Sick of Diabetes

Improving Medication Adherence for

Type 2 Diabetes in Sweden

Klara Espling, Karina Katajeva-

Montanaro, Clotilde Pinchet, Q.A.

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1. Introduction

Diabetes mellitus is one of the most prevalent chronic diseases, affecting 10.5% of the global population (International Diabetes Federation [IDF], 2021), with cases rising from 200 million in 1990 to 803 million in 2022 (World Health Organization, 2024). It refers to a group of conditions associated with impaired regulation of glucose levels in the bloodstream and, thus, a potential for persistent elevated blood glucose concentrations (Sapra & Bhandari, 2023). Type 2 diabetes (T2D) is its most common form, comprising more than 90% of all cases (Chatterjee et al., 2017). Its growing prevalence is a major public concern, as it can lead to severe health complications, reduced quality of life, and a significant financial burden on healthcare systems (IDF, 2021). With Sweden's healthcare context offering a promising area for exploration and its immigrant population facing many challenges, this report analyses the care journey of a newly diagnosed T2D patient, examines the factors that hinder and encourage medication adherence, and proposes targeted solutions to improve adherence.

2. Background

2.1. What is T2D?

Glucose, a sugar and the body's primary energy source, is obtained from the breakdown of various foods and drinks we consume. For body cells to use glucose, insulin, a hormone produced by the pancreas, is needed. According to Sapra and Bhandari (2023), T2D starts when body cells become less responsive to insulin, causing glucose to accumulate in the bloodstream instead of being efficiently absorbed by body cells. Responding to this glucose buildup, the pancreas produces more insulin; however, the body continues to struggle to use insulin effectively. Over time, prolonged high blood glucose can impair the pancreas' capacity to produce insulin, exacerbating the condition.

2.2. The issue of poor medication adherence in T2D

In most cases, T2D treatments primarily manage rather than cure the disease, thus requiring lifelong management to prevent or reduce complications (Polonsky & Henry, 2016; Saraiva et al., 2020). While lifestyle modifications such as diet and exercise are essential, most patients cannot achieve proper glycaemic control through these alone (García-Pérez et al., 2013). Consequently, pharmacological treatment is often needed (García-Pérez et al., 2013).

Treatment effectiveness relies on patient adherence. However, around 57% of T2D patients globally fail to achieve the recommended glycated haemoglobin (HbA1c, a measure of average blood glucose levels over two-three months) target of <70 mmol/mol, with poor medication adherence recognised as a key contributing factor (Khunti et al., 2018; Polonsky & Henry, 2016). Medication adherence is defined as following prescribed timing, dosage, and frequency of medication use (Saraiva et al., 2020), while non-adherence occurs when patients deviate from these guidelines (Hugtenburg et al., 2013). Meta-analyses report adherence rates of just 54% for oral antidiabetic medication (Piragine et al., 2023) and 53% for insulin therapy (Boonpattharatthiti et al., 2024) among patients with T2D, highlighting that medication adherence remains suboptimal in this group despite its critical role.

2.2.1. Health impact

Medication non-adherence in T2D can worsen both physical and mental health. It is associated with slower improvement, if not further deterioration, in glycaemic control (Lin et al., 2017; Pladevall et al., 2004), which can increase the risk of serious health complications such as cardiovascular disease, blindness, kidney failure, and nerve damage (Farmaki et al., 2020). These complications often result in higher hospitalisation and emergency visits among non-adherent patients (Hepke et al., 2004; Lin et al., 2017). Non-adherence is also linked to higher mortality, with diabetes and its complications causing 6.7 million deaths in 2021 in the 20-79 years old global population (IDF, 2021). Given these risks, adherence to

medication is crucial for preventing complications and improving health outcomes in T2D patients.

2.2.2. Economic impact

Non-adherence to diabetes medication can impose a substantial economic burden. It leads to higher costs from hospitalisations, emergency visits and prolonged treatments (Cutler et al., 2018). While better adherence increases pharmacy costs, it also significantly reduces medical costs and total direct health expenditures (Evans et al., 2022). In 2021, Sweden ranked among the top 10 countries for diabetes-related expenditures per capita, reaching €9079.17 (IDF, 2021).

Beyond direct healthcare costs, medication non-adherence in T2D contributes to significant productivity losses for patients and caretakers (Zhao et al., 2013). In 2022, United States' labor productivity losses reached €112.02 billion, driven by factors such as reduced productivity and premature deaths (Parker et al., 2024). In Sweden, diabetes-related work absences cost €1,317–€2,254 per person in 2016, exceeding hospital care costs (Andersson et al., 2020). Since productivity losses increase as T2D progresses, improving adherence could help mitigate these economic impacts.

2.3. The Case in Sweden

2.3.1. Justification for country selection

Sweden was selected for this intervention due to the accessibility to data (e.g. the Swedish National Diabetes Register [NDR]), enabling a solid analysis. Despite Sweden's strong healthcare performance, diabetes prevalence is increasing, challenging the healthcare system. Indeed, it is classified as a public disease due to its high prevalence and significant health impact (AHCSA, 2019; Janlöv et al., 2023).

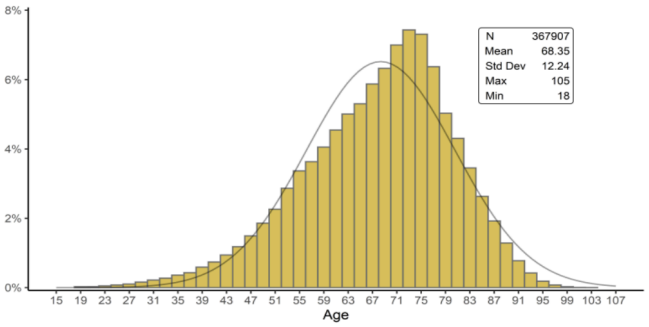
Additionally, the choice of the country is reinforced by the convenience sampling for the purpose of interviews (Appendix F). Finally, because Sweden provides universal health

care, it allows the study to exclude lack of financial resources as a cause of medication non-adherence.

2.3.2. Justification of target population

Primary care is responsible for treatment of the majority of individuals with T2D (NDR, 2020). According to primary care records, the average age of individuals diagnosed with T2D is 68.35 years (NDR, 2024; Figure 1). However, this study focuses on individuals aged 25–54, as they are in their prime working years (OECD, 2022). This choice is based on several factors: diabetes has a significant economