisational context in VGR will present the framework in which the proposed solution need to be adapted.

1.4 Delimitations

The thesis project is focused on the management of T2D, thus treatment aspects and management of T1D will not be covered. Furthermore, as T2D is mainly handled in the primary care, the use of eHealth solutions in the inpatient hospital care will not be covered in the project.

The project is performed together with diabetes nurses at primary care centres as well as T2D patients. However, patients are only involved in the study to a limited degree. The effect of this limitation is a partial lack of insight in the patient's needs and perceptions, factors which may be subject to an extension of the study. Another important stakeholder in the care process, the general physicians, are omitted in the development process. The reason not to include general physicians is due to their low degree of involvement in the lifestyle management in the T2D care process.

The study will use VGR as a starting point for investigating the feasibility of eHealth solutions in the T2D care, and the proposed solution will be based on findings from this area. Thus, the conclusions drawn from the study will not necessarily be general enough to represent health care organisations outside this context. Since there are regional variations in information structure and technical maturity, the aim of this project is restricted to the technical capabilities of VGR. Furthermore, discussions regarding data architecture will only consider the public care, since the technical conditions differ for each private care provider.

2

Theoretical Framework

This chapter covers diabetes related aspects intended to provide a foundation for understanding the key concepts in the thesis. The chapter also introduces some of the evidence in the literature regarding eHealth solutions in the T2D care, as well as a theoretical model that is used to analyse care processes related to chronic conditions.

2.1 Diabetes type II

In Sweden, about 430 500 individuals are estimated to have diabetes [17]. The corresponding number in VGR is 78 600, and of these are almost 68 800 registered as T2D patients. The majority of the diabetic patients in Sweden are men (57.3 %) and the average age is 68.4 years [17]. The BMI of T2D patients is on average 29.8 kg/m² [17], which can be compared to 25.4 kg/m² corresponding to the Swedish adult population in general [18]. T2D is often associated with an older population, sedentary lifestyle and poor diet, but there also exists a genetic predisposition. It is a complex disease, which is far from homogeneous. The condition and its symptoms may appear very different among the affected patients and it is not uncommon that T2D patients have more than one diagnosis to consider [19].

A T2D patient has a reduced sensitivity towards insulin [20], [21], the hormone ensuring glucose transport from the blood into the cells. Insulin is produced by β -cells in the pancreas [2, p. 2] and to compensate for the insulin insensitivity, the pancreatic β -cells increase the production of insulin. However, the increased levels of insulin can not be sustained over time and the production will at some point become insufficient [2, p. 241, 349], [21].

The insensitivity towards insulin causes the glucose to remain in the blood stream [2, p. 241, 349] and results in the characteristic elevation of blood glucose levels seen in diabetic patients. When exposed to a high level of blood glucose during a prolonged time, the blood vessels are more prone to damage [2, p. 8], [21], [22]. The effect is seen as a 15 % increased mortality, often due to vascular complications [21]. It is therefore important to keep the levels of blood glucose within normal ranges; below 6 mmol L⁻¹ before a meal and below 8 mmol L⁻¹ two hours after a meal [20].

Apart from the elevated blood glucose levels, hemoglobin in the red blood cells are irreversibly glycated when exposed to glucose in the blood. By measuring the level of glycated hemoglobin (HbA_{1c}), the long-term level of blood glucose can be determined. This mea-

surement gives an average of the levels of blood glucose during the last three months, as the time frame corresponds to the life span of red blood cells [22]. The HbA_{1c} level varies with age, among other factors, but a young and healthy person should have a value below 42 mmol mol^{-1} . A HbA_{1c} level above 70 mmol mol^{-1} on the other hand is considered high and associated with a high risk of complications, see Section 2.1.2 [23].

2.1.1 Diagnosis

A T2D diagnosis can be given if the measured HbA_{1c} is higher than 48 mmol mol^{-1} or the fasting blood glucose level is above 7 mmol L^{-1} at two different occasions. Important is also to exclude the possibility of T1D as well as other diseases [20].

2.1.2 Complications

One argument to maintain a low long-term blood glucose level is the decreased risk of complications [20]. Elevated blood glucose levels puts a strain on the blood vessels, which in turn affect vital organs in the body. On a macro-vascular level, T2D is associated with an increased risk of cardiovascular disease, such as heart attack and stroke [2, p. 8], [21]. To reduce the risk of being affected of these conditions it is important for diabetics to screen for factors related to cardiovascular disease, mainly hypertension and high blood lipid levels [21], [23].

T2D is also related to micro-vascular complications. Capillaries of specific importance are located in the nervous tissue, extremities, kidneys and retina [2, p. 8], [23]. Damaged nervous tissue can result in loss of protective sensation [2, p. 9]. In combination with damage to the small blood vessels in the extremities, diabetic ulcers can occur, especially in the feet [2, p. 125]. These are difficult to heal and may in worst case lead to amputation. To ensure that ulcers are not developed, or at least managed early in the process, status of the feet are regularly checked and foot care recommended [2, p. 10, 127], [23].

The vessels in the retina and kidneys are not only affected by high levels of blood glucose, but also by hypertension [2, p. 94, 109]. Complications in the retina include loss of sight and possibly blindness, while damaged kidneys may lead to kidney failure [2, p. 9]. Regular retinal fundus photography is therefore performed [2, p. 88] as well as measurements of the albumin in the urine, a protein that will leak into the urine if the minor vessels in the kidneys are damaged [23].

2.1.3 Treatment

The main goal of the T2D treatment is to lower the blood glucose levels, in order to prevent future complications. There are various strategies to obtain the reduction, and usually a combination of pharmaceutical and lifestyle interventions is initiated.

Pharmaceutical

The oral pharmaceutical drug Metformin is most commonly introduced upon diagnosis [20], [21]. Metformin increases the cells' sensitivity towards insulin, thereby lowering the blood glucose level [21], [23]. There is a collection of other oral anti-diabetic pharmaceuticals available as well, whose mechanisms of action are different [20].

If a more intense regime is necessary, it is possible to treat the patient with insulin [21], [23]. Insulin is most often prescribed to patients who no longer can sustain the lower levels of blood glucose with Metformin alone, a natural progression of the disease [23]. Most patients will at some point lose their ability to produce insulin themselves, but the time frame before this event is possible to prolong by good disease management [23]. One of the main incentives for postponing the requirement of insulin is the increased risk of hypoglycemic events, work load and side effects for the patient [20], [21].

Lifestyle interventions

The progression of T2D is responsive towards changes in lifestyle and may be heavily influenced by altering diet and physical activity [24], but also by cessation of smoking, reducing alcohol intake and weight-loss [21]. Exercise and diet have the possibility to increase the cells' insulin sensitivity, reduce HbA_{1c} levels, and therefore also reduce the dependency of medical treatment [20]. To obtain an effect on the glycemic levels, the patient must take on an active responsibility for the lifestyle interventions required. The patient have to learn how to independently manage nutrition and a balanced diet, how lifestyle factors affect blood glucose values, and possibly also how to address weight-loss [2, p. 359]. The lifestyle interventions required are however individual, and the interventions must therefore be adapted to the capabilities of the patient [20].

Self-care

The collective term for the above mentioned interventions is self-care, which refers to the responsibility of the chronically ill patient to care for their own health. This includes the ability to manage symptoms, treatment, physical and psychosocial consequences, and lifestyle changes inherent to living with a chronic condition [25]. It is important to note that the self-care needed is not the same for all patients and not necessarily consistent over time. Riegel et al. [26] have proposed to separate the self-care into three stages seen in Figure 2.1; self-care maintenance, self-care monitoring, and self-care management.

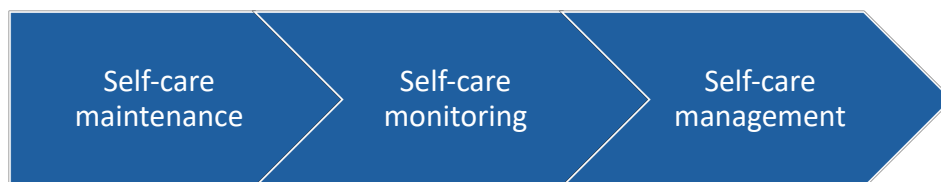


Figure 2.1: The three stages of self-care as described by Riegel et al. [26].

Self-care maintenance corresponds to the behaviour ensuring physical stability, and may be self-determined or agreed upon with the health care provider and based on evidence-based guidelines. Self-care monitoring is defined as the process of systematic body monitoring, where clinically significant changes are possible to detect and a reasonable action is available in response. On the highest level is self-care management, which refers to the patient's ability to independently evaluate physical and emotional changes, and thereby determining appropriate actions [26]. At this level, the patient is empowered to take on an active responsibility for their self-care. The patient's ability to make informed decisions is a desired state in the self-care, and is enhanced by promoting the advancement from self-care maintenance to self-care management [26].

2.1.4 National guidelines

The National Agency of Health and Welfare (NAHW) is responsible for the national guidelines of diabetic care in Sweden. The guidelines includes 135 recommendations, based on clinical evidence, that are intended to help the health care prioritise their work and financial resources, to increase the quality of care for all diabetics in Sweden [23]. According to the national guidelines [23], all T2D patients should be offered an annual visit to a physician at the primary care centre, as well as a visit to the primary care centre's diabetes nurse once each year. The main goal of the visits are to ensure a sufficient treatment regime, maintenance of a good glycemic control and vascular health, and to prevent complications. Whenever possible, the national guidelines also contain target levels for T2D. One such target value is a $\text{HbA}_{1c} < 52 \text{ mmol mol}^{-1}$ [23], a level which about 52 % of T2D patients in Sweden fulfilled in 2017 [17].

All regions in Sweden are responsible for incorporating the recommendations into their clinics, and to assist in this work VGR has formulated its own regional guidelines [20]. However, to ensure that the measurements are done in accordance with the guidelines, the region has also formed a financial incentive. By registering blood pressure, HbA_{1c} , LDL-cholesterol, microalbuminuria and smoking habits in the National Diabetes Register (NDR) annually, primary care centres will be financially reimbursed [27].

2.2 eHealth and diabetes type II

As described in Chapter 1, eHealth has been suggested to be a possible tool in the T2D care. This section presents some of the clinical evidence seen in the literature.

2.2.1 Clinical impact of eHealth solutions

One of the critical factors in T2D treatment is the need of self-care. Even though this is acknowledged by the health care, there is still a lack in the potential of educating and motivating patients enough to undertake an active role in the care [7]. Several studies [28]–[30] have suggested that eHealth solutions can be used to meet this gap in the T2D care. Quinn et al. [28] performed a randomised controlled trial (RCT) to test the clinical outcome of using a mobile device with a self-care coaching application in the T2D treatment at 26 different primary care centres. The intervention resulted in a $1.9\%^1$ reduction in HbA_{1c} , compared to 0.7% in the control group which received usual care. A similar trend was shown by Noh et al. [29], whose RCT including 40 patients over a 7-month period indicated that a web based educational program reduced the HbA_{1c} levels with 1.53% . As mentioned in Section 1.1, Su et al. [10] performed a meta analysis of 55 RCTs investigating the clinical effect of implementing an eHealth solution. Their results showed that T2D management supported with eHealth, especially teleconsultations, reduces the HbA_{1c} levels significantly. Apart from reduced HbA_{1c} values, Chomutare et al. [30] observed that eHealth solutions have been shown to be an useful tool for increasing quality of life for T2D patients.

¹One percentage corresponds to 11 mmol mol^{-1} .

2.2.2 Behavioural science and diabetes management

There is a growing body of literature [31]–[34] attempting to use behavioural science to understand the cognitive factors behind adherence to lifestyle interventions, an essential part of T2D management and its related eHealth solutions. One of the most commonly used behavioural models in eHealth literature is the social cognitive theory [34]. The theory aims to form an active and engaged patient by increasing self-efficacy, which is the self-perceived ability to successfully change behaviour under given circumstances. Increased self-efficacy has been shown effective to promote self-care behaviour and decrease HbA_{1c} levels among T2D patients [24].

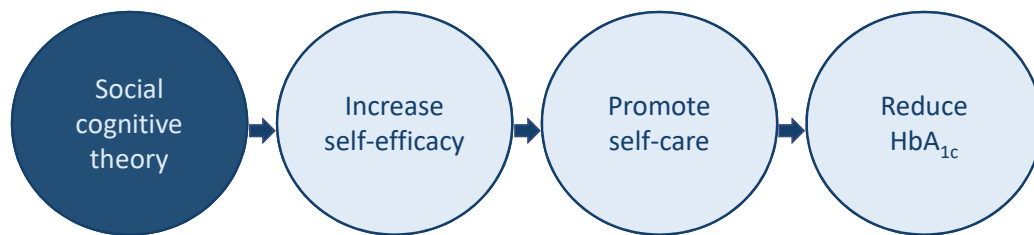


Figure 2.2: The anticipated effects of using social cognitive theory elements in eHealth solutions for T2D.

Some of the common features in eHealth solutions that deliberately incorporate social cognitive theory factors are self-monitoring, goal setting, and social support features [32]. Self-monitoring has been observed to be the most frequently incorporated health behaviour theory construct [34], and the effectiveness of self-monitoring is suggested to be its possibility to highlight problematic actions, and thereof make the patient more prone to change [33]. Self-monitoring has also been shown to build confidence to meet diet and activity goals [33]. The importance of goal setting is consistent with the impact of reinforcements on personal efforts, and has been proven effective to engage patients in lifestyle interventions [33]. Furthermore, reinforcements via social support may be incorporated by enabling the patient to share data with peers or facilitating communication with health care personnel [34].

When analysing studies implementing eHealth to support self-care of T2D, a considerable variability among the included functions can be observed. Chomutare et al. [30] performed a comparison of eHealth tools available commercially and interventions proven useful in evidence based guidelines. The most common features observed in the studied eHealth solutions were insulin and medication recording, present in 65 % of the investigated tools. Other common features were data exportation and communication, diet recording, and weight management. When comparing the observed features with variables manifested in clinical guidelines, it was noted that education and personalised feedback was absent in most applications, despite being considered as some of the most prominent factors in successful diabetes management [30].

2.2.3 Diabetes education

Although there is an observed shortage of available solutions with incorporated educational elements [30], studies have shown that eHealth can be used to facilitate the diabetes

education for patients. In 2014, Pereira et al. [35] published a review of 14 eHealth based T2D educational programs, which suggested that diabetes education over the internet can be an effective tool to increase glycemic control and diabetes knowledge among T2D patients. All of the studied interventions included a web based education program, where the program in some cases also were available on a smartphone. The degree of adaptability according to patients' needs varied between the studies, but a majority of the interventions included a nurse communication function. In all of the studies, the web based intervention was proven more effective compared with a control group receiving usual care [35]. However, it was found that communication with health care personnel was an important success factor as well as the most appreciated benefit of the web based programs [35].

One of the RCT studies [36] included in the review by Pereira et al. [35] evaluated the effectiveness of two educational programs, one delivered over the internet and one in printed format, as compared to a control group receiving usual T2D care. The intervention groups received an educational program and an individually designed exercise program based on a physical test. After 12 weeks, both intervention groups had increased their physical activity and decreased their HbA_{1c} significantly compared to the control group, although no significant differences were found between the printed and web based format. The appreciated features in the web based program was the promptness of feedback, personalised information, and the availability of updated results [36].

2.2.4 Similar research projects

A study in Sweden [37] has investigated which services should be provided by an eHealth solution for T2D. In the study, five T2D patients were invited to three workshops where they expressed their challenges in the self-care of T2D, and their wishes and needs of an eHealth solution. The most prominent challenge was *Acceptance of diagnosis*, as the study participants had perceived it difficult to accept their new life situation. Acceptance made it easier to follow recommendations and develop adequate self-care skills. To facilitate the acceptance of the T2D diagnosis, an eHealth solution was suggested to include communication possibilities, both with health care personnel and other T2D patients. Furthermore, the information provided in the solution should be individualised according to patient prerequisites to make it easier to understand [37]. The same research group has published a related study [38], where it was concluded that the need of support for T2D patients varies during different phases of the disease. As newly diagnosed, the main focus is to accept the diagnosis and develop self-care skills while patients with a longer diabetes duration have more issues with complications and medication management [38].

Another Swedish multidisciplinary research group is performing a study on a web based educational program to promote health behaviour among T2D patients [39]. The solution aims to increase self-efficacy by providing daily thought-provoking questions which will facilitate self-reflection, and thereby improve the motivation for health behaviour change among the patients [40]. The aim is to provide an individualised care adapted to the patients' prerequisites. The study was initiated in 2015 and includes over 10 000 diabetic and non-diabetic study participants [39]. At present, no results have been published.

A research group in Norway have attempted to establish an educational eHealth program to increase self-care motivation for T2D patients [41]. The program was based on behavioural science models, and consisted of four parts where each part addressed different aspects

of self-care. In the program, patients were encouraged to make written reflections about how they perceived different aspects of their life with diabetes, and they also received consultations from health care personnel. The participating patients expressed that the written reflections were valuable to create space and time to reflect upon diabetes self-care in their everyday life. The dropout rate was however a problem in the study, as many of the participants did not maintain the motivation to fulfil the intervention due to technical issues and a lack of face-to-face encounters with health care personnel [42].

2.3 Chronic care model

There are several theoretical models available to describe and organise the care process of chronic diseases. Each model highlights different aspects of the care that are important for the patient's health outcome. Shared attributes of many models are the importance of self-care and close collaborations between patient and care provider. The most commonly used model in the T2D care is the Chronic Care Model (CCM) [43].

The CCM was formed by Wagner et al. in 1996 [44] and has been updated since [45]. The original article [44] states that there is a mismatch between the needs of chronically ill patients and system deliveries, as the care system is primarily designed to handle acute illness [45]. The CCM is an attempt to summarise the clinical evidence for how to create a care that is proactive and patient-centred, by highlighting six different aspects of the care system [43], [46]. The components in the model are diverse but interrelated, therefore improvements in one component usually produce improvements in other components as well [45]. As its ultimate goal, the CCM creates active patients with a high self-efficacy who meet a prepared care team [44]. The result is high quality encounters and improved clinical outcomes [45].

The value of utilising the CCM in organisational development of the health care has been evaluated at several occasions, and studies [46], [47] have assessed its effect on diabetic care in primary care centres. Strickland et al. [46] found that using the CCM to some extent improves the T2D care, seen by how often physiological parameters were measured and treatment adjusted accordingly. They also pointed out that clinics which have incorporated CCM are more open to innovation, and more likely to provide guidance regarding physical activity [46].

Below follows a description of each CCM component and what part of the health care process they address.

A. Health care organisation

To create an environment where organisation and re-organisation is possible it is important to have support from managers of the health care system and the clinic. By introducing organisational goals and incentives that prioritises chronic care, any barriers related to innovation and changes can be reduced [45].

B. Clinical information system

The clinical information system is important as it allows for a systematic way of organising information regarding patients. In this context, it often refers to a computerised medical record. Information systems are also useful for creating reminders, alerts, bookings and other key administrative tasks related to the chronic care of patients [43], [46].

C. Decision support

The decision support ensures that the care given is of high quality. This can be done by integrating scientifically proven guidelines and recommendations into the daily practice and routines, and keeping the organisation up to date about changes. But, quality and support for decision making can also be achieved by having access to consultations with specialists [43], [45].

D. Delivery system design

To create a patient-centred care with a seamless flow through the system there should be a well-planned and recognised design of the process and its intended services. The planned process should acknowledge the responsible actors, both regarding communicative tasks, data collection and interpretation [43], [46], [48], [49]. This component also include coordination around planned visits for the patients, such as phone calls and letters [43].

E. Self-management support

One of the main goals with the care of chronically ill is for the patient to be well-educated and have a good set of skills regarding the condition [48]. It has been shown that a good understanding and a feeling of control regarding the condition increases the patient's quality of life and allows for better use of the health care system [46]. To promote patient empowerment, a personalised decision support system has to be built. This can be done by education, by setting and working towards goals with a structured action plan, but also by giving feedback and providing necessary tools or supportive resources [43], [45], [49].

F. Community resources

The final component addressed in the CCM is the importance of utilising community resources whenever possible. By building a relation to the community outside the regular care, the patient can gain social support and reduce some load from the health care organisation itself. Community resources could include offers such as health programs and support groups, but also the possibility of involving relatives in the care [43], [45].

2.3.1 eHealth enhanced Chronic care model

Due to technological advancements there is a drive towards including more information and communication technology (ICT) services in the CCM model's components, particularly since many eHealth solutions suits the patient-centred care that the CCM emphasises [48], [50]. To highlight the possibilities of eHealth and increase the ease of implementation in the health care, Gee et al. [48] formed the eHealth enhanced CCM (eCCM) in 2015. A visualisation of the model can be seen in Figure 2.3. The model utilises the already recognised CCM and merges it with the concept of technology implementations.

The enhancements in *A. Health care organisation* include strategic plans to incorporate technology into the organisations. The *B. Clinical information system*, which is already an ICT system, should be supported with patient portals, possibly through mobile devices.

Developments of the *C. Decision support* includes improving the visualisation of data and giving access to protocols and guidelines at the right occasions, but also providing alerts and reminders. The enhancements in *D. Delivery system design* include interoperability aspects and a feasible patient-provider communication portal system. The *E. Self-management support* involves monitoring or communication tools which can be used to keep track of data and involve patients in their treatment plan, as well as engaging into action. Finally, the *F. Community resources* in the CCM should, according to the eCCM, also include online communities and support groups [48].

The eCCM also includes two additional elements, the components *G. Feedback loop* and *H. eHealth education* [48]. If eHealth is to be implemented and offered to patients it is important that they receive the right education and knowledge to utilise these tools appropriately. Therefore, eHealth education is considered an important aspect when implementing digital solutions in the health care [48]. The final addition in the eCCM is the complete feedback loop between care takers, providers and systems. A feedback loop ensures that data is collected, transmitted, interpreted and addressed according to established standards, but also that the care process is personalised and communicated to the patient. The result of such a loop is better health outcomes and interactions [48].

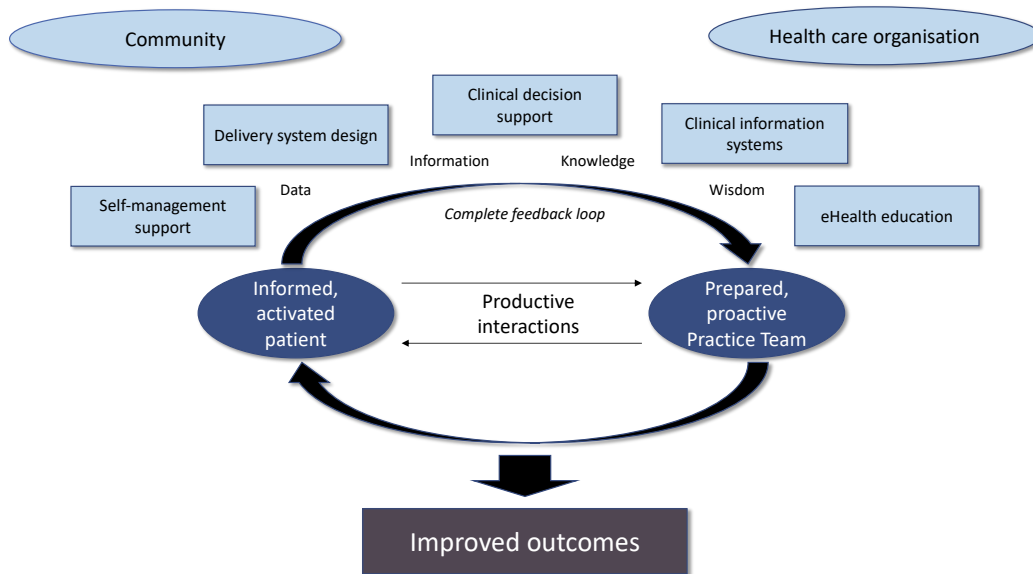


Figure 2.3: The eHealth enhanced chronic care model. Simplified version of Gee et al. [48], reprinted with permission via license CC BY 2.0.

3

Methods

This chapter describes how the study was performed and the methods used throughout the project. The research process is described, and the data collection methods are presented. Lastly, a discussion regarding the methodological and ethical considerations is held.

During the project, a collaboration with four primary care centres in both the public and private care sector within VGR was carried out. The collaboration was used to map the present T2D care process and its objectives, as well as to establish requirements for an eHealth solution in the T2D care. T2D patients were also interviewed to capture their perception of the present care. Based on the findings from the literature and the interviews, a suggestion of an eHealth concept was proposed.

3.1 Research process

The project was divided into three main phases, which can be seen in Figure 3.1. However, there are no clear borders between the different phases, and they do overlap to some extent.

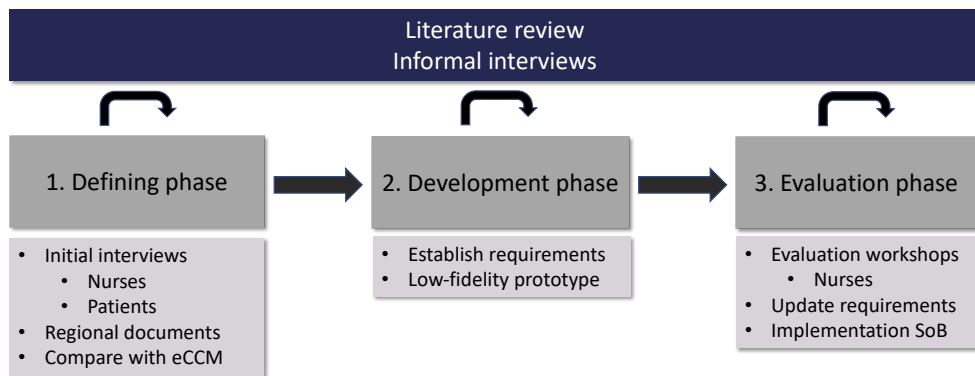


Figure 3.1: Overview of the research process.

During the initial defining phase, an exploratory research strategy was performed to gather an understanding of VGR and the area of eHealth. Interviews with diabetes nurses as well as T2D patients were also conducted during this phase to learn about T2D and its

associated care. The focus was to map the present diabetes care process and to explore the feasibility of eHealth solutions in the VGR context. The data acquired from the interviews was analysed with the eCCM, which provided a framework for how to incorporate clinical evidence from the literature in practice.

After having obtained an understanding of the current state of the T2D care process, the aim of the second phase was to identify factors which make patients not adhere to their treatment, and how to promote them to reach the state of self-care management. Additionally, the functional and non-functional requirements for an eHealth solution was established, which were used to produce a low-fidelity prototype of an eHealth concept.

In the third phase, the developed prototype was evaluated in a workshop and the nurses were again consulted to share their perception of the suggested requirements and prototype. The comments collected during the workshop was used to refine the requirements, although the prototype remained unchanged. The updated requirements were also compared with the functionality of the Swedish national Support and Treatment platform (SoB) to explore its feasibility in the T2D care.

During the entire project, the literature was reviewed to put the observed data in a theoretical context. Furthermore, personnel within health care and IT at VGR were interviewed in informal settings to take part of their respective expertise.

3.2 User centred design

The design process was inspired by the method of User Centred Design (UCD). The concept of UCD was first described by Norman et al. in 1986 [51] and has since then become a widely accepted method in product development [52]. The method emphasises the role of the user, from the initial research to evaluation of the developed product. However, UCD is not about asking the users what they want, but an UCD practitioner should instead profile its user and understand its needs before forming the initial prototype, and then continuously evaluate the proposed solutions in collaboration with the users [53]. In this project, the profiling has been performed in various but complementary ways to capture the many aspects of diabetes care management.

The two main stakeholders in the project are T2D patients and diabetes nurses in the primary care. The developed eHealth solution has been formed with the patient as the intended user and the diabetes nurse as the intended owner of the product. The suggested solution must thus be adapted to the present care process, and fill a clear function from the nurse's point of view.

3.2.1 Process mapping

To capture the behaviour of the users, the diabetes care process was mapped based on interviews with diabetes nurses and guidelines from the NBHW in Sweden. Process mapping may be performed by a number of different methods, but the method described by Rentzhog [54, p. 42] was used in the project as it was recommended by researchers at the "Center for Health care Improvement" department at Chalmers University of Technology. In the method, the process flow is decomposed to its logically related components to gain an

understanding of the system [54, p. 42]. The method thereafter emphasises the importance of defining the core processes of the organisation and questioning whether the defined processes provide end value to the consumer, in this case the patient.

An initial care process map was developed based on national guidelines before the first interview with the nurses. The interview guide can be seen in Appendix A. Thereafter, the collected data was used to sketch the average diabetes care process on the studied care centres. By compiling the results from the two approaches, the final care process map was developed. For visualising the process, a swim lane activity diagram and American National Standards Institute (ANSI) standard was used [54, p. 117].

3.2.2 Personas

To understand the stakeholders of the developed solution, two personas were created. A persona is a narrative user profile developed based on representative information of the intended user. The function of the persona is to establish an understanding of the typical user early in the development process [55]. The personas developed should aim at representing user archetypes, by the means of demographics, health, and technical proficiency [56, p. 360]. According to Junior & Filgueiras [55], the persona should furthermore focus on the actions of the users and what the users find frustrating, rather than defining what the users want. By using personas, the developer can avoid the pitfall of focusing on extreme users [55].

The developed personas were based on interviews with diabetes nurses and patients, as well as statistics from the NDR in Sweden [17]. During the interviews with the nurses, specific questions were asked about the patient's perceptions of the care. The goal was to identify areas which were seen as problematic for the patients. The gathered data was thereafter combined with the literature to form a persona aiming at characterising a typical T2D patient in the intended target group. Moreover, a persona was also created for the diabetes nurse, based on the results from the corresponding interviews.

3.2.3 Establishing requirements

In traditional software engineering, two types of requirements are considered; functional and non-functional [56, p. 356]. The functional requirements define what the system should do and which purpose it should fulfil [56, p. 357]. It serves as a basis for developing an eHealth solution by defining the functionality offered by the product. In this project, the functional requirements are based on a number of contextual challenges in the T2D care. The challenges are identified using process mapping and the eCCM, where the two methods are used to analyse gathered data in a theoretical framework. The conclusions from the analysis provide an understanding of the intended users and their needs, which serves as a basis for what the solution should deliver. The non-functional requirements, on the other hand, state the constraints on the system and its development [56, p. 357]. The non-functional requirements were investigated by studying regional documents and having informal discussions with personnel within IT at VGR to understand the organisational and technical framework in which the developed solution has to be adapted.

3.2.4 Prototype development

The purpose of a prototype is to provide a tool which can be used as a basis for communication with stakeholders. A prototype is useful when aiming to clarify vague requirements and establish a common understanding of the problem [56, p. 391]. In the present study, the purpose of the constructed prototype was to conceptualise the requirements of how an eHealth solution could support the T2D care.

In product development processes, the procedure of low- and high-fidelity prototyping is usually distinguished [56, p. 391]. A low-fidelity prototype does not look like the final product, but serves as a visualisation of the idea. It is supposed to encourage exploration and modification of the developed product [56, p. 392]. In this project, the low-fidelity prototype was made out of paper to enable easy modification during the development process, and support communication during the evaluation workshop. In contrast, a high-fidelity prototype produces a prototype which appears more like the final product. It can be used for selling ideas to the final customer, but has the disadvantage of not being as flexible as the low-fidelity prototype [56, p. 392]. A high-fidelity prototype was assembled in SoB to evaluate if the platform fulfilled the posed requirements.

3.2.5 Evaluation workshop

The developed concept was evaluated using a low-fidelity paper prototype in a workshop together with the previously interviewed diabetes nurses, using a method for heuristic evaluation inspired by Sharp et al. [56, p. 512]. The purpose of the evaluation workshop was to assess the applicability of the developed concept and confirm the correctness of the captured requirements. The interview guide for the evaluation workshop can be found in Appendix B. The session began by a short briefing of the low-fidelity prototype and the intended eHealth concept. The nurse was thereafter given a set of tasks to perform in order to give a sense of the intended features, both from the patient's and the nurse's point of view. Afterwards, the nurse was asked about their perceptions of the functions and its feasibility in the present care process. The functional requirements used to create the product was presented and discussed at the end of the interview.

3.3 Data collection methods

In the project, multiple data collection methods have been utilised. A literature search was conducted to obtain an initial understanding of the field of eHealth. To acquire a practical perspective, empirical data was gathered by studying regional documents and conducting interviews with patients and employees in the primary care. The following sections describe how the data was collected.

3.3.1 Literature search

A literature review of the field was performed to obtain an overview of the research area. As pointed out by Bryman & Bell [57, p. 9], the initial literature study serves the purpose of positioning the conducted study in the context of previous research. Therefore, special focus was put on the concepts and theories that has been applied to the field of eHealth and chronic diseases and the research strategies used in similar studies.

Literature on the topic of diabetes and eHealth was mainly obtained by scientific articles and books. The literature was gathered using the databases Scopus, Summon and Google Scholar. The databases were searched using the keywords “diabetes eHealth”, “diabetes type II treatment”, “diabetes type II self-care”, “diabetes education”, “chronic care eHealth”, and similar. Abstracts and conclusions of the articles were first read to assess the relevance of the article in the research project before the full article was read. The books were primarily accessed through the library of Gothenburg University and Chalmers University of Technology.

3.3.2 Interviews

Interviews at the participating primary care centres were conducted with five primary care nurses, specialised in diabetes care. The diabetes nurses were all working part-time in four different primary care centres in VGR, either in private or public centres. Table 3.1 shows a summary of the interviewees.

Table 3.1: Information about the interviewees, their care unit and involvement in the study. For comparison of care centre size, patients are reported as number of diabetes patients per full-time employment.

Primary care centre	Management	T2D patients	Diabetes nurse	Defining phase	Evaluation phase
1	Public	520	A	✓	✓
2	Private	620	B	✓	✓
			C	✓	✓
3	Private	1030	D	✓	
4	Public	720	E	✓	✓

The interviews were performed in a semi-structured format. A template of topics to cover and possible questions to ask was formed, and used during the interviews. However, the interviewees were free to talk about the intended subject in their preferred order, a method described by Trost [58, p. 55]. Using the semi-structured format, the interviewer has the possibility of guiding the conversation in the preferred direction, but does also allow for elaboration where the interviewee has relevant experience [59]. All of the interviews were conducted with one diabetes nurse at the time, except the interview with the diabetes nurses at primary care centre 2, which was held in pair. The interview guide for the nurses is found in Appendix A.

The interviews were conducted through personal meetings at the interviewee’s office. The interviews were held in Swedish, and were recorded and transcribed in order to verify statements and avoid misunderstandings in retrospect. About one hour was dedicated to each interview and the interviewees were reminded about the intention of the project before starting. During the interview, one interviewer had the responsibility of interviewing while the second managed recording and took extra notes when necessary. However, both researchers had the possibility of asking follow up questions and additional probing questions.

To obtain an understanding of the patient’s perceptions of the diabetes care process and

their experiences of self-care, five patients were interviewed over the telephone. The interviewees were recruited via the Diabetes association in Gothenburg, but some were residents in other regions. Table 3.2 shows an overview of the interviewed patients, and the interview guide can be seen in Appendix C. All patients were younger than 65 years and prescribed the oral pharmaceutical Metformin (see Section 2.1.3). Similar as in the interviews with the primary care centres, the semi-structured format was considered appropriate to allow the interviewees to freely elaborate on the posed questions, but the interview guide was used to moderate the conversation in the intended direction.

Table 3.2: Information about the interviewed patients, including gender, diabetes duration, and region of residence.

Patient	Gender	Diabetes duration [years]	Residence
1	Male	<1	VGR
2	Male	1.5	VGR
3	Male	<1	Stockholm County
4	Male	2	VGR
5	Female	<1	Region Uppsala

Apart from the semi-structured interviews mentioned above, personnel within health care and IT at VGR were consulted to share their knowledge of the region and the health care performed. To obtain an understanding of how the process of implementing eHealth in the health care may be achieved, examples of previously implemented solutions in the region were identified and the responsible actor was interviewed in an informal setting.

3.4 Methodological considerations

During the thesis project, a qualitative research strategy was used. The qualitative research strategy was considered appropriate since the aim of the study was to obtain a deep and nuanced understanding of the requirements of an eHealth solution directed towards T2D patients. Yet, a risk with conducting qualitative studies is that objectivity cannot be guaranteed [58, p. 134]. Using interviews as the primary data collection method, the results depend on the interviewee's perceptions of the diabetes care process and the questions raised in the interview. Although objectivity was strived for, the content of the interviews were partly influenced by the interviewees responses as follow up and clarifying questions were posed by the authors. Thus, conducting interviews with the same interview guide may produce a different result in another setting. The effect of the subjectivity was minimised by comparing the interview statements with national guidelines for managing diabetes.

In the project, only a small number of diabetes nurses and patients were interviewed. Ideally, the data collection should be finalised when redundancy has been reached [58, p. 144], but this was not possible in the thesis project as it was found difficult to get in contact with primary care centres and T2D patients. However, the answers from the interviewees did converge and they all agreed on the central points which indicates that the small population may be enough for the purpose of the study.

In the process of conducting qualitative research, the factors credibility, transferability, dependability and confirmability should be assessed [57, p. 400]. Together, they can be

used to evaluate the trustworthiness of the study. One method to ensure the credibility of the study is to use multiple data sources in the process of triangulation [57, p. 402]. Triangulation was performed using interviews as well as national guidelines to map the diabetes care process. Moreover, as the study was executed in VGR, the transferability of the findings was not the main scope of the project. But as most guidelines concerning diabetes care are general in Sweden, the findings may be of interest in other regions in the country. Regarding dependability, the aim has been to write the methods chapter in a way that enables replication of the conducted study, including the literature review, interviews and prototype development. Finally, confirmability has been strived for as personal values and perceptions regarding the findings have been aimed to be kept minimal.

3.5 Ethical considerations

When performing qualitative studies, there are a number of ethical aspects to consider. The main aspect is to protect the study participants and the data they have provided. This consideration can be grouped into two major areas; whether there is harm to participants or lack of informed consent [57, p. 134]. The integrity of the participants has been ensured by avoiding direct quotation and referencing that may allow identification, thus avoiding potential harm caused by the shared information. Furthermore, the interviewees participated on a voluntarily basis. They were informed about the purpose of the study and the publication of the thesis prior to the interview, and they were allowed to cancel the interview at any point without giving an explanation.

Extra caution must be taken when handling medical data. During the project, no primary patient data has been handled and the information provided from the interviewees are presented in a generalised manner, thus not allowing for identification of individuals.

4

Organisational context

This chapter describes the context to which an eHealth solution should be adopted when implemented in the Swedish health care, with focus on VGR. The chapter also includes two examples of eHealth solutions that are currently used in the region.

4.1 The health care system in Sweden

In Sweden, the health care system is governed in three levels; national, regional, and municipal [60], as seen in Figure 4.1. On a national level, the government is responsible for setting the overall political agenda, and the authorities are responsible for formulating national guidelines and evaluating the health care. The regions organise the health care to ensure that all inhabitants have access to care of high quality, and manages the health care centres within the region. There are 20 regions in Sweden, and each region has the freedom of adapting the care according to the local conditions. The municipalities are mainly responsible for the care of elderly and care outside health care centres.

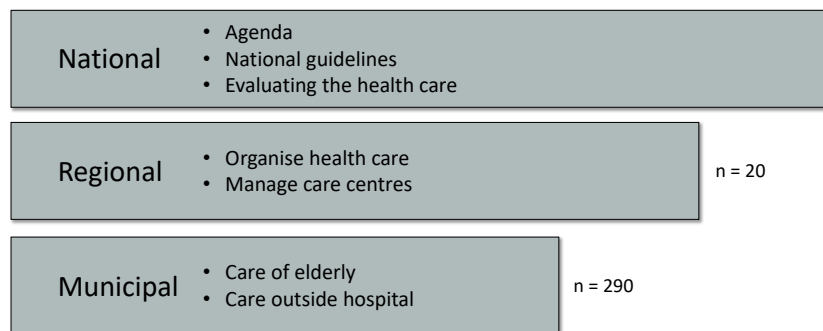


Figure 4.1: Different actors and their responsibilities in the health care system in Sweden. The number n of regions and municipalities are indicated to the right of the box.

The health care is primarily financed through regional and municipal taxes (70%). The rest is due to government subsidies (21%), other sources (6%) and a small amount (3%) from patient fees [60]. The care is performed by both public and private providers, where the private care providers are mainly found in the primary care. Most private care providers have an agreement with the region that grants them the same reimbursement as public care centres. This reimbursement is divided into a fixed and an adjustable part, where the adjustable part is supposed to even out for demographic differences and premier for meeting national requirements.

4.1.1 Vision for eHealth 2025

The government in Sweden has set up a strategic plan called *Vision for eHealth 2025* which states that Sweden should be world leading in utilising digital solutions in the health care by 2025 [12]. The purpose of the vision is to support optimal exploitation of the available resources in the health care. The aim is to obtain an effective health care of high quality, equal for all inhabitants in Sweden. The term digitalisation in the vision refers to information digitalisation, where analogue information is transferred into a digital format, and the digitalisation of society, which refers to the transformation process of the society where ICT is fully integrated. To realise the vision, many stakeholders must cooperate. The regions and the municipalities have the responsibility of realising the vision on an operational level, which includes planning, financing, and implementing the vision, whereas the government have responsibilities of legislation and supervision.

4.2 The Region of Västra Götaland

VGR is the second largest region in Sweden with approximately 1.6 million inhabitants. The regional government has responsibilities of the local traffic in the region, the cultural life, regional development, and the health care, which is the largest department [61]. The health care government of VGR is divided into a political and a civil servant organisation (Figure 4.2), where the political organisation has responsibilities of making decisions about how the health care should be performed to fulfil the needs of the inhabitants. The civil servant organisation receives the decisions from the political organisation and coordinates the care units to ensure that the decisions are performed in an adequate manner. The care units deliver care to the inhabitants of VGR.

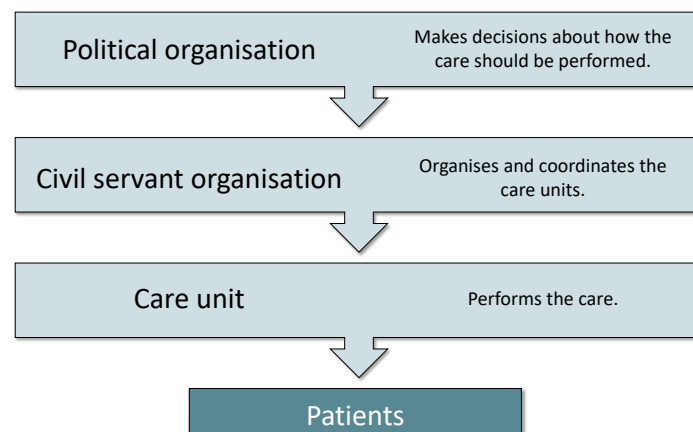


Figure 4.2: The regional organisation of VGR.

4.2.1 Vision

VGR's vision *The good life* describes the long term goal of the regional development and includes five focus areas which captures the wide set of responsibilities of the regional government; a sustainable business environment, leading competence development, an infrastructure of high standard, a leading culture region, and a good health [62]. To reach the goal of a good health, VGR has formulated a health care strategy called *The transition* ("Omställningen"). The objective of the strategy is to meet the needs of the patients and use the available resources effectively. The strategy has four elements, and one of them

is to promote digital care services in accordance with *Vision for eHealth 2025*. The work includes developing new digital care services as well as to implement available solutions, and some of the dedicated focus areas include digital care visits and internet based support and treatment [63]. The strategy is realised through annual action plans as well as continuous evaluations [13].

4.3 Interoperability

A foundation for digital collaboration is interoperability, which is the property of a system that enables communication with other systems [64]. This is usually obtained by formulating standards which the participating actors commits to follow. Interoperability can be divided into four levels; juridical, organisational, semantic and technical interoperability [65]. The list should be read from top to bottom, as each level sets the boundaries for the level beneath. In the following sections, interoperability aspects are elaborated from a Swedish eHealth perspective.

Juridical interoperability

The juridical interoperability regulates the storage, exchange and structure of medical documentation [65]. In Sweden, the parliament's legislation, the government's regulations, and the department's directives define the juridical interoperability on a national level. Furthermore, the European Union (EU) has set up a framework to support and regulate the exchange of medical information within and between countries. Table 4.1 summarises some of the laws, regulations and directives that are of importance for eHealth solutions.

Table 4.1: Juridical framework concerning medical devices in Sweden.

Type	Responsible	Name	Comment
Law	The Swedish Parliament	The Health and Medical Service Act (1982:763) [66]	Dictates how the health care should be performed in Sweden.
	The Swedish Parliament	The Patient Data Act (2008:355) [67]	Regulates the care givers handling of personal data in the health care.
Regulation	NBHW	HSLF-FS (2016:40) [68]	Regulations on how to keep EHRs, such as the information security required, the structure, and whom are given access to patient data.
	EU	General Data Protection Regulation [69]	Regulates data privacy and protection for individual citizens in the EU.
Directive	EU	Medical Devices Directive [70]	Harmonises the laws concerning medical devices in the EU, and defines the manufacturer's responsibility for medical products.

Organisational interoperability

Interoperability on an organisational level is concerned with aligning operational goals and incentives to ensure that collaborators are coordinated. Moreover, to obtain organisational interoperability, organisations should establish a common method of communicating their

requirements to enable collaboration over organisational borders [64]. As an overall goal, the NBHW in Sweden has stated that all health care should be accessible, equal and patient centred [71]. This goal thus provides guidance in the development of health care and defines the overall framework. Specific to eHealth, *Vision for eHealth 2025* [12] establishes a common vision of the technological development in the health care sector.

Semantic interoperability

To enable exchange of information between organisations, it is essential that the organisations interpret the information alike. Semantic interoperability defines terminology standards for exchanging information between systems, in order to combine information from different sources and process it in a meaningful manner [64].

There are various national and international projects aiming to form semantic standards in the health care. The NBHW publishes the report *National Information Structure* [65] each year, which serves as a reference for a common health care nomenclature in Sweden. Much of the content is based on the international standard SNOMED CT (Systematised Nomenclature of Medicine Clinical Terms) [72] which provide a structure for a systematised representation of medical terminology, including all areas of clinical information such as diagnoses, treatment methods, and medicines [72].

Technical interoperability

The technical dimension of interoperability covers the technical issues of connecting different computer systems together. The technical interoperability is a prerequisite for the information architecture, and includes key aspects such as open application interfaces, data integration and security services [64].

There are a number of international organisations aiming to develop common technical standards for data exchange in clinical information systems. HL7 (Health Level Seven International) is an organisation and a set of standards concerning exchanging and developing electronic health records (EHR) [73]. The standards include, but are not limited to, formats for messaging and data exchange, decision support, and common health data definitions in clinical documents. Two of the main HL7 standards are HL7 version 2 and FHIR (Fast Health care Interoperability Resources). HL7 version 2 is a database query language which provides a messaging standard for exchange of patient care and clinical information [73]. FHIR describes data resources and an API (application programming interface) for exchanging EHRs. The API technology enables developers to provide medical applications which may be integrated into existing clinical information systems [74].

For health and fitness devices, the international association Continua develops the design principles for data exchange. The principles are based on existing standards from HL7 and IEEE (Institute of Electrical and Electronics Engineers) but are adapted to clinical information systems that will interoperate over wired and wireless local area and wide area networks with sensors, gateways, and EHRs from a broad range of manufacturers [75]. The patient reported data from health and fitness devices are classified as PROM (Patient Reported Outcome Measure) data. The data is first regarded as clinical information after the care provider has reported it into the EHR.

4.4 IT governance in the Swedish health care

The digitalisation of health care in Sweden is coordinated and developed on a national level by Inera, which is a company owned by the regions and municipalities in Sweden. The stakeholders in the IT governance are many, as the data architecture shall meet the requirements from patients, health care personnel, authorities, researchers and external vendors. Inera therefore has the responsibility of overseeing the requests from the stakeholders, and aligning them into the national information structure. Apart from the national coordination, each region has its own IT organisation responsible for managing the operational data infrastructure, including clinical information systems [76].

4.4.1 National data architecture

The national data architecture managed by Inera can be seen on a schematic level in Figure 4.3. In the centre of the data architecture is the National Service Platform. The platform is a virtual service (Enterprise Service Bus) to which IT systems in the health care are connected, thereby facilitating information exchange. Instead of being connected directly to other IT systems, each system ensures connection to the National Service Platform which serves as a mediator. The platform is under constant development and based on international semantic and technology standards such as SNOMED, HL7 version 2 and FHIR [77].

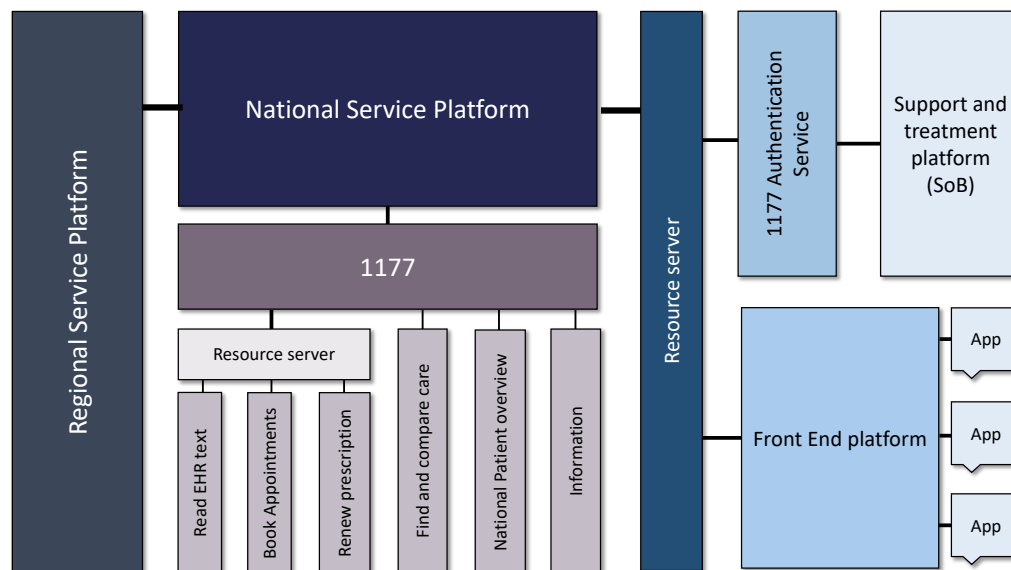


Figure 4.3: National data architecture. Adapted from [78].

Many of the available services are accessed by patients through 1177 (1177 Vårdguiden), which is a health care platform available in all regions of Sweden. 1177 is divided into open and closed pages, where the open pages consist of general information about medical conditions, health care legislation, and where to find care units. The closed pages, on the other hand, provide a secure communication channel between the patient and the care provider. Among the e-services accessed via the closed pages of 1177 are appointments booking at the care centre and renewal of medical prescriptions. If the care provider is compliant with the service, the patient is also able to read EHR text via 1177. The portal has been shown successful and in May 2017, two million users logged in to manage their

health care contacts, where it can be noted that 68% of the sessions were on a smart phone or tablet [79].

To protect patient data but allow for information exchange between the care giver and external patient directed applications, there is a resource server connected to the National Service Platform. The resource server acts as a gatekeeper to accept or decline the access of data using specific access tokens. The connection between external applications and the National Service Platform is realised as a front end platform. At the moment, this platform is under development and the connection is therefore not available in practice [78]. A connection to the resource server that is currently being used is to SoB, which is accessed via the authentication services of 1177. The platform is managed by Inera and contain a patient centred service that provides internet based support and treatment [80]. It is possible to integrate external services in the platform, but it also supports the development and design of new solutions. To date, the platform has mainly been used in the psychiatry care, see Section 4.5.

4.4.2 Regional data architecture

The regional data architecture can be seen in Figure 4.4. It should be noted that the visualised structure is the target architecture in the ongoing project *The transition*, mentioned in Section 4.2.1, thereby all of the described functions are not yet available in practice.

Connected to the National Service Platform is the Regional Service Platform. It has similar characteristics and features as its national counterpart and serves as a portal between the national and regional services. The Regional Service Platform also stores master data, which contain registers of organisational structure, contracts, ID services, and more. [81]

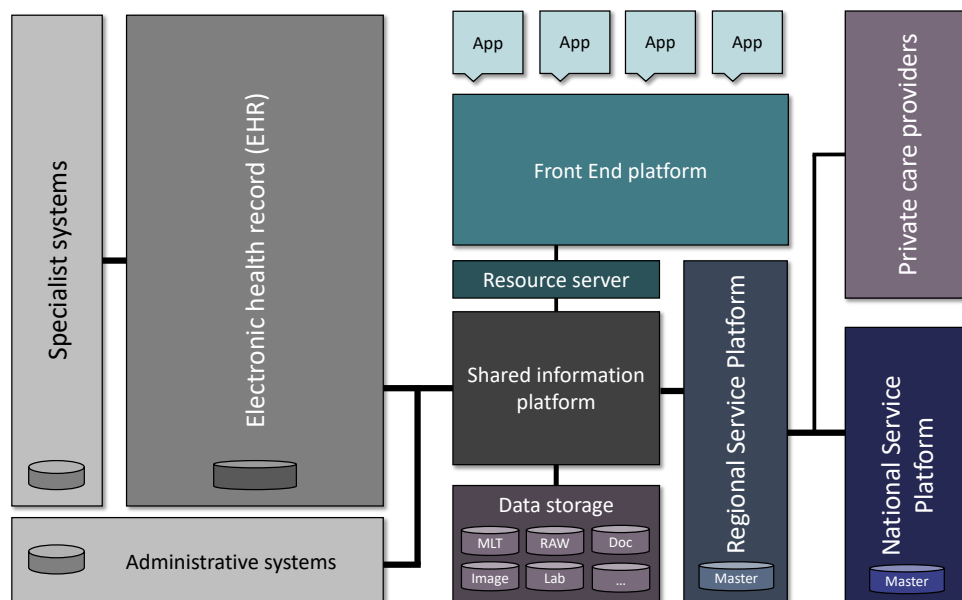


Figure 4.4: Regional data architecture. Adapted from [81].

Private care providers' service platforms are connected to the regional and national service platform to allow for import and export of data. However, this requires the private care providers to comply with the established semantic and technical integration standards.

To coordinate the information structure in the region, a shared information platform is proposed to be located in the centre of the architecture. Some of the features of the platform are requirements management towards other systems, and providing an integration interface that promotes operational data exchange between systems, such as different clinical information systems. The interface also allows for data exportation, which is useful for analysis of medical data in operational monitoring and research [81]. The shared information platform is not available at present, but pre-studies are conducted to explore its preferred capabilities.

Similar as in the national architecture, external applications are allowed to be integrated through a front end platform. The front end platform contain established standards and support services which ensures that applications can be integrated successfully in the existing infrastructure. The intention of enabling application integration is to promote a more continuous and rapid development of systems and user interfaces, as compared to the more rigid internal systems [81].

The common data storage is present to ensure a vendor neutral storage for data elements that needs an additional storage apart from its source system. Data from dismantled systems are also stored here before archiving [81].

A fundamental component in the health care is the EHR, which is used to support the vast majority of the health care operations. Typical functions of the system are patient administration, patient health records, and lab system integration [81]. At present, VGR is in the process of procuring a new EHR, where the stated requirements for the new system includes the possibility of continuous updates and open API's to adjacent systems, to further enhance the technical interoperability [13].

Supporting systems include specialist systems and administrative systems. Specialist systems include clinical information systems that provide functionalities not covered by the EHR, such as imaging software. Administrative systems are systems required to support the operational functions, for instance accounting systems. These two types of supporting systems are, together with the EHR, not managed by the operational IT in VGR but is procured from an external software vendor [81].

4.5 Implemented eHealth solutions in VGR

Digital solutions have been introduced in the psychiatry care and the care of chronic obstructive pulmonary disease (COPD) in VGR. The solutions highlight two different development methods for eHealth implementations in the health care. The first solution, used by the adult psychiatry clinic, is based on the 1177 platform. The solution is independent of an external service provider, and therefore managed by the region. The second solution, used at the COPD centre, is managed by an external company and is only intended to be used by the specific care centre. Both of the solutions allow the patients to report vital data to their care provider who decide whether to act upon the results. The data provided by the patient is classified as PROM data and is in need of professional analysis before regarded as clinical information [75].

4.5.1 ePsychiatry

In 2017, VGR initiated a project that aims to develop digital support and treatments for adult psychiatric clinics in the region [16], [82]. The project was formed as a realisation of *Vision for eHealth 2025* and the appointed operator is the ePsychiatry unit, which is a subdepartment of the addictive disorders clinic at Sahlgrenska University Hospital in Gothenburg. The unit assists the clinics in the development of solutions that are intended to be used in their everyday care [16]. The solutions are mainly developed in the service platform SoB and are therefore classified into two groups; those used to support the regular treatment plan, and those that replace the regular treatment [82].

Digital solutions are offered to the patient through their regular care giver, who are responsible to assess if the digital format is suitable for the patient. If so, the care provider initiate the support or treatment by making a selected digital program available to the patient through the e-service provided by 1177 [82].

At present, it has been observed that the digital format is a good alternative when the treatment is based on cognitive behavioural therapy (CBT), a combination often referred to as iCBT. CBT includes educative elements that requires goal setting, performing assignments, and reflection in ones daily life. These treatment traits has been shown to be transferable to a digital format, with the positive outcome of promoting the treatment to continue beyond the clinics meeting room. Some examples of areas that has been addressed with the SoB platform are; treatment for depression, anxiety and stress, and support in treatments that requires home assignments and logging, such as keeping sleeping journals [82].

4.5.2 Distance monitoring of COPD patients

The COPD centre at Sahlgrenska University hospital in Gothenburg is currently evaluating the possibility of using home monitoring to support their patients. The system used in the clinic is acquired from the companies FocusCura and FRISQ who are responsible for continuous software development and management. The solutions are to date not connected to the existing IT infrastructure, and vital data must be transferred manually between the solution and the clinical information systems. However, the aim is to integrate the solutions to the front end platform to promote synchronous data transfer.

The users access the solutions via tablets provided by the COPD centre. Upon consent, the patients are given an iPad with three installed applications (*cVitals*, *cContact* and *FRISQ*), a data connection, and a number of CE-labelled devices that transfer data via Bluetooth. Through the application *cVitals* and the devices, the patient log physiological parameters two times per week. Parameters of interest are blood pressure, steps taken, heart rate, oxygenation and weight. The patient can also fill in questionnaires to estimate perceived effort. The *FRISQ* application gives the patient an overview of their treatment plan and trend curves, while *cContact* enables the patient to reach out to their care giver through text messages, or to other patients via anonymous chatting functions. The information is communicated to the care provider through the same applications, which provides an overview of the patient's health status. The care provider will also receive alerts when patients' vitals are exceeding limits. This allows them to contact patients with drifting values, either indirectly by giving the patient a notification to log parameters more often, or directly via video calls through the *cContact* application [14].

The COPD centre had at the time of the interview about 10 connected patients and one nurse with one hour of dedicated time each day to evaluate their vitals and make necessary video calls. The possibility of video calls were highly appreciated by the nurses, who reported that it provided more information to them than a regular phone call. The patients perceived the home monitoring solution as a good complement to their regular treatment. The only reported issue were of technical characteristics due to the Bluetooth synchronisation being unstable [14].

5

Defining phase

This chapter presents the results from the interviews with the participating diabetes nurses and T2D patients. The care process of T2D is described chronologically and the organisational goals in each step are identified. The care process is further compared with the eCCM elements.

5.1 The care process of diabetes type II

An overview of the mapped care process is seen in Figure 5.1. The map should be viewed upon as an average process of the patient's contact with the primary care. However, even though a variability between different care centres was observed, the conformity within individual care centres was high.

1. Seek care

The symptoms of T2D may go unnoticed for several months as they often intensify slowly without alarming the patient. Instead, most cases of T2D are detected at an annual check up related to another condition, such as hypertension or high blood lipids. T2D can also be detected when the patient is hospitalised for other reasons, as a blood glucose test is part of many routines. The majority of the interviewed patients received their diagnosis in connection to other health related issues and contacts with care providers.

2. Diagnosis

The T2D diagnosis is done by a physician, either at the hospital or a primary care centre. For the patient, the diagnosis is usually a wake up call, but this can vary. Since the symptoms may not be apparent in the early years of the condition, neglect is common. One nurse expressed the wide variability of reactions among patients upon a T2D diagnosis as:

“It is very individual. Some [patients] get very worried and some not at all. Some think that it can be good to get a diagnosis so that they change their lifestyle. [...]. Some of them don't want the diagnosis. I had one patient today who came for the third time, he doesn't even believe he has diabetes.”

All of the interviewed diabetic patients expressed that their diagnosis was unexpected, as they did not relate the perceived symptoms with T2D. However, most of them did accept their diagnosis shortly after receiving it.

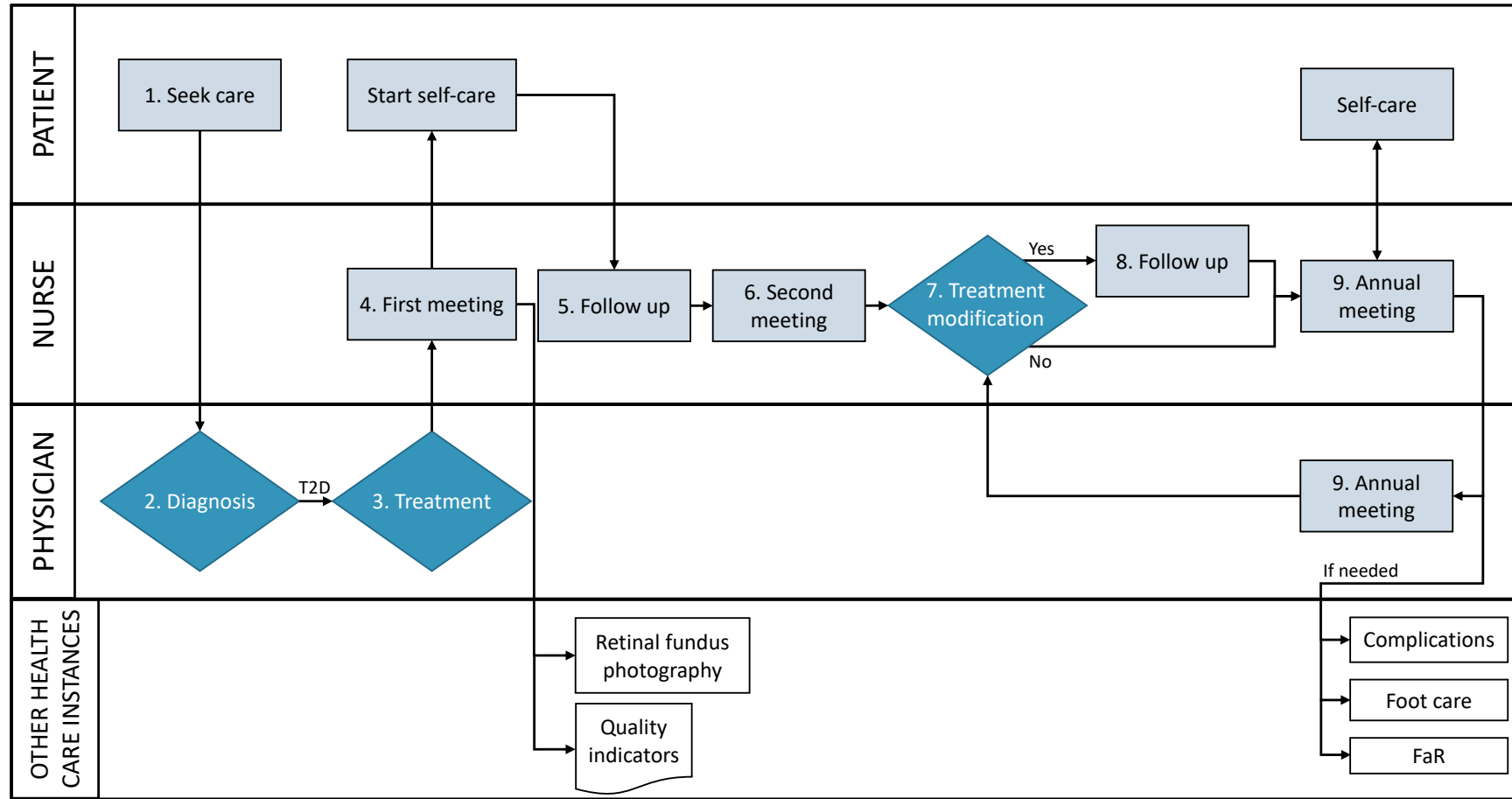


Figure 5.1: The mapped T2D care process.

3. Treatment

Upon diagnosis, the main focus is to handle acute health issues and lower the blood glucose level. The physician makes a decision of treatment, most common is the oral pharmaceutical Metformin. In more severe cases, insulin treatment is initiated.

4. First meeting

The first meeting with a diabetes nurse is held short after the diagnosis, but the time varies between one day and two months depending on the severeness of the case and availability of appointments. The meeting is usually one hour long and begins with a review of the patient's medical history and lifestyle in general. A referral to retinal fundus photography is sent, and quality indicators are measured and forwarded to NDR.

One important aim of the first meeting is to educate the patient about T2D and the effect of lifestyle interventions on the progression of the condition. There is an extensive set of knowledge required to successfully manage the self-care of T2D, and only little can be covered in the allocated time. For further reading after the meeting, the patient most often receive information folders about T2D and lifestyle. The nurses stressed on the importance of having insight in the patient's prerequisites and to adapt the education according to the patient's capabilities. One nurse expressed the task of educating the patients like:

"I want them to feel well-informed and that they are taking part in their treatment. [...]. It is a great challenge to try to push and be informative without scaring people. Be informative and objective, but supportive."

All of the interviewed patients had received some education at the first meeting, but it was mostly perceived as being on a very basic level. Instead, the appreciated part was the possibility of asking questions regarding self-care. Some patients wished for more concrete advice on self-care issues, and the potential benefits of lifestyle interventions. On the other hand, the trust for given advice varied, as some patients expressed their doubt in the given diet recommendations. Several patients relied on information found on the internet instead, but they also admitted that it had been difficult to assess its trustworthiness.

5. Follow up

About two days to three weeks after the first meeting, the diabetes nurse follows up with the patient over the phone. During the follow up, the nurse provides answers to additional questions that may have appeared after the first meeting. Furthermore, potential side effects of the oral medication are discussed. From the patient's point of view, this follow up gives a sense of safety and care.

6. Second meeting

The diabetes nurse arranges for a second meeting to be held about three months after the first. The time span is set in consideration to the physiological limit of measuring HbA_{1c}. The newly measured HbA_{1c} is used as a foundation when discussing the feasibility of the chosen treatment regime, if modifications are necessary and how the self-care is proceeding. Apart from HbA_{1c}, additional relevant parameters such as weight and waistline are measured. Based on the outcome of the first months, the nurse and patient together form a plan for the upcoming self-care.

The aim of the second meeting is mainly to reflect upon the first months of T2D self-care

and provide guidance to the patient. A refresh of knowledge and discussion regarding recently arisen questions are also held. The nurse consolidates the given knowledge by probing what the patient remember, and complement the information lost.

7. Treatment modification

Based on the outcome of the second meeting and if the HbA_{1c} has reached target levels or not, the treatment regime is adjusted accordingly.

8. Follow up

If a treatment modification is necessary, a follow up is scheduled two to three months later. The follow up's main objective is to ensure that the self-care is adequate and no side effects are unmanageable. The follow up is done by the nurse, either by a phone call or visit. The physical visit is only necessary if a new HbA_{1c} is required.

9. Annual meeting

When the patient has reached a treatment level ensuring that the progression of the condition is halted to reasonable levels, the visits to the physician and the nurse are kept annual, according to national guidelines. Most of the interviewed diabetes nurses tried to summon their patients with a six month interval between them and the general practitioner, so that the ongoing meetings becomes biannual instead. They considered this to be a good strategy to keep the patients involved.

During the annual meetings, similar discussions as in the second meeting are held and quality indicators are measured and forwarded to NDR. Upon need, there is a possibility to send referrals to foot care, physical activity support (FaR) or other health instances. The aim of the meeting is to make sure that the treatment is sufficient and to assess if currently undertaken lifestyle interventions are working according to plan. Moreover, the meeting has the function of supporting the patients in their self-care and thereof motivating them to pursue their treatment. As the patients are responsible for managing their self-care on a daily basis, the meeting is supposed to be a chance to discuss problems that have emerged during the year.

The annual meeting also serves an important purpose of making the patients feel acknowledged for their daily efforts. However, the nurses indicated that some patients think the purpose of the annual meetings is monitoring, and that the nurse is a "police" whom they have to report good results. This attitude prevents an open discussion regarding T2D management, and makes the meetings less effective. In the early years of the condition, the nurses also experience difficulties in engaging the patients enough to make them show up on their scheduled meetings.

"[...] but we can't force people to show up either. Diabetes is easy to ignore since it is not obvious that you are affected. [...]. Sometimes the patients doesn't take in their diagnosis until they have physical symptoms such as lost eye sight, but sometimes it is just that there is no energy left to deal with it."

5.2 Comparison with the eCCM

In the following section, the mapped T2D care process is compared with the eCCM elements, described in Section 2.3. Table 5.1 summarises the comparison.

Table 5.1: Comparison between the T2D care process and the eCCM. *Yes* indicates an existing component that is perceived as well-functioning by the authors. *No* indicates absence of the component. *Partly*, refers to component's that are identified to a minor extent or does not function as intended.

eCCM elements and prominent components			Identified in care		
			<i>Yes</i>	<i>Partly</i>	<i>No</i>
A. Health care organisation	1. Incentives		✓		
	2. Organisational goals		✓		
	3. Strategic technology plan			✓	
B. Clinical information system	1. Electronic medical record		✓		
	2. Booking system			✓	
	3. Patient portal			✓	
C. Decision support	1. Use evidence-based guidelines		✓		
	2. Utilise gathered data			✓	
	3. Data visualisation			✓	
	4. Consult specialists		✓		
D. Delivery system design	1. Coordinated care		✓		
	2. Interoperability			✓	
E. Self-management support	1. Educate patient			✓	
	2. Provide patient with skills			✓	
	3. Set goals			✓	
	4. Feedback			✓	
	5. Treatment plan				✓
	6. Offer ICT tools				✓
F. Community resources	1. Health programs			✓	
	2. Social support/Network			✓	
	3. Social media				✓
G. Feedback loop	1. Dialogue			✓	
	2. Short response time		✓		
	3. Data communicated			✓	
H. eHealth education	1. Knowledge to utilise tool		Not applicable		

A. Health care organisation

The presence of incentives for eHealth implementations (A1) differ between the organisational levels of the health care. *Vision for eHealth 2025* is an organisational goal (A2-A3) on a national level, including both non-financial and financial incentives. The vision encourages regions to take action to improve their health care, with the focus on eHealth opportunities. This has influenced VGR to include eHealth in the project *The transition* (A2-A3).

At the individual primary care centre level, the plans, incentives and organisational goals are more sparse. There is little time available for technological implementations and improvements in the everyday care, and few diabetes nurses were aware of any recent or ongoing eHealth projects in their care centre. Only one nurse could state otherwise, but the project in mind was not related to diabetes.

B. Clinical information systems

All of the studied primary care centres used EHRs (B1-B2), which provided the nurses with structured information about the patients. However, the four primary care centres included in the study used three different EHRs, and their technical interoperability were scarce. If a patient changed primary care centre, it was in most cases not possible to transfer the record electronically between the care centres. Moreover, visits to other health instances were not visible in the EHR.

Even though the primary care centres were using clinical information systems, the tools did not always support the nurses in their work. One nurse expressed the difficulties of using the EHR as:

“There are ridiculously many clicks. Both for doctors, nurses and the personnel at the lab. Everything has become slower since we incorporated the new system, and we can take fewer patients. [...]. It does not feel worked through, the developer of the system clearly doesn’t understand our operations.”

Although the platform 1177 (B2-B3) was accessible to all the studied primary care centres, the service was not used to a large extent in the T2D care. Furthermore, the majority of the interviewed patients were not aware of the personal pages of 1177, and if they were, the pages were mostly used to renew prescriptions.

C. Decision support

There was a strong consensus among the interviewed nurses regarding the vivid use of the national T2D care guidelines (C1). The guidelines state which data to collect, and which goals should be strived for in the treatment [23]. The guidelines were considered clear and defined the scope of their work, thus providing a feasible framework for their tasks.

The most prominently used data was the HbA_{1c}. Its trend curve was usually discussed and was perceived as helpful from the patient’s point of view to understand the long term effect of interventions (C2-C3). Furthermore, the blood glucose was often monitored a couple of days prior to a meeting to explore how it responds to diet and physical activity (C2-C3). Despite collecting various physiological parameters, all of the nurses emphasised that the qualitative assessment of the patient’s health status was very important and stressed on the importance of setting gathered data in the context of the patient’s life situation.

In discussions regarding how data was visualised, the tools mentioned was Medrave and the NDR database (C3). These tools mainly work on an aggregated organisational level rather than individual patient level. One nurse described how she previously used binders to create summarising paper files of her diabetic patients to get a better overview:

“For a while I used binders, but it doesn’t work here due to the number of patients. In the binders, I organised the patients according to month of visit. I had a note for each patient where I adjusted and checked what parameters to update. But you forgot anyway. It would be really good if one could look it up easily. To have a lab-module stating debut, foot, eye, everything on a strip.”

Most of the contact with other professionals (C4) were conducted with physicians at the clinic, primarily regarding difficult patient cases. In addition, the nurses could make referrals to specialists when their own time or knowledge were a limiting factor, or special attention was required. Specialists relevant for a T2D patient are primarily dietitians, foot care specialists and ophthalmologists. According to the diabetes nurses, the availability of dietitians is very limited and only the most difficult cases receive dietary consultations. The restricted use of dietitians was also raised by the patients. Many of them perceived the given dietary recommendations as vague and not being personalised. Most of them would have liked more education and a possibility to discuss diet and food choices.

D. Delivery system design

The coordination between the nurse and other clinical instances (D1) was not regarded as a problem from the nurses’ point of view. Even though the possibilities of communication between the instances were sparse, it did satisfy the needs of the nurse and was not considered as a problem for the patients.

Regarding interoperability (D2), there was an alignment in the juridical, organisational and semantic interoperability as all of the primary care centres were complying to the same national standards and regional incentives. The technical interoperability were on the other hand scarce since the primary care centres used different types of EHRs which did not allow for coordination. Nevertheless, all of the primary care centres in VGR are connected to 1177 and there is thus a platform for digital collaboration even though it has not been used to a large extent.

E. Self-management support

As stated in Section 5.1, one of the purposes of the meetings with the diabetes nurse is to educate the patient and provide necessary skills to handle the condition independently (E1-E2). The primary focus is self-care, thereby including diet, physical activity and daily problem solving. The education is adapted to the patient’s prerequisites, but the information given is standardised and regulated by national documents. Having received the education, the patient should be autonomous enough to handle their self-care on a daily basis. However, some of the nurses brought up the challenging task of educating their patients in an effective way.

“It is a complex situation. Sometimes it feels like it needs even more clarity, even though you give the necessary information they come back for a fifth time and still don’t understand.”

The reported usage of goal-setting (E3) in the T2D care was not common, and there are no clear guidelines regarding how to use goals in the ongoing care process. Some nurses reported setting weight goals for the patient, but more common was the use of HbA_{1c} goals. If incorporated, the goals were set in collaboration with the patient to consider the patient's capabilities of reaching the proposed target level. The patients, on the other hand, expressed that they did not attempt to set any individual goals as they needed the assistance from a diabetes nurse to find a reasonable target level. Even less common was feedback (E4) regarding the goals as the patient was not encouraged to follow up on the goals in the time between the meetings and did in most cases not remember the proposed goal from the last meeting.

Few of the nurses reported setting up a personalised treatment plan for their patients (E5). A couple of years ago, VGR developed a T2D care plan called *Individual care agreement* [83], but the interviewed nurses implied that they did not use it. One diabetes nurse stated the following when asked about using treatment plans:

“No, I don’t use it. I think there is something that you can print out, but it has never really been used. There are a lot of good thoughts about patients having a clear treatment plan and target levels, but it has never made it into the practice.”

When asked about treatment plans and their insight in the care process, none of the patients could state that they were having a clear overview of upcoming events or anticipated progression of the condition.

The usage of T2D-specific eHealth solutions (E6), such as online support or apps, was scarce on the studied primary care centres, and only one of the interviewed patients used a T2D application on the phone. Some of the diabetes nurses had a list of apps which they recommended, but admitted that the support for eHealth solutions was minimal. However, both diabetes nurses and patients were positive about incorporating eHealth solutions in the care, especially for the younger patients. One diabetes nurse expressed the following when asked about eHealth interventions:

“I think it [technology] is good and it’s coming whether we want it or not. Then of course, our older patients can’t even measure their own blood glucose level and they don’t have a computer. But for the younger generation it is a good thing.”

F. Community resources

The usage of community resources was not part of the routines at the studied primary care centres. One diabetes nurse expressed that they had tried to start group based educational programs on the centre, but failed since the interest from the patients were shown to be weak. Instead, they relied on volunteer organisations in the neighbourhood, which organises recreational and educational activities free of charge (F1). Furthermore, the Diabetes association in Sweden has many local branches, who offer educational programs and group activities (F1-F2). The nurses expressed that the Diabetes association is a good complement, and said that they actively recommended some patients to contact them for extra support. There is also an active T2D community on Facebook (F3), where discussions regarding diet management, medication, and general problem solving are held. All of the interviewed patients were members in such a group, and they stated that it was a useful

resource for solving everyday problems and receive help to realise the material taught by the health care.

G. Feedback loop

In order to keep the patient involved in the care, it is important to provide relevant information and form a continuous dialogue between the care provider and the patient (G1). During the interviews, difficulties with maintaining a consistent dialogue between the patient and the care provider were raised. None of the interviewed patients felt that they had a good understanding of the intention of the care or overview of the care process (G3). From the nurses' perspective this shortcoming was partly related to the considerable number of patients and the long time intervals between the meetings. All of the interviewed diabetes nurses emphasised the need of availability outside the scheduled appointments (G2), and the patients specifically appreciated the access of the nurses' expertise for self-care issues. The availability avoids anxiety and confusion among the patients, but does also prevent a negative trend at an early stage. Most nurses solved the issue of availability by implementing scheduled telephone appointments, and a few by providing some patients with their email. The phone calls and email contact had to be managed in addition to the ordinary tasks, thus the time allocated to support the patients outside the physical appointments was limited.

H. eHealth education

Since no patient-centred eHealth solution has been identified to be used in the T2D care process the component is not applicable.

5.2.1 Summary

The findings above acknowledge the presence of national and regional guidelines as well as incentives to fulfil the eCCM components, but also implementation difficulties on a care centre level. The T2D patients are highly diverse, both regarding level of patient motivation, knowledge and abilities. A highly generalised set of treatment recommendations and educative material must therefore be adjusted according to the individual patient's needs.

During the interviews, several comments appeared that corresponded well with the general objective of the eCCM, the patient-centred proactive care. All nurses agreed on the importance of a patient-centred care, to build a good relation between the caregiver and the patient, and to make sure the care is adjusted according to the patient's capabilities. The ultimate goal of the treatment is to ensure that the patients feel good and are confident in their condition. This enables the patient to make informed lifestyle choices in their everyday life. One nurse said:

“You want the patient to feel well. Sometimes I write it in the EHR. [...]. An important part is that the patient feel that they are seen and treated in a good way. It is important that I reach them and meet them at their level. Patient-centred, if they feel that I care then so do they and then we reach results.”

6

Development phase

In this chapter the functional and non-functional requirements of the proposed solution are established, along with the intended users. The developed eHealth concept is presented using a low-fidelity prototype and user cases. Lastly, the accessibility of the systems' data elements are described.

6.1 Contextual challenges

In the light of the data collected during the defining phase, 12 challenges grouped into three problem areas was identified. An overview of these can be seen in Table 6.1. The challenges do in varying extent prevent the patient from adhering to given self-care prescriptions, thus increasing the risk for future complications. A common theme in all areas is the great variability among the patients, therefore the full set of challenges does not apply to all patients.

6.2 Requirements for an eHealth solution

The requirements are derived from the gathered data in Chapter 4 and 5, and the theoretical background presented in Chapter 2. The functional requirements were mainly produced in response to the contextual challenges in Table 6.1, while the non-functional requirements were developed from the empirical context in Chapter 4 and information from the primary care centres, see Chapter 5.

6.2.1 Functional requirements

The functional requirements, seen in Table 6.2, are divided into requirements from the patient and nurse perspective, as these user groups put different demands on the developed solution. The functional requirements defines what the solution should offer to the user in terms of service provided and functions included. The identified requirements are further elaborated upon in Section 8.2.1.

6.2.2 Non-functional requirements

The non-functional requirements, seen in Table 6.3, describe both technical and organisational constraints, thus realising how the services provided by the functional requirements

Table 6.1: Challenges identified in the T2D care.

Area	Problem	Description
1. Education	1.1 Extensive information	The patients are given an extensive amount of information in a short period of time.
	1.2 Relevance	The provided education may not be related to the patients' individual life situation.
	1.3 Trust	Differences among patients to trust the advice from health personnel.
	1.4 Receptivity	Patients have varying abilities and possibilities of receiving information.
	1.5 Acceptance	Many patients find it difficult to accept the diagnosis and their new life situation.
2. Self-care	2.1 Patient capabilities	Prerequisites for self-care among patients vary.
	2.2 Implementation	The received education and prescribed lifestyle interventions can be difficult for the patient to translate into real life situations.
	2.3 Motivation	Motivation for lifestyle changes must be evoked early and maintained for many years.
	2.4 Overview	There is no clear treatment plan available. The patient is not offered a method for visualisation of historical, present and future events or data.
	2.5 Feedback	The physical effects of lifestyle interventions are not always apparent and no direct feedback is given to the patient by health care personnel.
3. Communication	3.1 Reactive	The communication between nurse and patient most often appear when problems arise.
	3.2 Accessibility	There is only a small number of telephone appointments each day, and the nurse has a limited possibility to handle patient inquires outside physical meetings.

should be delivered and the quality expected. The requirements are divided into four main categories, where the first category address usability requirements from a patient and nurse perspective. The second category, operational, consider delivery aspects of the solution and the third, interoperability, states which external systems the solution must be compatible with. Lastly, security aspects are stated. The non-functional requirements are discussed further in Section 8.2.2.

Table 6.2: Functional requirements for an eHealth solution. The corresponding challenges from Table 6.1 are indicated.

User	Requirement	Description	Challenge
1. Patient	1.1 General education	The solution must include a basic set of general information about diabetes, risk factors, treatment, diet etc.	1.1
	1.2 Personalised education	The education must be possible to adapt to patient capabilities, problems and motivation.	1.2-1.4, 2.2-2.3
	1.3 Reflection	The patient must be able to reflect upon the educated material.	1.2, 2.1-2.3
	1.4 Tasks	The patient should be able to receive personal tasks.	1.2, 2.2-2.3
	1.5 Goal setting	The solution must facilitate goal setting in the treatment regime.	2.2-2.3
	1.6 Monitoring of progress	The patient must be able to monitor progress of education and treatment.	2.3-2.5
	1.7 Feedback	The patient must be able to receive feedback on progress.	2.5, 3.1-3.3
	1.8 Overview	The solution should provide an overview of the treatment process.	2.4
	1.9 Personalised treatment plan	The treatment plan must be possible to adapt to patient's needs, based on <i>Individual care agreement</i> .	1.4, 2.3
	1.10 Physiological parameters	Physiological parameters must be possible to log in an educational context.	1.2, 2.2-2.5, 3.1
	1.11 Notifications	If reported parameters are out of range, the solution should notify relevant users.	2.4-2.5, 3.1
2. Nurse	2.1 Patient overview	The nurse must be provided with a clear overview of individual patient's progress and logged parameters.	
	2.2 Patient list	The solution must include a list of patients where notifications are clearly visible.	
	2.3 Search	The nurse must be able to search for patients.	
	2.4 Add new patient	New patients should be possible to add during a patient meeting.	
	2.5 Education overview	The nurse must be able to read all educational material offered.	

Table 6.3: Non-functional requirements for an eHealth solution.

Theme	Requirement	Description	Criterion
1. Usability	1.1 Technical literacy	Should be adapted to medium technical literacy.	The intended users should be considered able to use a computer and basic software applications.
	1.2 Training	Should require minimal training for users.	The health care should not be required to provide education to patients for how to use the solution.
	1.3 Execution	The user should be able to fulfil its tasks rapidly.	Not require more than 3 clicks to reach the main functions.
	1.4 Language	Configuration to different languages should be possible.	Default Swedish.
	1.5 Accessibility	Must be possible to use with hearing loss or moderate visual impairment.	Information given in various formats, e.g. text, audio, video.
	1.6 Safety	The information provided or gathered must not harm the users.	Information based on national guidelines and compliant with The Health and Medical Service Act (1982:763).
2. Operational	2.1 Availability	Must be web based user interface.	Internet Explorer, Microsoft Edge, Chrome, Firefox and Safari.
	2.2 Presentation infrastructure	Must be available on different web browsers.	
	2.3 Presentation infrastructure	Must be available on mobile devices.	
	2.4 Reliability	The user interface must be constantly available.	99.5% up-time.
	2.5 Scalability	Must be possible to scale up for use in the entire VGR without lowering the defined performance.	Handle 30% of the T2D patients in VGR.
	2.6 Modification	Should be on modular form to enable continuous updates and modifications.	The architecture of the solution should allow for change, addition or renewal of integration interface.
3. Interoperability	3.1 Compatibility	Should be compatible with third party solutions to import data.	Compliant with Continua, FHIR, HL7.
	3.2 Compatibility	Should be compatible with third party solutions to export data.	Compliant with FHIR, HL7.
	3.3 Compatibility	Must be integrated to the regional service platform.	Enable access to the integration interface via the regional service platform.
	3.4 Semantics	Must be utilising semantic standards.	Compliant with SNOMED CT.
4. Security	4.1 Immunity	Must be protected against malicious interference.	According to national guidelines (T-boken) and The Patient Data Act (2008:355)
	4.2 Encryption	Data exchanged between client and server must be encrypted.	According to The Patient Data Act (2008:355). Encrypted information should only be possible to read by the solution or the connected API.
	4.3 Integrity	Safe storage of patient information must be provided.	According to national guidelines (T-boken), GDPR and HSLF-FS 2016:40.
	4.4 Authentication	Users must be identified via two-factor authentication.	Using BankID (patient) and SITHS (health care personnel).

6.3 The developed eHealth concept

There are various possibilities of how the described requirements, seen in Table 6.2 and 6.3, may be translated into practice. Based on the requirements as well as the implemented digital solutions described in Section 4.5, two personas and a low-fidelity prototype were developed. The development of the user interfaces was mainly done to ease the communication of the requirements during the evaluation workshop. By exemplifying and visualising the meaning of the posed requirements, feedback regarding possible updates and additions could be captured. The purpose of the prototype was to explore the feasibility of the included functions in the T2D care, and minimal focus has been given to design, usability and user experience.

6.3.1 Personas

Since the functional requirements address two different users, the patient and the nurse, two personas were formed to simplify the development of the prototype. The users John and Karin can be seen in Figure 6.1 and 6.2, respectively. John represents a large group of newly diagnosed diabetics where the care given is perceived as ineffective. In his case, prioritisation of diabetes management is difficult on a daily basis and commitment to lifestyle changes are sparse. The persona Karin is included to cover the care givers view. She is a diabetes nurse who aims to attain an individual relation with each patient but is struggling to obtain an overview and prioritise among the patients in need of extra care.

John	Personal information: Age: 62 years Job: Primary school teacher Family: Married Technical proficiency: Medium, uses iPad to play Candy Crush.	Medical information: Diabetes type II + knee arthritis Duration: 1 year BMI: 29 HbA _{1c} : 56 mmol mol ⁻¹ Medication: Metformin
	John has been a primary school teacher for 40 years. He is used to long days with lots of activities and a social environment. But time has taken its toll on his knees, and his arthritis is making it difficult for him to maintain his usual activities. One year ago, he was diagnosed with diabetes. The diagnosis was unexpected for John, who considers himself to be healthy. He has basic knowledge about diabetes and the lifestyle interventions required, but is struggling to prioritise diabetes management on a daily basis. Despite his perceived efforts, his HbA _{1c} value is still above the recommended level.	
Needs: John needs a treatment plan to motivate the interventions required. He also needs help to prioritise diabetes on a daily basis.	Motivations: He wants to keep on working as usual and feel secure in his diabetes management.	Frustrations: The diabetes management takes up too much time in his already stressful life. Diet management has been shown to be difficult.

Figure 6.1: The user John, T2D patient.

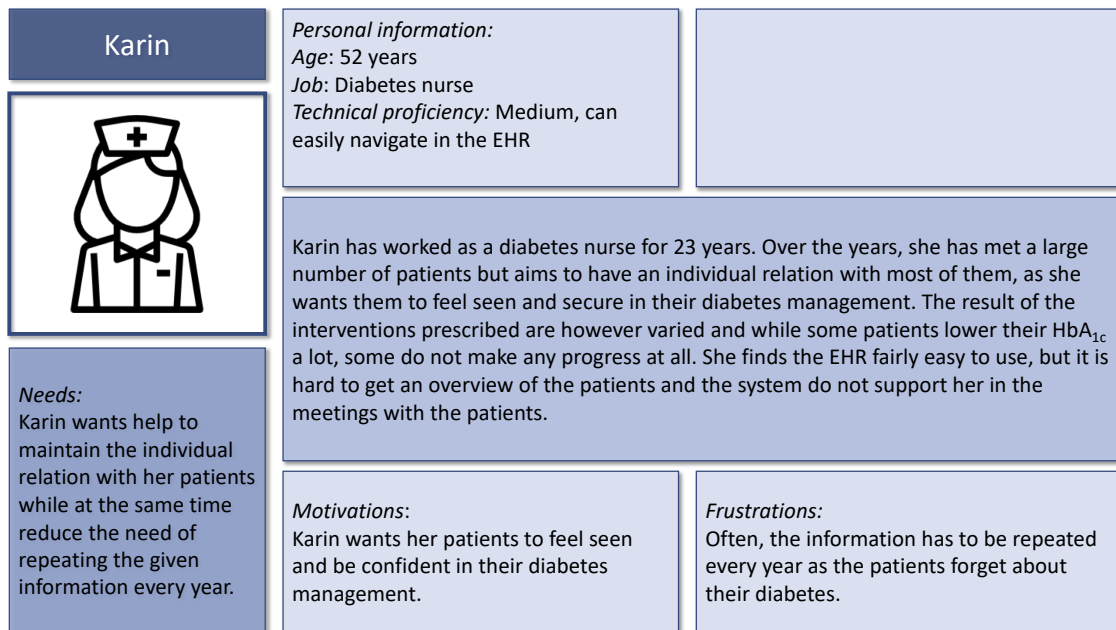


Figure 6.2: The user Karin, diabetes nurse.

6.3.2 Intended use of solution

The recommended users of the solution are newly diagnosed patients who are considered capable but in need of assistance to reach the state of self-care management (Figure 2.1). Before introducing the solution, an assessment of the patient's motivation and technical literacy must be performed to estimate the applicability of the solution. If the patient is considered eligible, the nurse and patient together make up a program consisting of relevant educational sections and assignments, as well as an individualised care plan which facilitates goal setting and data visualisation.

A key feature of the solution is the incorporation of reflective sections, which encourage the patient to apply the educational content to their everyday life and identify potential pitfalls. By supporting the patient to reflect and register difficulties in the self-care, the time at annual meetings can be spent more efficiently as well as being more personalised. The nurse, on the other hand, has the possibility to passively monitor the enrolled patients between meetings via an overview of logged data. The nurse can also provide feedback, even though the solution should not primarily be used as a communication tool.

6.3.3 Low-fidelity prototype

Two user interface conceptualisations, a patient and nurse view, were created and visualised as low-fidelity prototypes on paper. A subset of them are shown below. The complete set of generated user interfaces are available in Appendix D. To obtain a more detailed overview of the solution, see the sitemap in Appendix E.

Figure 6.3 shows the patient's home page with the main functionalities of the solution. From the start page, the patient can access their treatment plan, educational sections, a

general help section, and log values. Using notifications, the patient can see where actions are required. The middle and left view in Figure 6.3 show an example of a task and a reflection. Figure 6.4 includes the logging function, data visualisation and treatment plan. The education function with an example of a section and a reflection is seen in Figure 6.5.

The nurse's interface is seen in Figure 6.6 and 6.7. The left view in Figure 6.6 shows the home page for the nurse. From here, the nurse can access an overview of the enrolled patients, read available educational material, add a new patient, and access the general help section. The middle and right views in Figure 6.6 show an example of choices to make when adding a new patient to the system. Figure 6.7 shows a visualisation of a patient's information. In the patient overview, notifications indicate that something particular has happened, in this case a hyperglycemic event.

6.3.4 User cases

To further increase the understanding of the practical use of the solution, a number of user cases were constructed, available in Appendix F. The user cases were used to form a template for the evaluation workshop, which is described further in Chapter 7. The first six user cases aims to highlight the functions provided to the patient, while the last two are directed towards the nurse's functions.

6.3.5 Data elements

Depending on user, different sets of data can be viewed and added to the system. Table 6.4 shows the corresponding grant access diagram. The full set of data elements and their inherent relations are available as an ER-diagram in Appendix G.

Nurses should be able to view all educative material and tasks, as well as their patient's information, reflections and logged values. Furthermore, they should be able to add feedback, events, target values and lab results to the system, which can be displayed in retrospect. All patients should be able to access their own information and the general education. The personal education and tasks can be viewed if the responsible nurse has granted them access. Similarly, the responsible nurse determines the set of target values and lab results that can be accessed. A patient has the possibility to add logged values and reflections to the system, which also can be viewed in retrospect. Finally, patient's may view given feedback and events.



Figure 6.3: The patient's user interface. Left view, the home page. The middle interface shows a task, and the left, a reflection.



Figure 6.4: The patient's user interface. Left view, the recording function. The middle view, data visualisation. The right view shows the treatment plan.



Figure 6.5: The education function of the patient’s user interface. Upper left, the personal and basic education sections, along with the personal reflections and tasks. The remaining views shows an example of an education section, including information given in text and video, as well as a reflection.

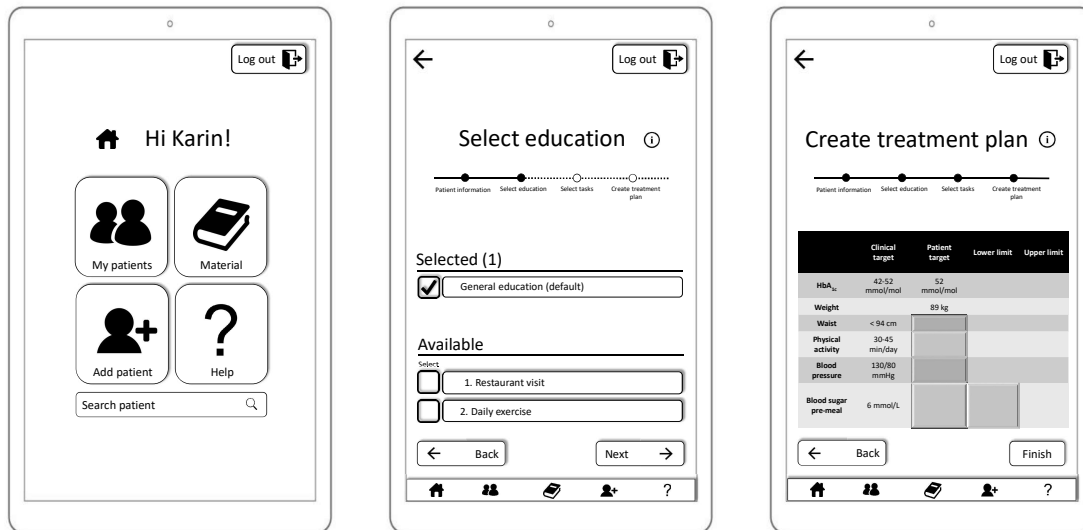


Figure 6.6: The nurse's user interface. Left view, the home page. The two right views available options when adding a new patient to the system.

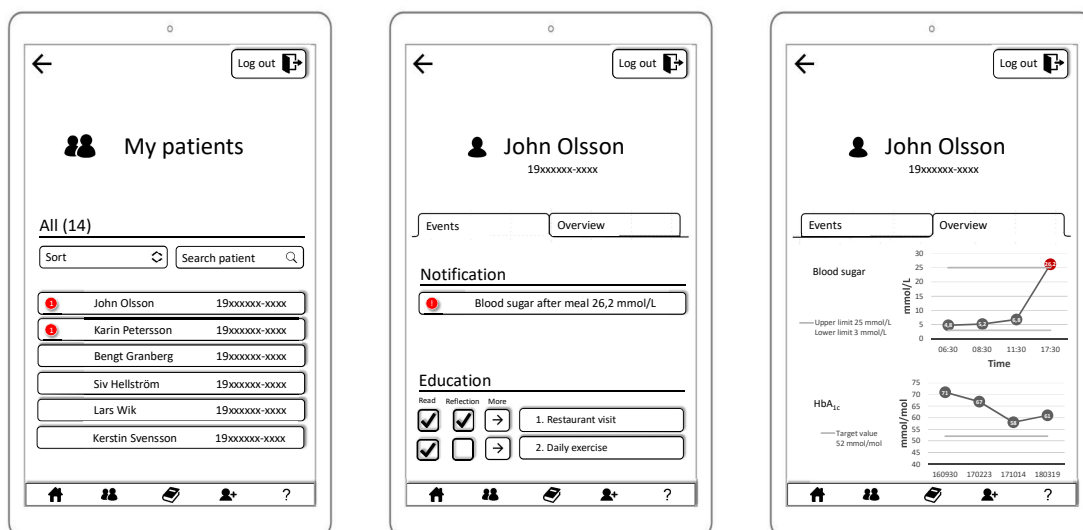


Figure 6.7: The nurse's user interface. The left view gives an overview of the patients and the two right shows a patient's information.

Table 6.4: Access granted to the users. Dark grey cells indicates the data elements a nurse may grant the patient access to.

Element	Nurse		Patient	
	<i>View</i>	<i>Add</i>	<i>View</i>	<i>Add</i>
Patient information	✓	✓	✓	
General education	✓		✓	
Personal education	✓		✓	
Tasks	✓		✓	
Reflections	✓		✓	✓
Feedback	✓	✓	✓	
Event	✓	✓	✓	
Target values	✓	✓	✓	
Lab results	✓	✓	✓	
Recorded values	✓		✓	✓

7

Evaluation phase

This chapter presents the results from the evaluation workshop with the diabetes nurses. Based on the findings, the functional requirements are updated. Lastly, the requirements are compared to the functionalities of SoB to explore the platform's feasibility in the T2D care.

7.1 Findings from the evaluation workshop

In this section, a sample of comments collected in the evaluation workshop are presented. The focus of the workshop was to evaluate the functions included in the developed eHealth solution and its feasibility in the T2D care, therefore user interface comments are excluded.

The selection of topics included in the solution was considered relevant in the T2D care, and the possibility to individualise the solution according to the patient's needs was appreciated by the nurses. The solution was described as realising the intention of the national guidelines and recommendations, since it uses generalised material in an individualised way. The nurses also stated that the solution could empower the patients, by providing them with an overview of their care process and aiding with structure, as well as showing the possibilities of self-care. Nevertheless, some of the nurses stressed on the fact that the digital solution's role is to enhance the care, and not replace the existing care process.

7.1.1 Feasibility in the health care context

The impression of the proposed solution was that it corresponded well with the daily work of the nurses and could be infused in the regular diabetes care without any considerable adjustments. The solution did also align well with the current development of the T2D care, which is to shift the responsibility from the health care to the patient, by promoting self-care and patient capabilities.

The technical level of the solution was considered appropriate among the nurses, and they believed that they could use the solution with little training, and so also their patients. A future implementation must however be done in close collaboration with health care personnel, as they had experiences from IT systems which were not used as intended due to scarce implementations. Furthermore, the interoperability with other IT systems, such as the EHR, was considered important to avoid the risk of more documentation which would increase the workload further.

From the nurses' point of view, the patient overview was appreciated as it enabled them to passively assess their patients' status and thus avoiding the need to make extra phone calls to follow up with their patients. One nurse raised a concern that some patients do not want to be monitored, and might become stressed if they were using the solution. But overall, the solution was regarded as helpful in the meetings with the patients. The main advantage was the possibility to know on beforehand which parameters to focus on during the meeting, since the patient could highlight certain areas as problematic. This could make the meeting more of a collaborative discussion, thereby preventing the patients from feeling monitored and spending time on reporting results.

7.1.2 Suggested users

The eHealth concept and the prototype was developed with the persona John in mind, see Figure 6.1. During the evaluation workshop, the nurses were asked to consider which patients the solution might be suitable for. The responses were diverse, ranging from young and newly diagnosed, to most patients except newly diagnosed, and to those who are motivated towards lifestyle changes and are interested in technical solutions. A clear target group was thus not identified by the nurses, and individual skills and motivations must therefore be considered to assess if the patient is an eligible user.

One motivation raised as to why younger recently diagnosed patients were chosen as a suitable target group was due to the high risk of future complications. A young T2D patient will live with the condition for many years and have more time to develop complications, therefore it is important that they establish self-care skills soon after diagnosis. If the patients are older at the time of diagnosis, complications will not have time to develop before other health related issues or causes of mortality becomes more prevalent. Also, younger patients are in general more comfortable with using digital tools and may therefore have less hindrance related to utilising the solution. On the other hand, one nurse raised a concern that newly diagnosed patients already have a lot to consider and did not want to burden them further.

7.1.3 Recommended improvements

The nurses stated that the physiological parameters included in the solutions are important, but that qualitative parameters should be considered as well, since they are important to understand the well-being of the patient. Qualitative parameters could be general, such as quality of life measures or more focused on certain aspects, such as stress.

To make the patient involved in the care, it was suggested that the patient should be able to add their own tasks. This would promote the patients self-efficacy without having to involve the care. Moreover, the nurses advised that the patient should be able to write reflections hidden from the care to avoid the feeling of monitoring.

The nurses requested the ability to write personalised tasks in collaboration with their patients at the meetings, as well as having the possibility to add new educational sections to support the distribution of new recommendation and guidelines.

The trend curve of physiological parameters was appreciated by the nurses, and according to them, many patients like to receive a visualisation of the gathered data. To give further

insight as to why trend curves fluctuated, or not, it was requested that recorded values would be possible to comment when added to the system. The nurses also suggested that the solution should include a prediction of a future trend curve, to effectively show the anticipated effect of the prescribed interventions.

7.2 Updated requirements

The functional requirements were updated according to the findings in the evaluation workshop. The updated list can be found in Table 7.2. The changes made to the functional requirements are the addition of writing a private reflections (1.4), the possibility to add tasks and educational sections (1.6 and 2.6), log qualitative parameters (1.13), comment recordings (1.14), and view trend curves (1.15). The corresponding update to the table with information accessibility for the users can be seen in Table 7.1. The non-functional requirements has not been updated as they were not discussed in the evaluation workshop.

Table 7.1: Update of access granted to the users. Added accessibility is seen as a (✓) and blue cell indicates elements the patient may grant the nurse access to. Dark grey represents elements the nurse grants the patient access to.

Element	Nurse		Patient	
	<i>View</i>	<i>Add</i>	<i>View</i>	<i>Add</i>
Patient information	✓	✓	✓	
General education	✓	(✓)	✓	
Personal education	✓	(✓)	✓	
Tasks	✓	(✓)	✓	(✓)
Reflections	✓		✓	✓
Feedback	✓	✓	✓	
Event	✓	✓	✓	
Target values	✓	✓	✓	
Lab results	✓	✓	✓	
Recorded values	✓		✓	✓

Table 7.2: Updated functional requirements for an eHealth solution, where the added requirements can be seen in bold.

User	Requirement	Description	Challenge area
1. Patient	1.1 General education	The solution must include a basic set of general information about diabetes, risk factors, treatment, diet etc.	1.1
	1.2 Personalised education	The education must be possible to adapt to patient capabilities, problems and motivation.	1.2-1.4, 2.2-2.3
	1.3 Reflection	The patient must be able to reflect upon the educated material.	1.2, 2.1-2.3
	1.4 Private reflection	The patient should be able to make reflections hidden from nurse.	
	1.5 Tasks	The patient should be able to receive personal tasks.	1.2, 2.2-2.3
	1.6 Addition of tasks	The patient should be able to add tasks.	
	1.7 Goal setting	The solution must facilitate goal setting in the treatment regime.	2.2-2.3
	1.8 Monitoring of progress	The patient must be able to monitor progress of education and treatment.	2.3-2.5
	1.9 Feedback	The patient must be able to receive feedback on progress.	2.5, 3.1-3.3
	1.10 Overview	The solution should provide an overview of the treatment process.	2.4
	1.11 Personalised treatment plan	The treatment plan must be possible to adapt to patient's needs, based on <i>Individual care agreement</i> .	1.4, 2.3
	1.12 Physiological parameters	Physiological parameters must be possible to log in an educational context.	1.2, 2.2-2.5, 3.1
	1.13 Qualitative parameters	The patient must be able to report qualitative parameters.	
	1.14 Comment	Recorded parameters and completed reflections must be possible to comment.	
	1.15 Trend curve	The recorded parameters should be visualised in a trend curve with anticipated regression.	
	1.16 Notifications	If reported parameters are out of range, the solution should notify relevant users.	2.4-2.5, 3.1
2. Nurse	2.1 Patient overview	The nurse must be provided with a clear overview of individual patient's progress and logged parameters.	
	2.2 Patient list	The solution must include a list of patients where notifications are clearly visible.	
	2.3 Search	The nurse must be able to search for patients.	
	2.4 Add new patient	New patients should be possible to add during a patient meeting.	
	2.5 Education overview	The nurse must be able to read all educational material offered.	
	2.6 Modification	The nurse should be able to add new education sections and tasks.	

7.3 Preparations for a high-fidelity prototype

Before producing a high-fidelity prototype, there are a number of factors to take into account. First, integration to the regional and national data architecture must be considered. Second, if the solution should be implemented in the SoB platform, its functional and technical constraints must be acknowledged. In the following sections, these issues are elaborated upon.

7.3.1 Data architecture

The data architecture of the eHealth solution is dependent on the choice of development method. In this context, two alternative possibilities are considered. The first possibility is to develop the solution as an external app and integrate the solution to the regional Front End Platform, seen as alternative A in Figure 7.1. The second alternative is to integrate the solution in the national SoB platform, seen as alternative B in Figure 7.2. With alternative B, there is a possibility to translate an external vendor's treatment program into the platform as well as building a solution from scratch, by utilising the embedded design functions. Alternative A and B put separate constraints on the integration interfaces which must be considered in the development process (see Section 4.4).

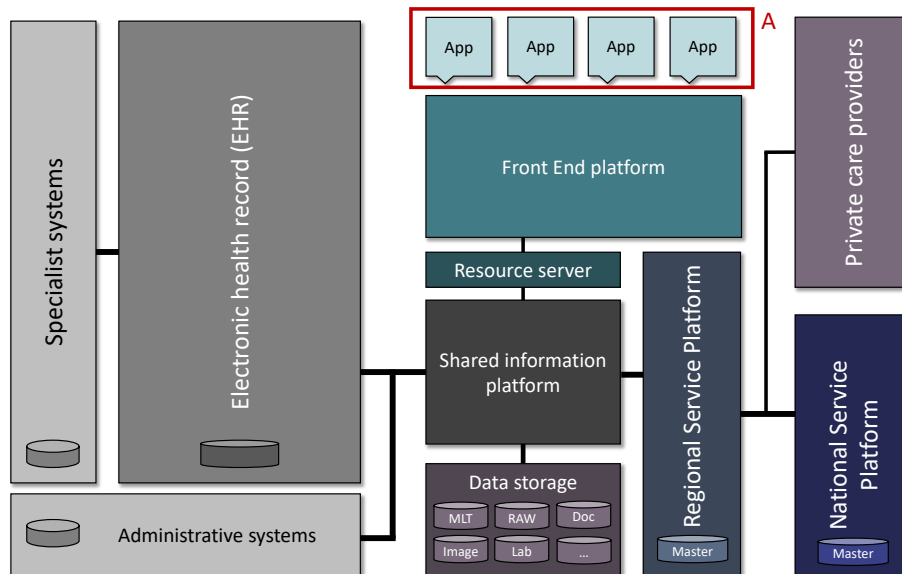


Figure 7.1: Alternative A shows where in the regional data architecture an eHealth solution is to be integrated if offered as an external application.

7.3.2 Implementation in the Support and treatment platform

The possibility to incorporate the updated requirements in SoB was investigated to test the platform's applicability in the T2D care. It was found that the majority of the requirements could be met by the platform. A schematic overview of the incorporated functional requirements can be seen in Table 7.3, and the non-functional in Table 7.4. To obtain an idea of how an high-fidelity prototype in SoB may assemble, user interfaces are shown in Figure 7.3 and 7.4. The user interfaces was developed by the authors in the design tool in SoB, based on the low-fidelity prototype. More figures can be found in Appendix H.

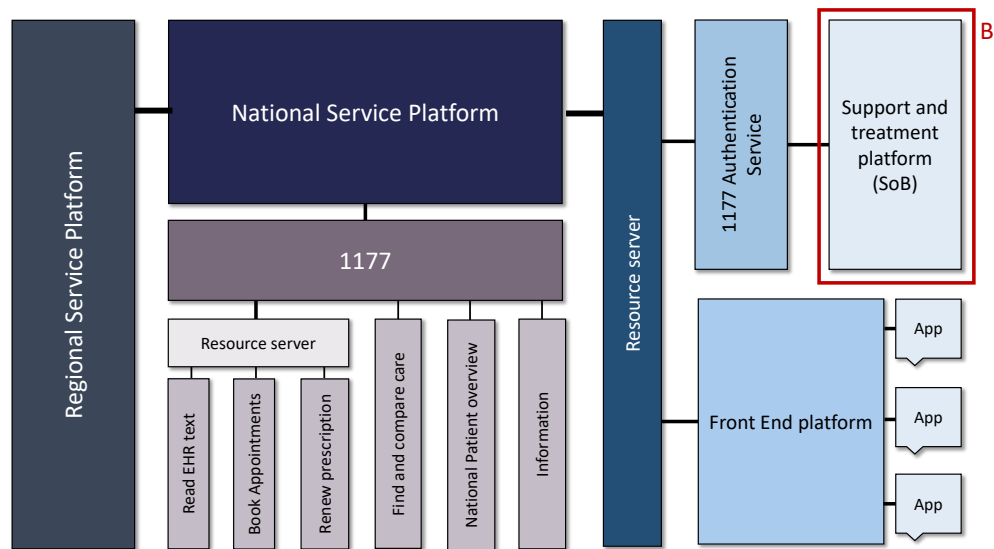


Figure 7.2: Alternative B shows where in the national data architecture an eHealth solution is to be integrated if made available through the SoB platform.

Functional requirements

Most of the functional requirements are met by SoB due to the platform's possibility of adding education modules with associated questionnaires as well as scheduled events. It is also possible to introduce a message function in connection to certain sections, which can be activated and deactivated by the care giver. Furthermore, the nurse is able to choose which modules should be accessed by the patient, thus facilitating a personalised education. In the example shown in Figure 7.3, the nurse has activated a personalised education section regarding smoking cessation. One drawback of the platform is that the patient is not able to add any components, and all of the given information is visible for the nurse, which discourage private reflections for the patient. Also, the treatment plan could not be incorporated as suggested in Chapter 6, due to the only visible data in the platform being education and logged parameters. From the nurse perspective, all posed requirements were met.

Non-functional requirements

In general, the non-functional requirements demonstrated a good compliance with the functionalities of SoB. The platform has a simple interface, and evaluations have shown that most users find it pleasant to work with [79]. The main advantage of the platform is the high security, as it is a part of the IT systems managed by Inera, and VGR have already established routines for its management. At present, a disadvantage of the system is the inability to integrate with the clinical information systems, and information provided in the platform must therefore be documented multiple times.

Table 7.3: Functional requirements aligned with SoB. Descriptions of the functional requirements are available in Table 7.2.

User	Requirement	Implementation SoB		
		<i>Yes</i>	<i>Partly</i>	<i>No</i>
1. Patient	1.1 General education	✓		
	1.2 Personalised education	✓		
	1.3 Reflection	✓		
	1.4 Private reflection			✓
	1.5 Tasks	✓		
	1.6 Addition of tasks			✓
	1.7 Goal setting	✓		
	1.8 Monitoring of progress	✓		
	1.9 Feedback	✓		
	1.10 Overview		✓	
	1.11 Personalised treatment plan		✓	
	1.12 Physiological parameters	✓		
	1.13 Qualitative parameters	✓		
	1.14 Comment	✓		
	1.15 Trend curve		✓	
	1.16 Notifications	✓		
2. Nurse	2.1 Patient overview	✓		
	2.2 Patient list	✓		
	2.3 Search	✓		
	2.4 Add new patient	✓		
	2.5 Education overview	✓		
	2.6 Modification	✓		

Table 7.4: Non-functional requirements aligned with SoB. Descriptions of the non-functional requirements are available in Table 6.3.

Theme	Requirement	Implementation SoB		
		Yes	Partly	No
1. Usability	1.1 Technical literacy	✓		
	1.2 Training			✓
	1.3 Execution		✓	
	1.4 Language	✓		
	1.5 Accessibility	✓		
	1.6 Safety	✓		
2. Operational	2.1 Availability	✓		
	2.2 Presentation infrastructure	✓		
	2.3 Presentation infrastructure		✓	
	2.4 Reliability	✓		
	2.5 Scalability	✓		
	2.6 Modification		✓	
3. Interoperability	3.1 Compatibility			✓
	3.2 Compatibility			✓
	3.3 Compatibility		✓	
	3.4 Semantics			✓
4. Security	4.1 Immunity	✓		
	4.2 Encryption	✓		
	4.3 Integrity	✓		
	4.4 Authentication	✓		

Patient view

The patient access SoB via the e-Services in 1177 by using BankID or a personal code to log in. The home page (*Översikt*) of the solution can be seen in Figure 7.3. From the home page the patient can see their current tasks (*Aktiviteter*) and planned education (*Aktuellt innehåll*), and previous education (*Tidigare innehåll*). Through the tabs on the top of the page, the patient can access the messaging function (*Meddelanden*), and see results from logged parameters and questionnaires (*Resultat*). More figures of the patient's view can be seen in Appendix H.

Nurse view

The nurse enters the platform via Inera's web page, and the personal SITHS card. At start, the nurse can see a list of all patients who have been assigned an internet support program. When choosing a patient, an overview of planned tasks and education is visualised (*Hantera*), see Figure 7.4. Based on predefined parameter limits, the system may issue a warning if logged values exceed the set levels. These warnings are also seen on the home page. Through the tabs, the nurse can get an overview of previously logged parameters (*Resultat*), messages (*Meddelanden*), a time line of performed events (*Tidslinje*), as well as a flagged events (*Händelser*). More figures of the nurse's view can be seen in Appendix H.

The screenshot shows a web application interface for a patient's home page. At the top, there is a teal header with the '1177 VÄRDGUIDEN' logo on the left, 'E-tjänster' in the center, and a 'Logga ut' button with the text 'Inloggad som Jane Doe' on the right. Below the header, a breadcrumb trail reads 'Hem » Stöd och behandling » Internetstöd för Diabetes typ II'. The main title is 'Internetstöd för Diabetes typ II'. Below the title are three tabs: 'Översikt' (selected), 'Meddelanden', and 'Resultat'. A status bar indicates '0 dagar sedan Internetstöd för Diabetes typ II startade. (rek. 30 dagar)' and 'Telefonnummer ej angivet'. The interface is divided into several sections: 1. 'Information från vårdgivaren' (Information from the provider) with a 'Visa snabbguide' link and a dropdown arrow. 2. 'Aktiviteter' (Activities) showing 'Nästa aktivitet: 2018-04-23 18:00' and a 'Historik' link with a dropdown arrow. 3. 'Favoriter' (Favorites) with a dropdown arrow. 4. 'Aktuellt innehåll' (Current content) with a sub-header 'Grundläggande utbildning' (Basic education) and a '1 dagar kvar' (1 day left) indicator. It contains a list of topics: 'Att arbeta med Grundutbildning om diabetes' (Working with Basic education about diabetes), 'Vad händer i kroppen?' (What happens in the body?), 'Fysisk aktivitet' (Physical activity), and 'Kost' (Diet). 5. 'Tidigare innehåll' (Previous content) with a sub-header 'Rökning' (Smoking) and an 'Att fylla i' (Fill in) section. It contains a list of topics: 'Att arbeta med Rökning och diabetes' (Working with Smoking and diabetes), 'Hur påverkar rökning din hälsa?' (How does smoking affect your health?), and 'Hur kan du sluta röka?' (How can you quit smoking?).

Figure 7.3: The patient's home page in the developed SoB prototype (in Swedish).

The screenshot displays the nurse's home page in the developed SoB prototype. The page is in Swedish and shows patient information for Jane Doe, who is being treated for Internetstöd för Diabetes typ II (Version 1.0). The page includes a navigation bar with tabs for Mina, Alla, Avslutade, Export, Personal, Användargrupper, Inställningar, and Administration. Below the patient information, there are tabs for Hantera, Resultat, Meddelanden, Tidslinje, and Händelser. The main content area shows the patient's current status (Senaste aktiv: Aldrig), the start date (Moment startade: 2018-04-19), and the responsible caregiver (Ansvarig behandlare: [redacted]). There is also a section for activities (Aktiviteter) with a list of tasks and their completion status. At the bottom, there is a table of completed activities (Avklarade moduler) with columns for Namn, Utförda aktiviteter, Senaste utförda aktivitet, Resultat, and Historik.

Namn	Utförda aktiviteter	Senaste utförda aktivitet	Resultat	Historik
Logga blodsocker	4/5	2018-04-23 14:00	Resultat	Historik
Tobaksanvändning	1/2	2018-04-22 10:00	Resultat	Historik

Figure 7.4: The nurse's home page in the developed SoB prototype (in Swedish).

8

Discussion

This chapter summarises the key findings in the study and provides a discussion on how they align with the reviewed literature. Moreover, implementation aspects are discussed as well as the used methods in the study. Lastly, subjects for future research are proposed.

8.1 Challenges in the diabetes type II care

Three main challenge areas in the T2D care have been identified; education, self-care, and communication. These areas are interrelated and do affect each other even though they have been separated for simplicity in this study.

On the topic of patient education, the main issues are related to the extensive amount of information delivered to the patients in a standardised manner. The interviewed nurses expressed that it is difficult to adapt the information according to the patient's needs, although individualisation has been highlighted as crucial to obtain an effective education [36]. It is furthermore essential to manifest the given information in the patient's everyday life [30], but this was indicated to be a challenging task to achieve in an one hour long meeting. Another aspect may also be due to lack of acceptance of the diagnosis itself [37], as the meeting with the diabetes nurse is held soon after the diagnosis. On the other hand, the interviewed patients perceived the given information as being on a very basic level, and they admitted that they had complemented the given education with information found on the internet. It therefore appears to be a mismatch between the patients' expectations and the health care system deliveries.

The purpose of the education is to prepare the patient to take an active responsibility for their self-care [23], but national evaluations and findings from the interviews point out that the adherence to life style interventions is low [7]. This may be due to that the education is not manifested enough to make the patient able to make informed decisions in everyday situations. The present study suggest that this have resulted in the concerns observed among the interviewed patients, who desired support in everyday decisions such as specific diet and exercise management. When comparing with the model for self-care described in Section 2.1.3, most patients are located at the *Self-care maintenance* level, as they are aware of the interventions required but are not independent enough to perform them without support from health care personnel [26]. The goal, however, is to enable a majority of the patients to reach the *Self-care management* level, where they are able to take independent decisions on a daily basis based on self-perceived measures.

The reason for the non-adherence to national guidelines [7] is a multifaceted problem. The interviews with T2D patients indicate that the lifestyle changes required may be difficult to implement on a daily basis. After the initial meetings, the patients are in most cases left on their own, without any feedback on performed efforts. This is directly contradicting to the social cognitive theory, where reinforcements on personal efforts are emphasised as a success factor of lifestyle interventions [31], [33]. It was also observed in the patient interviews that they often sought for affirmation from their diabetes nurses regarding undertaken lifestyle interventions, as the patients often brought up anecdotes about specific events where they had received compliments from the nurse. This suggests that feedback is highly valued by the patients and is an important factor to maintain motivation.

The communication between patient and care provider was declared to be well-functioning in the physical meetings at the care centre, and apart from the motivational function mentioned above, the meetings often serve the important purpose of building a relation between the patient and the nurse. The physical meeting should therefore be maintained an important cornerstone in the T2D care. Yet, the supportive role of the nurse may at times not be clear, as the nurses expressed that many patients feel monitored and assume that they have to show a certain facade towards the nurses instead of using the nurses' expertise to bring up self-care obstacles to discuss during the meeting. Outside the scheduled appointments, the communication were as described by Wagner in 1996 [44], still focusing on acute events rather than chronic care support.

8.2 The developed solution

In order to shift the diabetes care from the present self-care maintenance to the desired self-care management state, the challenges discussed above and seen in Table 6.1 has to be addressed. The challenges were therefore transferred into the functional requirements (FR) seen in Table 6.2 and the non-functional requirements (NFR) seen in Table 6.3, and as a response to these, the concept presented in Section 6.3 was developed.

8.2.1 Functional requirements

Since the self-care management state requires a well-informed patient, and the feasibility of web-based diabetes education programs have been described in several studies [29], [35], [36], one of the core functions included in the solution is the educational section (FR 1.1-1.2). But to obtain an effective education, the studied material must be set in the context of the patient's everyday life. This is achieved by incorporating reflective elements, tasks and goals in the solution, which also has the function of consolidating the knowledge (FR 1.3-1.5). These suggestions are based on the findings in studies using social cognitive theory to enhance the self-care (Section 2.2.2) [41] and are inspired by the regional iCBT project at the ePsychiatry unit (Section 4.5).

The lack of insight to the patient's own care can be countered by providing an overview of the process (FR 1.6 and 1.8), where past and upcoming events are visible. This has been shown successful at the COPD centre (Section 4.5), where the overview was appreciated by both patients and health care personnel, and has shown to be effective in decreasing anxiety among patients. The overview can also be accompanied with a personalised treatment plan (FR 1.9), including parameters from the regional document *Individual care agreement* [83].

However, all of the parameters available in the document are not important for every patient, as a wide variability of needs has been observed. It is therefore difficult to suggest a “one size fits all” solution to enhance the care, which has been highlighted in other studies as well [30], [35]. This has led to a prioritisation of adaptability of the proposed solution. The possibility of adaptation are transferred into the functional requirements as the personalised set of education material and treatment plan (FR 1.2 and 1.9), as well as reflections, tasks and goal setting (FR 1.3-1.5).

Finally, from a patient’s perspective, it is suggested that valuable insights to the condition may be gained by recording parameters and relating them to established goals (FR 1.5 and 1.10) [32], [33]. To be most efficient, this should be done in a structured format where the data is set in a relevant context [26]. To bring further value to the gathered data, reinforcements on efforts can be achieved by providing the patient with personalised feedback on accomplishments (FR 1.7), and thereby increasing the self-efficacy [31], [34].

From the nurses’ perspective, the proposed digital solution aim to enhance the meeting with the patient and further individualise the care. Therefore, it is important that the solution provide the nurses with relevant information regarding each patient, and a clear overview of their health status (FR 2.1-2.2). During a regular meeting, a new patient should be possible to add to the system without any major disruptions (FR 2.4). The solution should also aim to minimise the need of administrative tasks outside scheduled appointments, to align with the nurses’ shortage of time.

8.2.2 Non-functional requirements

When implementing a digital solution in the health care, a large number of non-functional requirements (NFR) has to be fulfilled and only a subset of them are covered in Table 6.3. The presented requirements intend to provide a foundation for the understanding of the organisational and technical constraints when developing an eHealth solution in VGR, based on the current situation and the proposed target data architecture [81]. The full set of requirements are generally established in collaboration with health care and IT personnel in VGR, but additional stakeholders might also be relevant.

The first theme of the non-functional requirements is usability. The information from the primary care centres indicated that there is a great variation regarding technical literacy among their patients. The age span is wide, and the younger patients are more used to digital solutions than the older (Section 5.2). However, neither the ePsychiatry unit or the COPD centre experienced any need of adapting the solution to patients with lower technical literacy as these patients tend to learn how to use the solution over time (Section 4.5). The typical user could therefore be considered to have medium technical literacy (NFR 1.1). On the other hand, the nurses should not be required to provide training for how to use the solution (NFR 1.2), since the time allocated to support the patients is already limited. Previous studies have shown that the usability of the developed solution is of profound importance to maintain the participants’ motivation for the intervention [10], [35], [42], but usability can be difficult to measure quantitatively. However, the three click rule is a guideline to keep in mind during development (NFR 1.3).

The operational requirements addresses delivery. To enable implementation, the developed solution’s cost have to be adapted to a financially limited organisation with high safety

constraints (NFR 2.6, 4.1-4.4). If the solution is to use the authentication system of 1177, it has to be web based (NFR 2.1) and therefore also compatible with commonly used operating systems and technical platforms (NFR 2.2-2.3). By offering a web based solution the number of possible users are slightly reduced since it requires the patient to have access to a computer, tablet or smart phone, with an internet connection. To ensure that the system can be used in the regular care, without disturbing limitations, the solution needs to be scalable enough to support the usage of a reasonable portion of the T2D patients in the region (NFR 2.5). The suggestion is to aim for about 30 % of the T2D patients in VGR. The number is crude, but can be motivated by 54 % already having reached the region's target level of HbA_{1c} [17], and at the time about 68 % of the Swedish population above 75 years of age has an internet connection in their home environment [11].

The third theme, interoperability, considers interoperability constraints on a national, regional as well as organisational level. The diabetes nurses working in the primary care are already utilising a number of different software applications, and the developed solution must be integrated into the existing data architecture [81]. A common problem in the health care is that the same data has to be documented multiple times in different systems. The nurses therefore had a more positive attitude towards software that could import and export information from the EHR as this reduces the time needed for documentation. However, unlike the solutions used in the psychiatry and COPD care, the patient reported data is classified as PROM data which has to be overlooked by medical personnel before regarded as clinical information [75]. There will thus be a need of manual data transfer even though the data can be transferred into the EHR. The importance of IT systems integration coincides with *Vision for eHealth 2025* [12], which has also been taken into consideration in the region through their strategy *The transition* [13]. To meet the demand of interoperability, the solution should consider the recognised semantic and data standards (NFR 3.1-3.2, 3.4), but also be developed with the possibility to integrate to the regional service platform (NFR 3.3).

When handling medical data, the security aspects are of profound importance and must be considered when developing an eHealth solution. The Patient data act [67] state constraints on immunity and encryption of data, and provides a feasible framework for the development of eHealth solutions (NFR 4.1-4.2). Additionally, guidelines from the NBHW [68] and EU [70] pose additional security constraints on the system (NFR 4.3).

8.2.3 External application or SoB

Two different development methods are proposed in the project, either developing the solution as an external application or incorporated in the SoB platform. Alternative A in Figure 7.1 depicts where an external application would be introduced in the target data architecture of VGR. At present, the shared information platform and the security layer towards external applications does not exist, and incorporating an external application would therefore cause further documentation requirements for the health care personnel, an effect which was stated as highly unappreciated. However, there is a large amount of digital solutions available off-the-shelf, and the need of developing the proposed solution from scratch may not be necessary. A thorough sweep of the market could therefore be of interest to identify similar solutions that can be modified in order to meet the requirements.

Instead of creating an external application there is also the possibility of utilising the

SoB platform, as described in Section 7.3.2. Figure 7.2 shows SoB's placement in the architecture, see alternative B. The core system is already fully available through the national services, and is updated regularly to extend its functionalities. By implementing the solution in SoB it can easily be offered to the entire region, as well as nationally, since the only requirement is for the care provider to be connected to 1177. The drawbacks of the platform are a decreased freedom for the developer in terms of features and design. In the platform's present format, the usability of SoB could be improved to enhance the user experience. As an example, the platform is not easily navigated for an inexperienced user, which could cause patients to lose motivation for participation. Furthermore, alike an external application, the platform currently lacks integration possibilities to the clinical information systems. The main reason for this shortcoming is related to the regional data architecture not yet being fully developed. However, the recording function included in the proposed solution creates PROM data. Thus, there will be a need of manual documentation.

Additionally, by producing the solution in SoB the region may become fully responsible for the management and administration of the system. This is in some cases not preferred by VGR, since managing IT support is time and resource consuming. The middle way would therefore be for an external provider to offer the solution through the SoB platform, which has been done with a number of the solutions provided by the ePsychiatry unit.

8.3 Considerations before an implementation

In the previous studies of eHealth implementations described in Section 2.2 and 4.5, variations occur when considering available support for the users, level of involvement of health care personnel and provided technology, such as mobile devices or internet access. Quinn et al. [28] provided the patients with all the required equipment, and reimbursed the care centre financially. Noh et al. [29], on the other hand, only recruited patients already having access to internet and a mobile phone, and did not involve the care providers. Despite this, they indicate similar effects on HbA_{1c} levels. In the VGR context, the available support for the COPD and psychiatry patients also differed (Section 4.5). In the COPD study, the care centre provided the patients with all necessary devices and offered the patients one hour of support from nurses each day. In the psychiatry care, patients are only considered eligible if they can utilise the solution independently in their home setting. This is partly due to the prerequisites for the two patient groups being quite different. Patients at the COPD centre are in general older and in a later stage of the condition, whereas psychiatry patients are more diverse. T2D patients can be placed between the two patient groups as they are in general older but very diverse in terms of capabilities and medical needs. If internet based support for T2D patients should be incorporated in a large scale in the region, the costs for providing resources to the patients and care providers should be compared to the estimated cost savings due to rationalisations and a decreased number of hospitalisations.

Another aspect of the described studies in Section 2.2 is the rapid increase of internet access and use over the recent years. In many of the mentioned studies, the main dropout factor was due to lack of internet access [35], [36]. In the study by Kim et al. from 2006 [36], only 26.9% of the participants indicated access to and comfort with using the internet. One assumption made in the current study is that the amount of people having access to internet is higher in comparison with the above mentioned studies, since it has been observed on a macro level in Sweden [11], but it should preferably be studied in the concerned target group before implementation. It is also important to consider the users'

technology preferences. As mentioned in Section 4.4.1, most of the users accessed 1177 via a tablet or smart phone. The user interface should therefore be adapted to these types of devices to enhance usability.

When considering implementation of an eHealth solution it is essential to establish an interdisciplinary collaboration between IT management and health care operations where both parties share a common vision of the future digital environment. Today, there is a considerable distance between the IT organisation and the health care operations. With a closer collaboration, the potential for capturing and meeting the actual needs of the users is increased. A good example of such a cooperation is the ePsychiatry unit, where representatives from health care and VGR IT are collaborating to develop new digital solutions. Furthermore, as the technical environment is changing rapidly, the digital solutions must be continuously evaluated to stay updated. The proposed regional target data architecture seen in Figure 4.4, which suggests an adaptable modular structure, is believed to be important for improving developmental opportunities as it will enable individual systems to be added or removed without affecting other systems.

Even though not being the main scope of the project, the organisational short and long term impact of introducing the proposed digital solution in the T2D care must be acknowledged. The anticipated effects of introducing the proposed eHealth solution include health improvements and reduced costs but also organisational changes. In the short term, the nurses are required to undergo an adaptation process to incorporate ICT in their regular care process and commitment will be important in order to learn whom the optimal user is. It will require initial costs related to education and implementation, but also a willingness from the organisation to change their work processes. In the long term, the solution aim to promote more effective meetings with the patients as both parties come prepared, and the nurse can provide the patient with expertise on relevant issues. Moreover, the expectation is that the promotion of self-care management will increase the adherence of lifestyle interventions, thus reducing the risk for future complications and costly hospitalisations.

8.4 Limitations of method

The developed solution relies on insights from a number of different research areas. This is partly related to the interdisciplinary nature of eHealth in general, but also the characteristics of T2D with its emphasis on lifestyle interventions. Areas that has been touched upon in the project are; medicine, informatics, engineering and social sciences. In an optimal development process experts in each of the fields are to be involved. Yet, in this project the authors have had to take upon most of these roles. In order to gain insight to each respective area, consultations with specialists in regional eHealth development has been held. This approach has required a number of minor iterations and updates to take place throughout the development process. Another consequence is that most of the presented parts can only serve as a basic foundation, rather than provide in-depth knowledge.

A large part of the presented concept is based on statements from the conducted interviews. It is therefore important to consider the interviewees state of mind during the data collection, since it has a direct effect on conclusions made. All of the involved nurses were happy to participate in the study and believed that the project was important for their future work environment. But, few had considered their role in the digitalisation process prior to the interview and they had little suggestions of digital improvements. Moreover,

the interviews were conducted at the primary care centres and this is believed to have distracted the participants as the interviews were occasionally interrupted by colleagues. Furthermore, most of the nurses were very gentle when providing feedback during the evaluation workshops, despite being encouraged to freely speak their mind. There is thus a risk that important comments have been missed.

Regarding the patient interviews, it is relevant to acknowledge that each of their cases were very specific. They all shared their private story, and it required much skill to listen carefully and still direct them towards the study's intention. Furthermore, as the patients were recruited on a voluntary basis, all of them were involved and interested in diabetes management. The gathered results would perhaps have been different if the patients were randomly selected.

During the project an understanding of the formal aspects regarding regional development processes have been obtained. The preferred course of action when initiating projects involving the health care is for the project to be introduced by the care providers themselves. Further iterations in the project will thus benefit from identifying a regional representative. In retrospect, a designated contact in the health care could have reduced the hindrance related to the recruitment of T2D patients and diabetes nurses. The small number of interviewees has led to the need of necessary generalisations in order to form conclusions regarding the targeted user group. More participants would have enhanced the trustworthiness of the study, especially considering that the involved patients are to represent a large and variable group. Another advantage would have been to gain information regarding previous or ongoing T2D development projects in the region prior to the study was conducted. The current lack of insight in the manner permits an unintentional overlap in posed research questions.

8.5 Recommendations for future research

When considering future research on the topic of T2D and eHealth, three possible directions have emerged. Firstly, the UCD process and requirements engineering emphasise the use of iterative approaches in order to develop a solution that will capture the needs of the users. In this project, one iteration has been performed, and there is thus a possibility to update the requirements further and so also the accompanying concept exemplification. With more iterations, the development process could benefit from involving a number of different stakeholders, such as health care personnel, patients, developers and designers, as different stakeholders put different demands on the solution. Another research aspect would be to consider the practical implementation of the suggested solution. When the designed concept is finalised, a pre-study with diabetes nurses and T2D patients can be conducted, in which it is important to have a close contact with the stakeholders to capture their perceptions during the daily use of the solution. Lastly, even though the present study has been focusing on the management of T2D, the development methodology and the results are transferable to other chronic conditions. The emphasis on self-care is common in the chronic care, as well as the issue of low adherence to lifestyle interventions. There is thus a possibility to cooperate across different specialities to transfer acquired knowledge and enhance the development process of eHealth interventions.

9

Conclusion

This chapter concludes the report and presents answers to the posed research questions.

RQ1: How can the management of T2D in the primary care be supported with digital solutions?

Diabetes education is essential to obtain an active patient who is ready to take on an independent responsibility for self-care, but the present diabetes education is too standardised and do not meet all needs of the patients. The proposed digital solution supports the educational process by allowing individualisation of content, self-reflection, and a structured data gathering method for patients. By bringing attention to areas of concern prior to annual meetings, a more productive interaction between patient and nurse is encouraged. Further support may also be given by the nurse through direct feedback on patients' progress.

RQ2: Which technical and organisational aspects should be considered before implementation of eHealth solutions in the T2D care?

This question was answered by a number of non-functional requirements, seen in Table 6.3. There is a strong drive towards a more digitalised health care in Sweden and a number of visions has been formed on a national and regional level to promote eHealth implementations. On the other hand, the development is hampered by lack of interoperability between the involved clinical information systems. At present, the regional data architecture enables eHealth solutions to be implemented, either as an external application, or through the SoB platform.

In conclusion, VGR do possess the technical and organisational elements required to introduce an eHealth solution in the T2D care and this study has provided a basic theoretical and practical foundation for a future implementation. More work is necessary to promote interoperability, but eHealth can be used to improve the self-care for individual T2D patients today.

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A

Interview guide 1

Interviewee:

Diabetes nurse

Purpose of the interview:

Obtain an understanding of the working situation of the diabetes nurse and the care process of a diabetic patient. More specifically, the focus of the interview is to understand the different aspects of the care process where information exchange, goals and gates are emphasized.

Short introduction about the researchers and the project.

Ask for informed consent. Check whether recording is ok.

Ask the interviewee to introduce themselves.

- For how long have you been working with diabetes?
- For how long have you been working on this primary care center?

General about their working situation.

- How many patients with T2D are listed on this primary care center?
- How many patients do you meet every week?
- How is your time divided between diabetic and general patients?
- Do you have any contact with other diabetes nurses?

Diagnosis

- In which setting is diabetes most commonly detected?
- Who sets the diagnosis?

First meeting

- What happens during the first meeting with a diabetes patient?
- What is the purpose of this meeting?
- How long is the meeting?
- Which other parties are involved in the first meeting?
 - How is this contact maintained?
 - Which information is exchanged between the parties?
- Does the patient receive any information folders or advice of internet sites to visit?
- Is there any follow up on the first meeting?

Routine visits

- How often does the patient visit the health care?
 - Which instances of health care do the patient meet during the routine care?
 - How is the communication between the different instances maintained?
- What is the purpose of the routine visits?
- What do you discuss during the routine visit with a diabetes nurse?
 - What do you measure?
 - Which feedback do you provide to the patient on the measured values?
 - What is the patient typically concerned about?
- Is there any possibility for the patient to seek care between the routine visits?

Self-care

- Which support do the patients have in their self-care today?
- What do you consider to be the health care's role in supporting the patient's self-care today?
- Which expectations do you have on the patient's self-care?
 - Are there any goals?
 - Are the goals followed up?
- Which diabetes education does the patients receive?
- Do you consider your patients to be informed about their condition?

Technology

- Which medical information system do you use?
- Are you using any software specially developed to manage diabetes?
- Is it common for the patients to use any kind of technical aid?
- Is there anything you specifically wish for in a technical solution?

B

Interview guide 2

Interviewee:

Diabetes nurse

Purpose of the interview:

Evaluate the developed eHealth concept.

Introduction where the goal and scope of the project are stated, and the intended outcome of the workshop is explained.

Short description of the identified problem areas.

Description of the concept and working methods.

- Education connected to every day life.
- Reflections.
- Feedback.

Show the solution for the interviewee.

- Give tasks from a patient perspective.
 - Enter the solution to read your scheduled education.
 - Read about the ongoing assignment.
 - Log blood glucose values.
 - Report completion of an assignment.
 - Take a look at your weight curve.
 - Read about your upcoming visit with the diabetes nurse.
 - Read the feedback given on reflection.
- Give tasks from a nurse perspective.
 - Check status of a patient.
 - Enter a new patient.

Evaluation of the solution.

- General comments.
- What is the key benefit of this solution?
- What feature do you remember the most after using the solution?
- Who would benefit from using the solution?
- What are the drawbacks of the intended solution?
- Who would not benefit from using this solution?

- What would you like to change about the solution?

Explain our requirements and how they are connected to the solution.

- Are all the presented requirements relevant?
- Are there any additional requirements?

Show and explain the identified problem areas.

- Are all the presented problem areas relevant?
- Are there any additional problem areas?

Workshop ending with final comments.

C

Interview guide 3

Interviewee:

T2D patient

Purpose of the interview:

Obtain an understanding of how the care process of diabetes is perceived from the patient's point of view. Discuss the usage of digital solutions in their everyday life.

Short introduction about the researchers and the project.

Ask for informed consent. Check whether recording is ok.

Ask the interviewee to introduce themselves.

- When were you diagnosed with diabetes?
- Are you taking insulin?

Diagnosis

- How was your diabetes discovered?
- How did you perceive the diagnosis, was it expected?

The first contact

- How long did you wait from the diagnosis to the first meeting with the nurse?
- What do you remember from the first meeting?
- What did you expect to obtain from the first meeting?
- How did you perceive the education regarding diabetes that you got from your nurse?
- Was the education relevant for you?
- Was the level of the education appropriate?
- Were you able to connect the given information to your everyday life?
- Did you know how to handle your diabetes self management after the first meeting?

Routine visits

- How often do you meet your diabetes nurse today?
- What do you discuss during the routine visits?
- What would you like to discuss during the meetings with the diabetes nurse?
- Have you sought contact with the diabetes nurse outside the scheduled visits?
- Do you know how to contact your diabetes nurse?

Self-care

- How does the diabetes affect your everyday life?
- Do you log any vital parameters at home?
- How much support do you receive from the health care to pursue your self-care?
- What do you consider to be the health care's role in supporting your self-care?
- What overview do you have over your care process?

Technology

- Which digital solutions do you use in your everyday life?
- Do you use any particular diabetes apps?
- Would you be interested in pursuing a digital education program regarding diabetes?
- How much time are you prepared to spend upon such a program?
- Have you used the web portal 1177, and if so, which parts have you used?

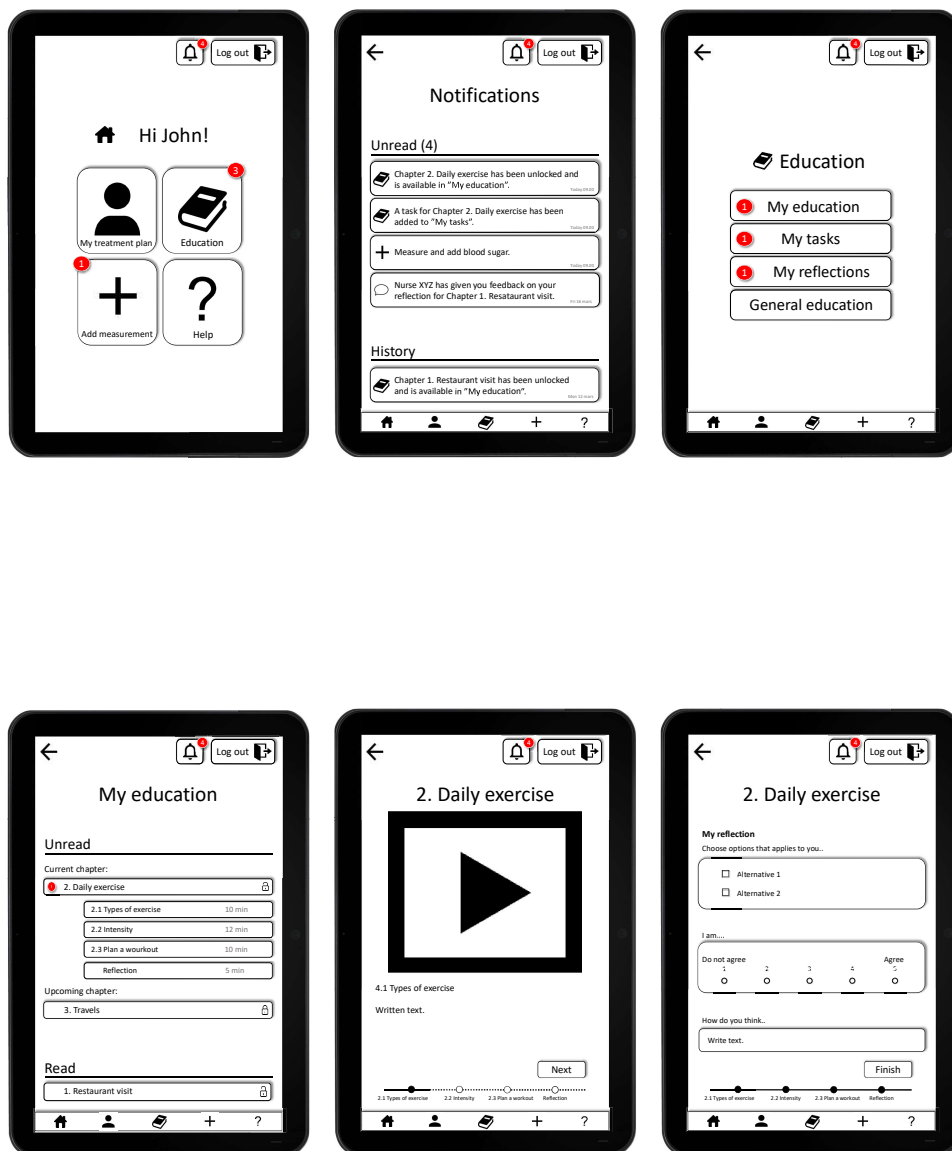
Closure of interview

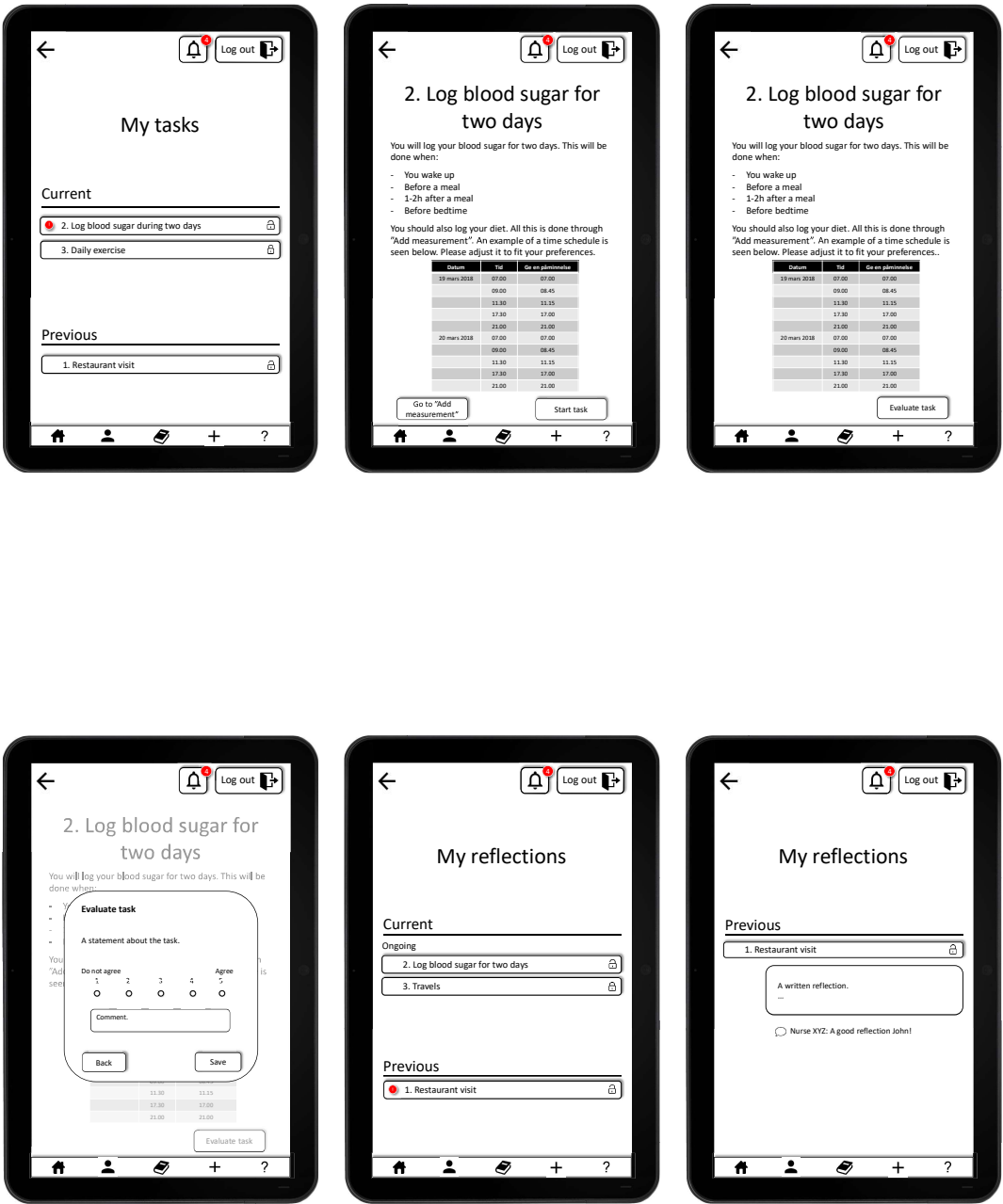
- Is there anything else you would like to discuss?
- Thank you for your participation.

D

User interfaces

Patient view



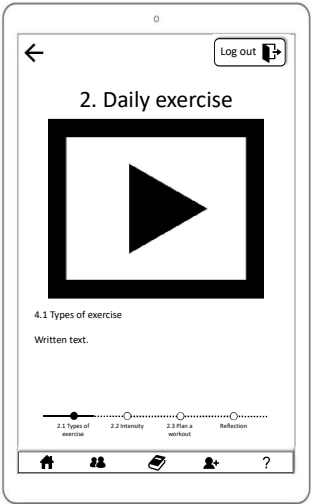
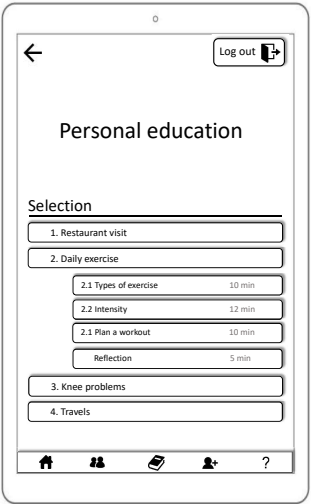
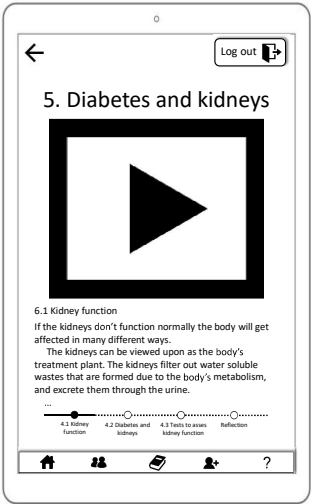
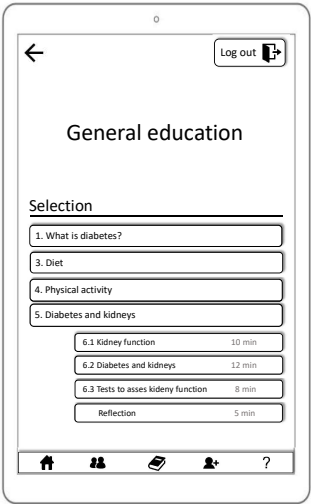
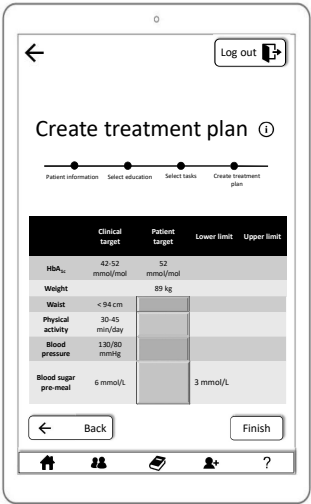


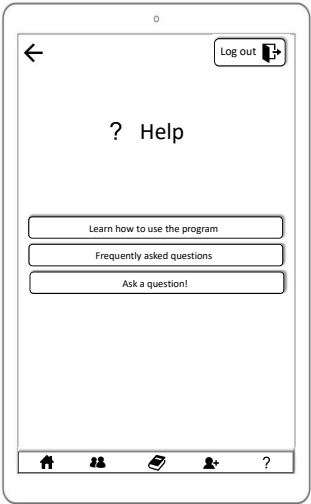
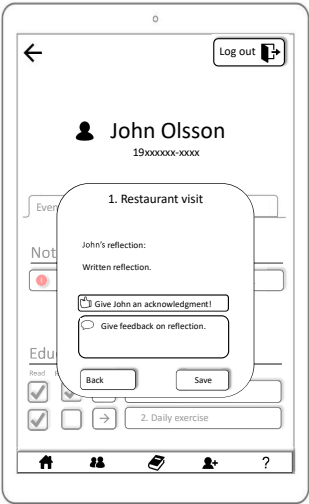
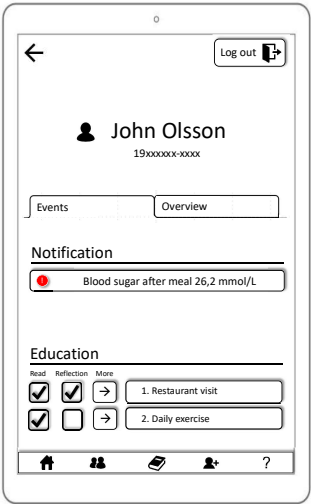
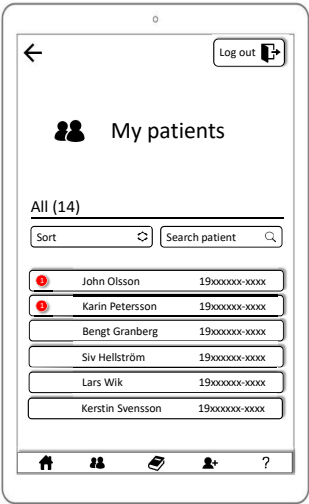
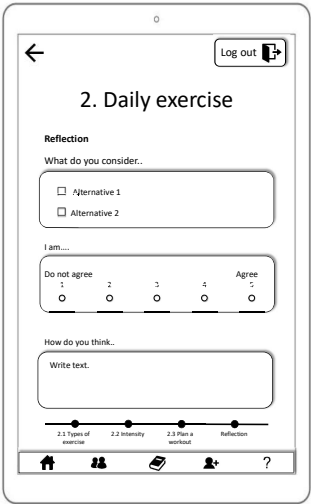




Nurse view







E

Sitemap

A schematic overview of the concept has been visualised in the form of two sitemaps, one for the patient view and one for the nurse view. The sitemaps describe the content and accessible pages in each view. The patient view of the solution is visualised in Figure E.1 while Figure E.2 shows a sitemap of the nurse's view.

Patient view

All patients are provided with a basic set of educative material regarding the condition (*Education-General*), as well as an individualised set of material that address the patient's specific concerns and problem areas (*Education-Personal*). To consolidate the educated material the patient is required to give reflections. A reflection is done before further education is possible. Each reflection is saved (*Education-Reflections*) to remind the patient of what has been taught. The reflections highlights areas the patient struggles with and can therefore be used in future meetings and discussions with the health care. Furthermore, patients can get feedback on reflections made (*Education-Reflections* or *Notification-Feedback*), either through comments or an acknowledgement.

To further consolidate the material and improve the patient's self-care skills a set of tasks related to the education is chosen (*Education-Tasks*). The tasks realises the material by transferring digital information to real life experiences. The tasks are also intended to be reflected upon. As with reflections regarding educational material, evaluations of performed tasks are saved (*Tasks-Finished*) to enable revision on an appropriate occasion.

Through the logging function the patient is given a set of parameters (*Logg-Parameter*) that can be measured in an home environment with simple monitoring devices or assessments. Measurements can be manually added or imported to the system through synchronisation with a home monitoring device. To reduce errors of manual inputs, a confirmation is required if values are exceeding an upper or lower limit. When adding a new measurement, the patient is provided with a trend curve of the parameter (*Parameter-Graphical display*), where previously added values are seen along with a target value and possibly also upper and lower recommended limits.

In combination with an assignment in an education section, directed measurements of diabetes related parameters can be performed. The required directed measurements are highlighted visually in the logging function, or through a reminder in the system (*Notification-Reminder*).

The patient is given an overview of the care process with a time line (*My plan-Time line*) including information about historical and future contacts with the health care as well as lab tests. Meetings included in the time line contain information regarding whom to meet, when, where and the intention of the meeting. A meeting notation also have the possibility of reminding the patient of tests to take and things to reflect upon in advance.

An overview of quantitative data is available through a table which includes the parameters in the T2D care plan *Individual care agreement* [83], with target values and current levels (*My plan-Treatment plan*). The treatment plan also gives the possibility of viewing the parameters as a trend curve, with the target value and limits included.

To ease the usage of the solution and increase compliance, a number of notification possibilities are included. The patient receives a reminder of scheduled meetings, directed measurements, available education sections to read and tasks to perform. Additionally, a notification will occur when feedback has been given on a reflection.

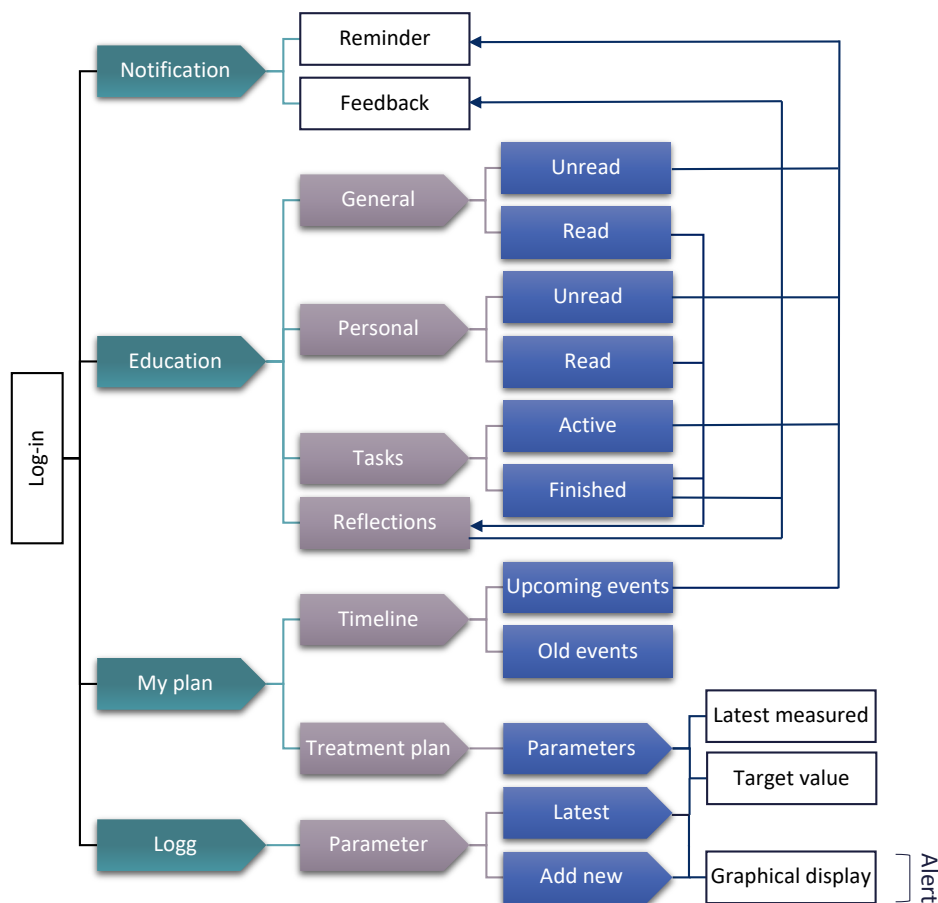


Figure E.1: Sitemap of patient's view.

Nurse view

The nurse has the possibility to add a patient to the system (*Add patient*). Required information (*Information*) is the social security number and name. However, the support will be more individualised if parameters such as age and gender is stored, as these factors have an effect the choice of target values for key parameters of T2D. In collaboration with the patient, educational sections and tasks that address the patient's concerns can be added (*Select education/Select tasks*). All educational material and tasks that is to be offered to patient's are also available for nurses to read (*Education*). Finally, personalised target values for a number of physiological and lifestyle parameters can be chosen, along with recommended intervals (*Create treatment plan*).

Each patient added to the system, by the nurse, is available either through the search function at the home page (*Search patient*) or a patient list (*My patients*). The search function requires a name or a social security number, while the patient list can be sorted according to parameters such as recent notifications, name etc.

When a patient has been selected, the nurse is provided with list of recent events (*Events*) and an overview of logged parameters and clinical measurements (*Overview*). Events includes notifications of drifting values (*Notifications*), finished reflections, educational sections and tasks (*Education*). Details regarding the events can be retrieved and the nurse have the possibility to give feedback to the patient, either through an acknowledgement or a written comment (*Feedback*). The overview of parameters is given through trend curves, with limits and target values (*Parameters*). Values exceeding limits are visually highlighted.

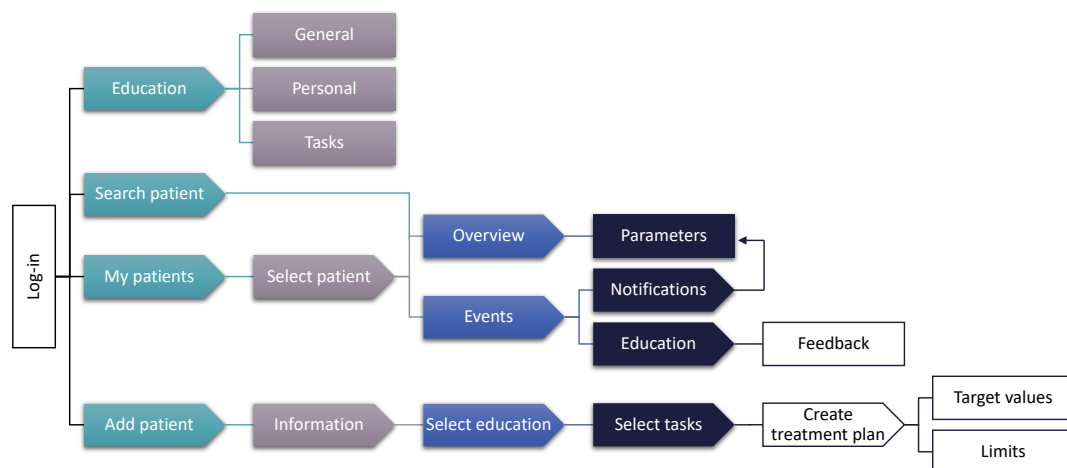


Figure E.2: Sitemap of nurse's view.

F

User cases

Below is a number of user cases presented, aiming to demonstrate the practical use of the proposed low fidelity prototype. Six user cases from the patient's view and two user cases from the nurse's view are presented.

Patient view

Table F.1: User case 1. Read educational material.

<i>Event</i>	The patient shall read education material.
<i>Trigger</i>	Patient motivation or notification of unlocked material.
<i>Preconditions</i>	Educative material has been chosen in collaboration with nurse at annual meeting. Material is scheduled to be read within a set date.
<i>Stakeholders</i>	Patient Nurse
<i>Action flow</i>	1. The patient access educative material through "Education". 2. The patient reads the unlocked education section in the system. 3. The patient reflects upon the educated material and answers to the questionnaire.
<i>Alternate flow</i>	1. The patient access educative material through notification. 2. The patient reads the unlocked education section in the system. 3. The patient reflects upon the educated material.
<i>Estimated time</i>	20 min

Table F.2: User case 2. Perform an assignment.

<i>Event</i>	The patient shall perform an assignment.
<i>Trigger</i>	Finished education section or notification of unlocked assignment.
<i>Preconditions</i>	Assignments has been chosen in collaboration with nurse at annual meeting. The assignments are scheduled to be performed within a set date.
<i>Stakeholders</i>	Patient Nurse
<i>Action flow</i>	1. The patient access assignment through "Education". 2. The patient reads about the assignment in the system. 3. The patient performs the assignment. 4. The patient reports the outcome and reflection of the assignment in the system.
<i>Alternate flow</i>	1. The patient access assignment through notifications. 2. The patient reads about the assignment in the system. 3. The patient performs the assignment. 4. The patient reports the outcome and reflection of the assignment in the system.
<i>Estimated time</i>	N/A

Table F.3: User case 3. Report blood glucose value.

<i>Event</i>	The patient shall report blood glucose value.
<i>Trigger</i>	Patient motivation or notification.
<i>Preconditions</i>	Blood glucose logging has been discussed at annual meeting and is unlocked. Nurse sets upper and lower limits. Patient have access to a self-monitoring device.
<i>Stakeholders</i>	Patient Nurse
<i>Action flow</i>	1. The patient access add blood glucose through "Logg" or notification. 2. The patient measures blood glucose. 3. The patient chooses the corresponding blood glucose value to add and save. 4. The patient gets an overview of logged blood glucose values.
<i>Alternate flow</i>	1. The patient access add blood glucose through "Logg" or notification. 2. The patient measures blood glucose. 3. The patient chooses the corresponding blood glucose to add and save. 4. The patient gets an alert that the blood glucose is exceeding predefined limits. 5. The patient gets a possibility to correct any mistake. 6. The patient gets an overview of logged blood glucose values.
<i>Estimated time</i>	5 min

Table F.4: User case 4. Display weight curve.

<i>Event</i>	The patient shall view weight curve.
<i>Trigger</i>	Patient motivation. Care centre visit.
<i>Preconditions</i>	Weight has been logged at some occasion.
<i>Stakeholders</i>	Patient
<i>Action flow</i>	1. The patient access treatment plan through "My plan". 2. The patient looks at weight trend curve available on the overview.
<i>Estimated time</i>	2 min

Table F.5: User case 5. Read about future event.

<i>Event</i>	The patient shall read about the upcoming visit to the nurse.
<i>Trigger</i>	Patient motivation. Reminder.
<i>Preconditions</i>	Scheduled meeting has been added to the system.
<i>Stakeholders</i>	Patient
<i>Action flow</i>	1. The patient access treatment plan through "My plan". 2. The patient locates the meeting of interest in the timeline. 2. The patient reads about the meeting.
<i>Alternate flow</i>	1. The patient obtains a reminder from the system. 2. The patient access meeting through the notifications. 3. The patient reads about the meeting.
<i>Estimated time</i>	2 min

Table F.6: User case 6. Read feedback on reflection.

<i>Event</i>	The patient shall read the feedback given on a reflection.
<i>Trigger</i>	Notification.
<i>Preconditions</i>	The nurse has read the reflection and given feedback.
<i>Stakeholders</i>	Patient Nurse
<i>Action flow</i>	1. The patient access reflections through "Education". 2. The patient locates reflection to which feedback has been provided. 3. The patient reads the feedback.
<i>Alternate flow</i>	1. The patient access reflection to which feedback has been provided through notification. 2. The patient reads feedback.
<i>Estimated time</i>	2 min

Nurse view

Table F.7: User case 7. Check status of patient.

<i>Event</i>	The nurse shall check the status of patients.
<i>Trigger</i>	Nurse motivation. Daily routine.
<i>Preconditions</i>	The nurse has set up an education program in collaboration with a number of patients.
<i>Stakeholders</i>	Nurse
<i>Action flow</i>	1. The nurse enters the list of the patients through "My patients". 2. The nurse sees that some patients have notifications. 3. The nurse chooses the patient of interest. 4. The nurse respond to event if necessary. 5. The nurse gets an overview of patient performance and logged values.
<i>Alternate flow</i>	1. The nurse chooses patient through "Search". 2. The nurse respond to event if necessary. 3. The nurse gets an overview of patient performance and logged values.
<i>Estimated time</i>	N/A

Table F.8: User case 8. Addition of new patient.

<i>Event</i>	The nurse shall add new patient.
<i>Trigger</i>	Discussion in meeting with patient.
<i>Preconditions</i>	The patient is motivated to try the system.
<i>Stakeholders</i>	Nurse Patient
<i>Action flow</i>	1. The nurse adds patient to the system through "Add patient". 2. The nurse adds required personal information about patient. 3. The nurse chooses education material and dates of completion. 4. The nurse chooses assignments to perform and dates of completion. 5. The nurse forms a treatment plan with target values, and lower and upper limits for possible parameters.
<i>Estimated time</i>	15 min

G

ER-diagram

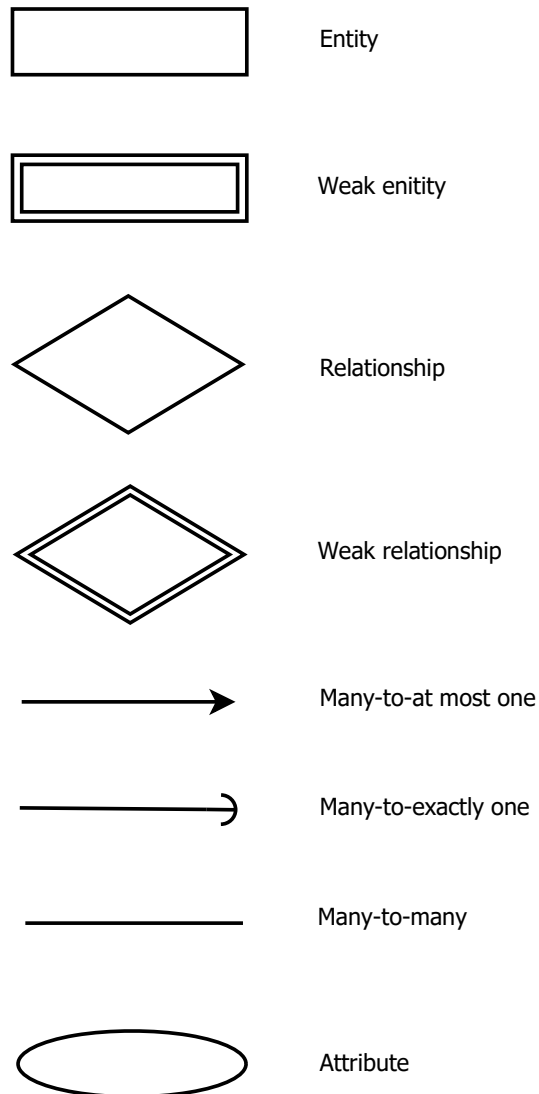


Figure G.1: Explanation of ER-diagram elements.

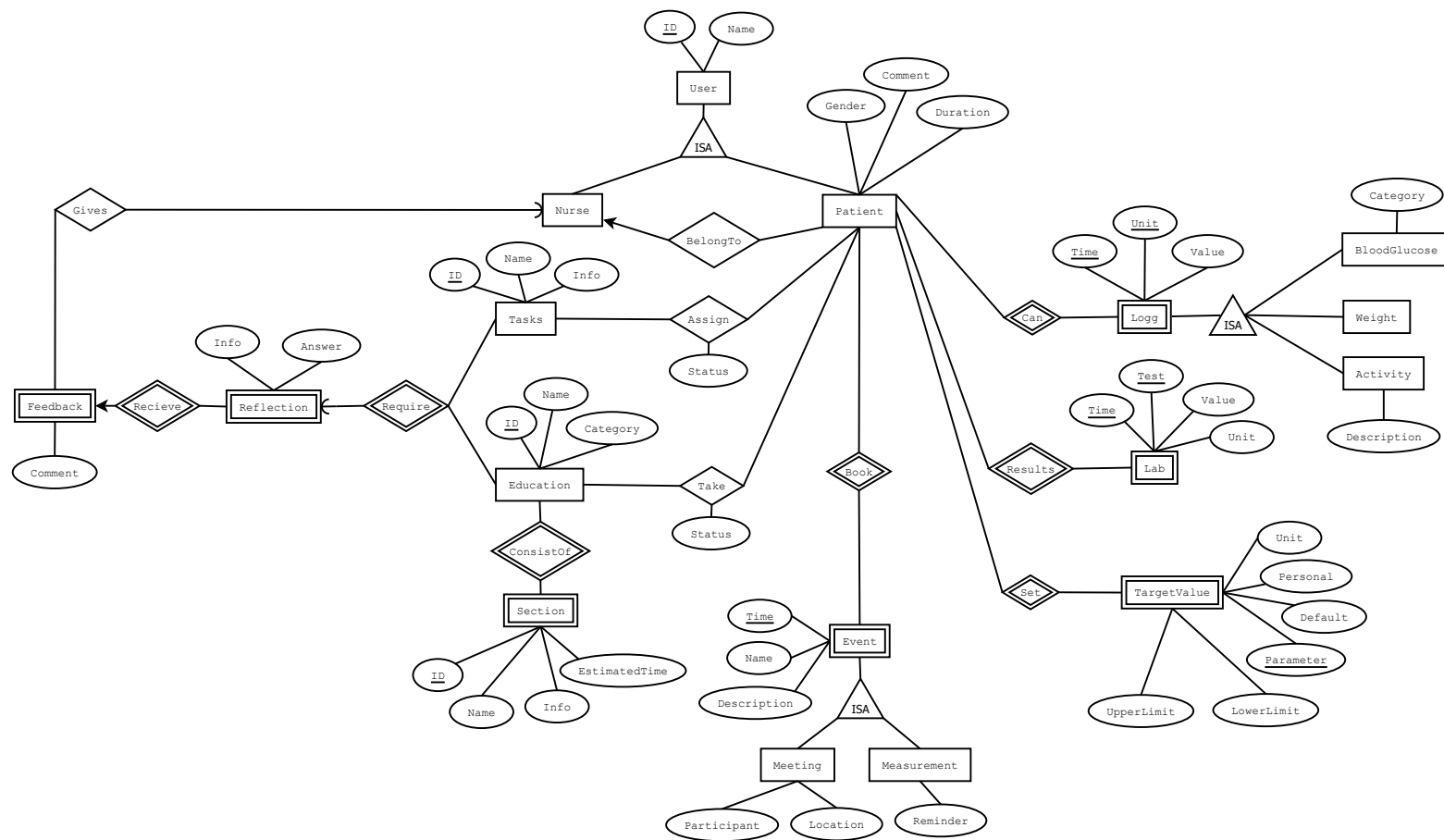


Figure G.2: ER-diagram of low-fidelity prototype.

H

Support and Treatment platform

Patient view



Figure H.1: Explanation for the symbols used in the system.

1177 VÄRDGUIDEN E-tjänster Logga ut Inloggad som Jane Doe

Hem » Stöd och behandling » Internetstöd för Diabetes typ II

Internetstöd för Diabetes typ II

Översikt Meddelanden Resultat

0 dagar sedan Internetstöd för Diabetes typ II startade. (rek. 30 dagar) Telefonnummer ej angivet

! Information från vårdgivaren Visa snabbguide

Aktiviteter Nästa aktivitet: 2018-04-23 18:00 Historik

★ Favoriter

Aktuellt innehåll

Grundläggande utbildning 1 dagar kvar

Att arbeta med Grundutbildning om diabetes

- Vad händer i kroppen?
- Fysisk aktivitet
- Kost

Tidigare innehåll

Rökning

Att arbeta med Rökning och diabetes

- Hur påverkar rökning din hälsa?
- Hur kan du sluta röka?

Att fylla i

Rökning

Figure H.2: Home page for the patient. The overview includes a progress bar, general information from the care giver, tasks (*Aktiviteter*), saved educational subsections (*Favoriter*), active educational sections (*Aktuellt innehåll*), finished educational sections (*Tidigare innehåll*) and questionnaires related to an education (*Att fylla i*). The educational sections can be expanded to see every subsection.

The screenshot shows the 1177 Vårdguiden website interface. At the top, there is a teal header with the 1177 Vårdguiden logo, 'E-tjänster', and a login button 'Logga ut' with the text 'Inloggad som Jane Doe'. Below the header, a breadcrumb trail reads: 'Hem » Stöd och behandling » Internetstöd för Diabetes typ II » Grundutbildning om diabetes » Vad händer i kroppen?'. The main heading is 'Internetstöd för Diabetes typ II'. Below this, there are three tabs: 'Översikt' (selected), 'Meddelanden', and 'Resultat'. The content area is titled 'Vad händer i kroppen?' and includes a star icon. The text explains that the body's cells require energy and that the body has a system to store energy in the liver and muscles. It then discusses insulin and blood sugar, stating that insulin is produced by the pancreas and helps transport sugar from food into the cells. It also mentions that high blood sugar can lead to complications like heart disease and stroke. At the bottom of the content area, there is a pagination bar with buttons '1', '2', '3', and a right arrow, along with a link 'Tillbaka till översikten'. The footer contains contact information: 'Ring supporten 0770-72 00 00', 'Mejla supporten', 'Läs mer om e-tjänster', and 'Webbkarta'. The bottom-most bar says '1177 Vårdguiden — En tjänst från Sveriges landsting och regioner'.

1177 VÅRDGUIDEN E-tjänster Logga ut Inloggad som Jane Doe

Hem » Stöd och behandling » Internetstöd för Diabetes typ II » Grundutbildning om diabetes » Vad händer i kroppen?

Internetstöd för Diabetes typ II

Översikt Meddelanden Resultat

Vad händer i kroppen?

I kroppens olika celler pågår en ständig aktivitet som kräver energi. Oavsett om vi går, står eller sover kräver cellerna därför tillgång till energi. Kroppen har utvecklat ett effektivt system för att lagra energi i särskilda energidepåer, bland annat i levern och i musklerna. Tack vare den här förmågan har kroppen tillgång till energi när som helst, även om vi bara äter och dricker ett fåtal gånger per dag.

Insulin och blodsocker

Kolhydrater och fett från maten innehåller mycket energi. Efter en måltid bryts kolhydrater ner till socker. Sockeret transporteras via blodet till de celler som ska lagra energin. För att sockret ska ta sig från blodbanan och in i cellerna måste det passera låsta celldörrar, dörrar som bara kan låsas upp av hormonet insulin. Insulin tillverkas och lagras i bukspottkörteln. När vi äter går en signal till bukspotts-körteln som frisätter insulin till blodbanan.

Kroppens system som tar hand om och lagrar energi är mycket effektivt men också ömtåligt. Om vi äter alldeles för mycket fett och socker blir energidepåerna överfulla. Då får insulin svårare att låsa upp celldörrarna och sockret stannar kvar i blodbanan, vilket leder till ett förhöjt blodsocker. Begreppet minskad insulinkänslighet syftar just till muskel- och levercellernas minskade känslighet för att låta sig öppnas av insulin. Det förhöjda blodsockret blir en signal till bukspottkörteln att producera mer insulin, ett tillstånd som kallas förstadium till diabetes. Till slut är bukspottkörteln uttröttad och producerar istället mycket mindre insulin. Det gör att blodsockret konstant är förhöjt och typ 2-diabetes är ett faktum (figur 2).

Ett för högt kaloriintag leder också till övervikt. När övervikten sätter sig kring buken blir leverns och bukspottkörteln förmåga att reglera blodsockret ännu sämre. Ett högt blodsocker skadar kroppens organ, ofta utan att det känns. När blodsockret har varit förhöjt under en tid blir man trött och orkeslös, får sänkt immunförsvar och kan drabbas av infektioner. Risken för stroke och hjärtinfarkt ökar kraftigt. Typ 2-diabetes är därför en allvarlig sjukdom.

1 2 3 »

[Tillbaka till översikten](#)

Ring supporten 0770-72 00 00 Mejla supporten Läs mer om e-tjänster Webbkartan

1177 Vårdguiden — En tjänst från Sveriges landsting och regioner

Figure H.3: An educational section with three subsections.

1177
VÄRDEGUIDEN
E-tjänster
Logga ut
Inloggad som Jane Doe

Hem » Stöd och behandling » Internetstöd för Diabetes typ II » Grundutbildning om diabetes » Fysisk aktivitet

Internetstöd för Diabetes typ II

Översikt
Meddelanden
Resultat

Fysisk aktivitet

Även med små, små förändringar minskar du risken för skadliga effekter av typ 2-diabetes, oavsett vad du gör och hur intensivt det blir. Allt beror på vad din kropp är van vid. Sitter du stilla mycket får du stor effekt av att stå upp en stund då och då. Det första som händer då är att blodsockret går ner. Det innebär att alla klarar av att göra den förändring som krävs, även om man har flera andra sjukdomar eller har värk.

Du är ofta stillasittande och vill börja försiktigt.



Så ökar du effekten av fysisk aktivitet:

Stå oftare

Ta en paus från stillasittandet var trettionde minut genom att gå eller stå en liten stund. Vill du gå ner i vikt? Se kolumn 3.

Du tar korta promenader eller liknande och du vill **behålla** din hälsa.



Så ökar du effekten av fysisk aktivitet:

Ta fler steg

Genom att öka din fysiska aktivitet upp till 7000 steg per dag ger du kroppen den aktivitet som krävs för att behålla kroppsliga funktioner.

Du vill se en större förändring.



Så ökar du effekten av fysisk aktivitet:

Öka takten

När du vill gå ner i vikt eller få ett starkare hjärta rör dig så att du blir lite extra varm och får högre puls.

Obligatoriskt att fylla i

Instruktion

Hur mycket fysisk aktivitet som krävs för att skapa positiva förändringar beror på din utgångspunkt. Det viktigaste är att du ökar mängden fysisk aktivitet. Ta en titt på var du befinner dig just nu för att se vad du behöver för att minska risken för hjärtinfarkt och stroke.

Fysisk aktivitet

Vilken av figurerna passar bäst in på dig?

☒ Du är ofta stillasittande och vill börja försiktigt.
☐ Du tar korta promenader eller liknande och vill behålla din hälsa.
☐ Du vill se en större förändring.

Hur många steg har du som mål att gå varje dag? (endast siffror)

5000

Spara och skicka

Senast sparat: 2010-04-19 10:01

1
2
3

Tillbaka till översikten

Figure H.4: An educational subsection with mandatory reflections and goal setting included.

1177 VÅRDGUIDEN E-tjänster Logga ut Inloggad som Jane Doe

Hem » Stöd och behandling » Internetstöd för Diabetes typ II

Internetstöd för Diabetes typ II

Översikt Meddelanden Resultat

0 dagar sedan Internetstöd för Diabetes typ II startade. (rek. 30 dagar) Telefonnummer ej angivet

! Information från vårdgivaren Visa snabbguide

Aktiviteter Nästa aktivitet: 2018-04-23 18:00 Historik

Logga blodsocker	Nästa: 2018-04-23 18:00	➔
Fysisk aktivitet	Nästa: 2018-04-23 20:00	➔
Tobaksanvändning	Nästa: 2018-04-29 10:00	➔

★ Favoriter

Aktuellt innehåll

Grundläggande utbildning 1 dagar kvar

Tidigare innehåll

Rökning

Förklaringar av symboler

☐ Kan läsas	☒ Pågående	☐ Det finns saker att fylla i på sidan
☐ Kan ännu inte läsas	☒ Färdig	

Öppen - fri att arbeta i Lästäge - du kan läsa men inte ändra i dina svar

Figure H.5: The tasks section can be expanded to see all active tasks and the time they are scheduled to be performed.

Hem » Stöd och behandling » Internetstöd för Diabetes typ II » Historik » Logga blodsocker

Internetstöd för Diabetes typ II

Översikt Meddelanden Resultat

Logga blodsocker

mån 23 apr 07:00

Blodsockernivå

mmol/l

Spara

Här kan du skriva en sidkommentar till din behandlare

Skriv kommentar

Figure H.6: Perform the scheduled activity Log blood sugar. When recording parameters it is possible to leave a comment.

1177 VÄRDGUIDEN E-tjänster Logga ut Inloggad som Jane Doe

Hem » Stöd och behandling » Internetstöd för Diabetes typ II » Meddelande

Internetstöd för Diabetes typ II

Översikt Meddelanden Resultat

Meddelanden

Här visas skickade och mottagna sidkommentarer. Nya kommentarer kan lämnas på sidor där kommentarsfunktionen är aktiverad.

Logga blodsocker 2018-04-23 14:00
Senaste meddelandet 2018-04-19 16:14

Detta är kommentarer på formulär: "Logga blodsocker 2018-04-23 14:00" [Gå till sidan](#)

Skriv meddelande

2018-04-19 16:14

Ok, bra då vet jag. [Visa mindre](#)

Jane Doe 2018-04-19 16:07
Kalas med tårta. [Visa mer](#)

Fysisk aktivitet 2018-04-21 20:00
Senaste meddelandet 2018-04-19 16:04

Figure H.7: The care giver may respond to a comment.

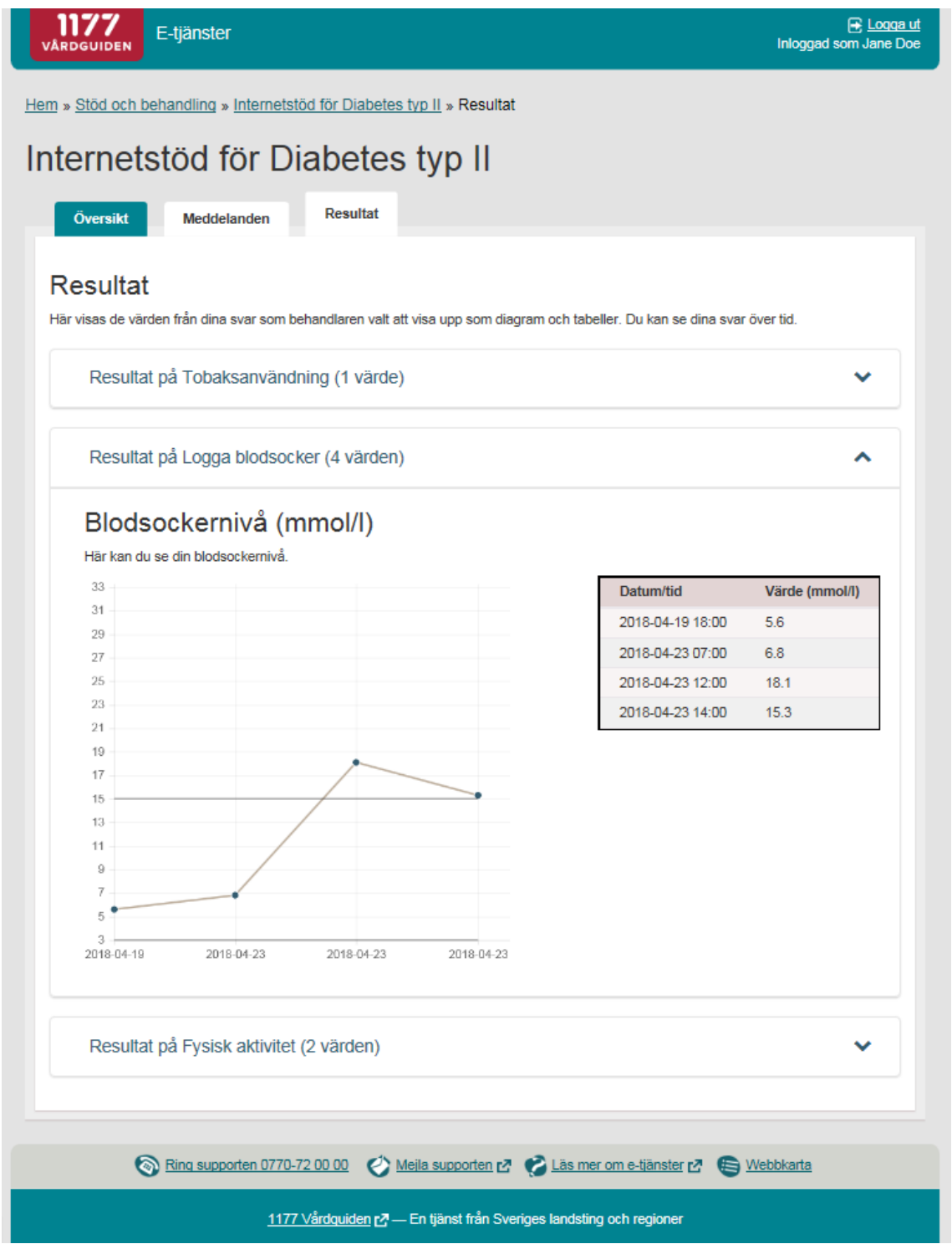
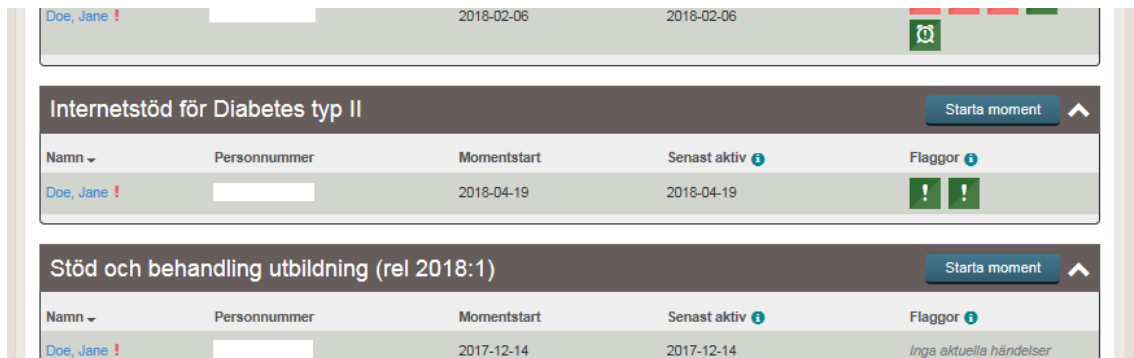


Figure H.8: Trend curve of recorded parameters with upper and lower limits.

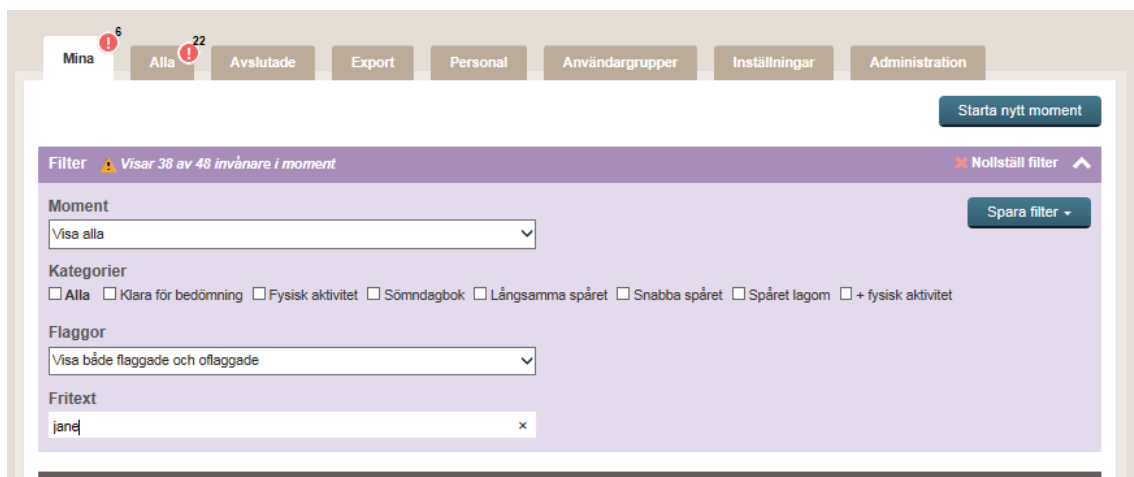
Nurse view



Internetstöd för Diabetes typ II				
Namn	Personnummer	Momentstart	Senast aktiv	Flaggor
Doe, Jane		2018-04-19	2018-04-19	!

Stöd och behandling utbildning (rel 2018:1)				
Namn	Personnummer	Momentstart	Senast aktiv	Flaggor
Doe, Jane		2017-12-14	2017-12-14	Inga aktuella händelser

Figure H.9: Home page with a patient list with name, social security number, when they were added to the system, latest log-in and notifications (*Flaggor*).



Filter Visar 38 av 48 invånare i moment

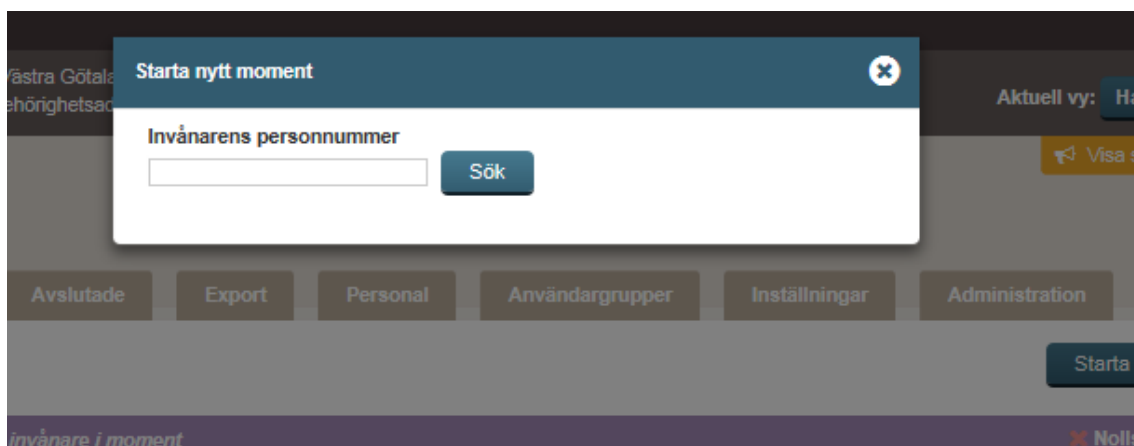
Moment: Visa alla

Kategorier: ☐ Alla ☐ Klara för bedömning ☐ Fysisk aktivitet ☐ Sömnloggbok ☐ Långsamma spåret ☐ Snabba spåret ☐ Spåret lagom ☐ + fysisk aktivitet

Flaggor: Visa både flaggade och oflaggade

Fritext: jane

Figure H.10: Patients can be found through the search function.



Starta nytt moment

Invånarens personnummer

Sök

Figure H.11: A patient can be added to the system with their social security number.

The screenshot shows a web application interface for a patient named Jane Doe. At the top, there is a navigation bar with tabs: Mina (6), Alla (22), Avslutade, Export, Personal, Användargrupper, Inställningar, and Administration. Below this, the patient's name 'Jane Doe' is displayed, followed by the program title 'Internetstöd för Diabetes typ II' and 'Version 1.0'. A secondary navigation bar includes 'Hantera', 'Resultat', 'Meddelanden', 'Tidslinje', and 'Händelser'. The main content area shows a summary of the patient's status: 'Dagar i momentet: 0 (rek. 30 dagar)' and 'Moduler avklarade: 0 av 2'. It also lists 'Senaste aktiv: Aldrig' and 'Moment startade: 2018-04-19'. A section titled 'Du har inga ohanterade händelser' is present. Below this, there are sections for 'Välkomsttext till invånaren', 'Aktuella moduler' (listing 'Grundläggande utbildning' with a 'Sätt till avklarad' button and 'Dagar kvar: 1'), 'Kommande moduler' (listing 'Rökning' with a 'Sätt till aktuell' button and 'Dagar kvar: 1'), 'Aktivitetsplaner', and 'Länkade moment'. At the bottom, there are buttons for 'Avsluta' and 'Vidmakthåll'.

Figure H.12: Overview of a patient. the home page includes the status of the patient, what educational section that are active (*Aktuella moduler*), finished and upcoming (*Kommande moduler*), and their tasks (*Aktivitetsplaner*). It is possible to activate or end an education (ställ till), or set a time for availability (*Dagar kvar*).

Mina > Jane Doe

Mina ¹ Alla ²² Avslutade Export Personal Användargrupper Inställningar Administration

Jane Doe ()

Internetstöd för Diabetes typ II
Version 1.0

Hantera Resultat Meddelanden Tidslinje Händelser

Dagar i momentet: 0 (rek. 30 dagar) Moduler avklarade: 1 av 2 [Egenskaper](#)

Senaste aktiv: Aldrig ¹ Ansvarig behandlare: [\[Redacted\]](#)
Moment startade: 2018-04-19 Telefonnummer: Ej inlagt i e-tjänsten ¹

[Se historik i tidslinjen](#)

Du har inga ohanterade händelser

Välkomsttext till invånaren [v](#)

Aktuella moduler [^](#)

Grundläggande utbildning [Sätt till avklarad](#) Dagar kvar: 1 [p](#) [v](#)

Avklarade moduler [v](#)

Aktivitetsplaner [^](#)

[Samlad historik](#) [Översikt aktivitetsplaner](#)

Namn	Utförda aktiviteter ¹	Senaste utförda aktivitet	
Logga blodsocker ¹	0/1	-	Historik p
Tobaksanvändning ¹	0/1	-	Historik p
Fysisk aktivitet ¹	0/1	-	Historik p

Länkade moment [^](#)

Länkningar [Lägg till länkning](#)

Det finns inga länkade moment [Välj moment](#) [v](#) [Lägg till](#)

[Avsluta](#) ¹ [Vidmakthåll](#) ¹

Figure H.13: Status of tasks.

Jane Doe ()

Internetstöd för Diabetes typ II
Version 1.0

Hantera Resultat Meddelanden Tidslinje Händelser

Dagar i momentet: 0 (rek. 30 dagar) Moduler avklarade: 1 av 2 [Egenskaper](#)

Senaste aktiv: Aldrig [i](#) Ansvarig behandlare: [i](#)
Moment startade: 2018-04-19 Telefonnummer: Ej inlagt i e-tjänsterna [i](#)

[Se historik i tidslinjen](#)

Olästa formulär utan flagga

- Fysisk aktivitet - var är du idag? ☐
- Tobaksanvändning ☐
- Logga blodsocker ☐
- 2018-04-22 10:00 ☐
- 2018-04-19 18:00 ☐
- 2018-04-23 07:00 ☐
- 2018-04-23 12:00 ☐
- Fysisk aktivitet ☐
- 2018-04-19 20:00 ☐

Aktiviteter

- [! Registrering utanför målvärden för aktivitet Logga blodsocker](#)
- [! Registrering utanför målvärden för aktivitet Logga blodsocker](#)

Välkomsttext till invånaren [v](#)

Aktuella moduler [^](#)

Grundläggande utbildning [Sätt till avklarad](#) Dagar kvar: 1 [v](#)

Avklarade moduler [v](#)

Aktivitetsplaner [^](#)

[Samlad historik](#) [Översikt aktivitetsplaner](#)

Namn	Utförda aktiviteter i	Senaste utförda aktivitet	
Logga blodsocker i	4/5	2018-04-23 14:00	Resultat Historik i
Tobaksanvändning i	1/2	2018-04-22 10:00	Resultat Historik i

Figure H.14: New activities from the patient will be seen on the home page.

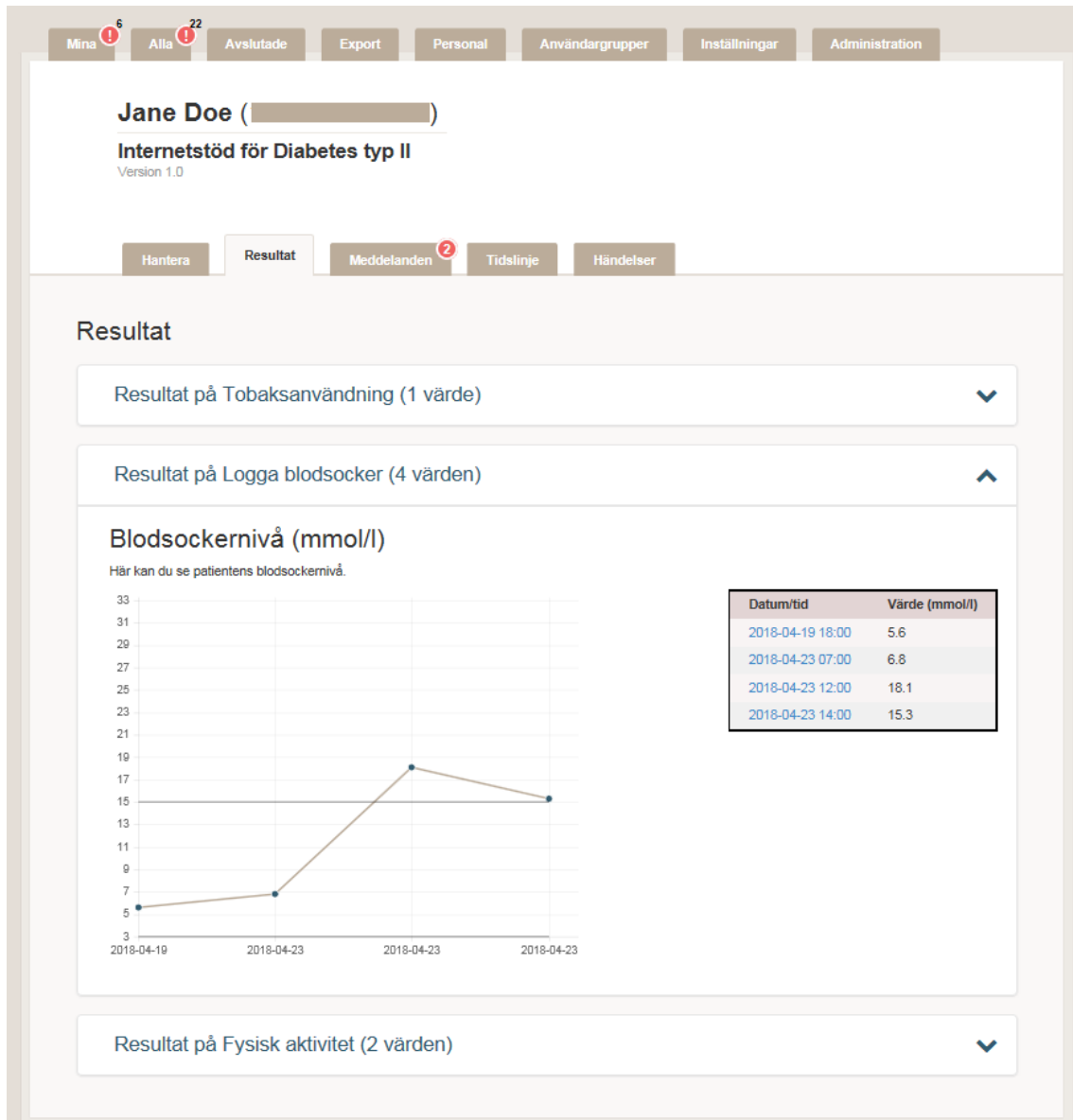


Figure H.15: Trend curve related to a task, upper and lower limits are available.

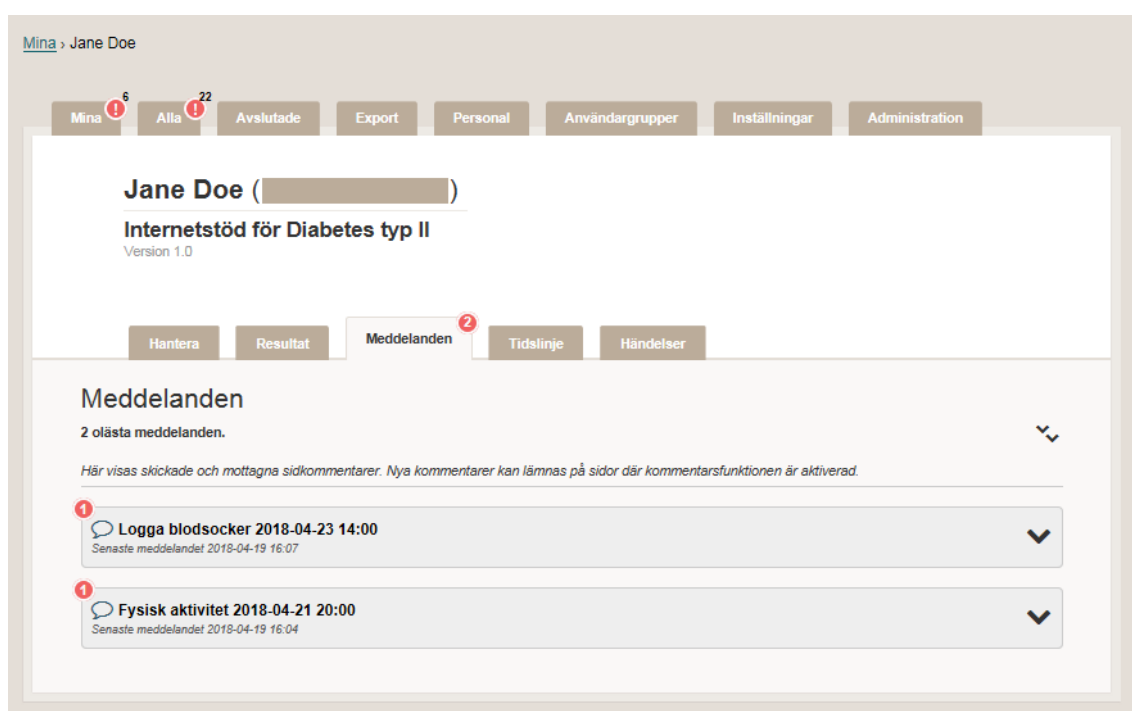


Figure H.16: Comments from the patient and notification of values exceeding limits.

The screenshot displays the user interface of a patient support platform. At the top, a navigation bar includes links for 'Mina', 'Alla', 'Avslutade', 'Export', 'Personal', 'Användargrupper', 'Inställningar', and 'Administration'. Below this, the user's profile 'Jane Doe' is shown, along with the title 'Internetsöd för Diabetes typ II' and 'Version 1.0'. A secondary navigation bar contains 'Hantera', 'Resultat', 'Meddelanden' (highlighted with a red circle), 'Tidslinje', and 'Händelser'. The main section, titled 'Meddelanden', indicates '2 olästa meddelanden' and '1 utkast'. A note states: 'Här visas skickade och mottagna sidkommentarer. Nya kommentarer kan lämnas på sidor där kommentarsfunktionen är aktiverad.' The first comment, 'Logga blodsocker 2018-04-23 14:00', is marked as an 'Utkast' (draft). It includes a text input area with the text 'Ok, bra då vet jag.' and a 'Skicka' button. A sidebar on the right offers a notification setting: 'Avisera till inkorgen i e-tjänsterna: Direkt'. Below the comment, a response from 'Jane Doe' dated '2018-04-19 16:07' is visible, stating 'Kalas med tårta.' with a 'Visa mindre' link. The second comment, 'Fysisk aktivitet 2018-04-21 20:00', is partially visible at the bottom.

Figure H.17: Comments from patient's can be viewed and responded to.

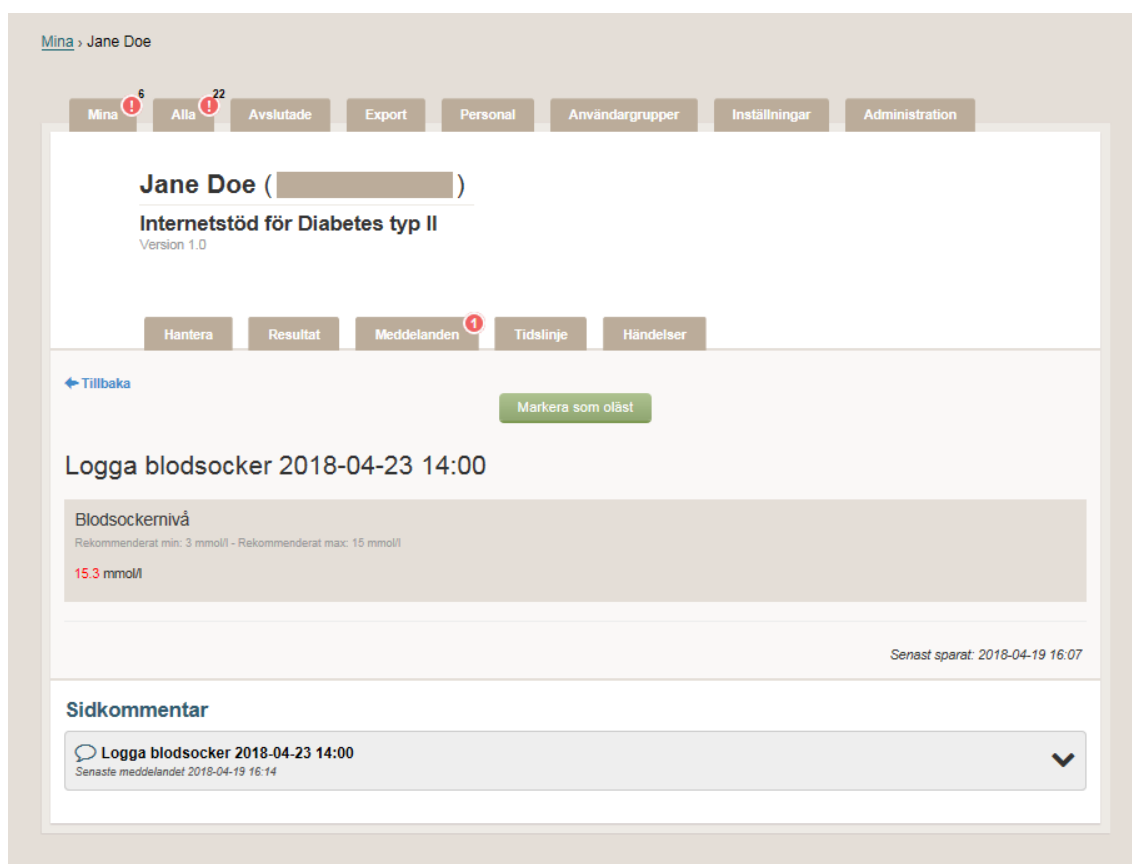


Figure H.18: A message regarding exceeding blood sugar.

Mina > Jane Doe

Mina ⁵ Alla ²² Avslutade Export Personal Användargrupper Inställningar Administration

Jane Doe ()

Internetstöd för Diabetes typ II
Version 1.0

Hantera Resultat Meddelanden **Tidslinje** Händelser

Visa mellan datumintervall: 2018-04-12 - 2018-04-19 ☐ Veckovis ☒ Hela perioden

Filter

☒ Alla ☐ Aktivitetsplaner ☐ Flaggor ☐ Formulär ☐ Meddelanden ☐ Modul ☐ Moment ☐ Resultat

Hela perioden

Aktivitetsplaner

Aktiviteten Logga blodsocker 2018-04-23 14:00 sparades
2018-04-19 16:07 av: Jane Doe

Aktiviteten Logga blodsocker 2018-04-23 12:00 sparades
2018-04-19 16:06 av: Jane Doe

Aktiviteten Logga blodsocker 2018-04-23 07:00 sparades
2018-04-19 16:06 av: Jane Doe

Aktiviteten Fysisk aktivitet 2018-04-21 20:00 sparades
2018-04-19 16:04 av: Jane Doe

Aktiviteten Fysisk aktivitet 2018-04-19 20:00 sparades
2018-04-19 16:03 av: Jane Doe

Aktiviteten Tobaksanvändning 2018-04-22 10:00 sparades
2018-04-19 16:03 av: Jane Doe

Aktiviteten Logga blodsocker 2018-04-19 18:00 sparades
2018-04-19 16:02 av: Jane Doe

Meddelanden

Logga blodsocker 2018-04-23 14:00 [Gå till konversation](#)

Ok, bra då vet jag.
2018-04-19 16:14 av: Anna Trischell

Kalas med tårter.
2018-04-19 16:07 av: Jane Doe

[Visa hela konversationen](#)

Fysisk aktivitet 2018-04-21 20:00 [Gå till konversation](#)

Idag kände jag mig lite förkyld.
2018-04-19 16:04 av: Jane Doe

[Visa hela konversationen](#)

Flaggor

Figure H.19: Time line with filtering options.

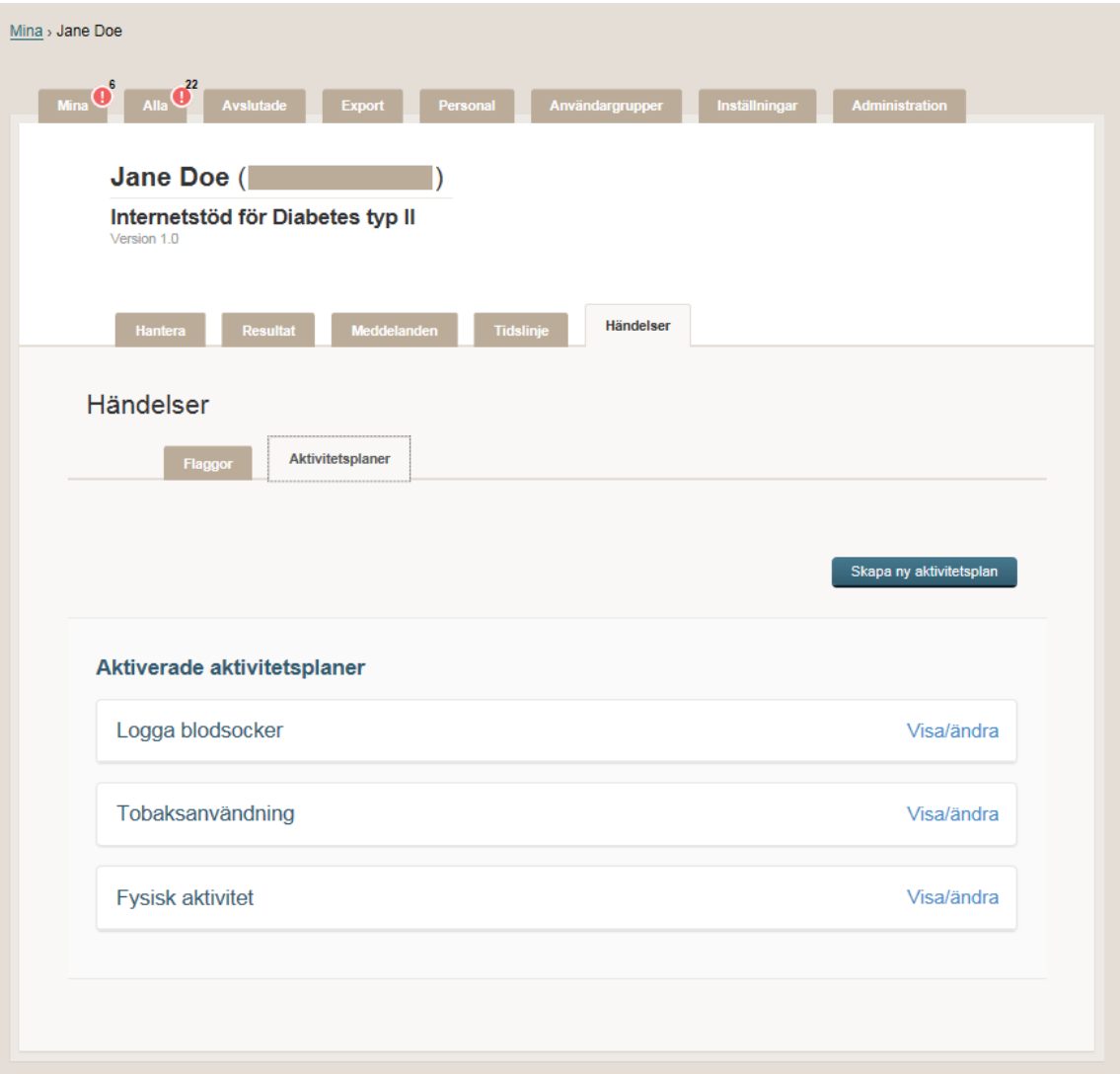


Figure H.20

Mina > Jane Doe

Mina ⁶ Alla ²² Avslutade Export Personal Användargrupper Inställningar Administration

Jane Doe ()
Internetstöd för Diabetes typ II
Version 1.0

Hantera Resultat Meddelanden Tidslinje **Händelser**

Händelser

Flaggor Aktivitetsplaner

Skapa ny flagga

Nytt meddelande/kommentar

Namn Nytt meddelande/kommentar

Nytt meddelande/kommentar

När Behandlare ▼ fått ett nytt meddelande

☐ Flagga till behandlare ⓘ ☐ Flagga till Invånare ⓘ

Spara

Aktuella flaggor

Det finns inga definierade flaggor

Figure H.21: The nurse can create personalised notifications (*Flaggor*) and tasks (*Skapa ny aktivitesplan*).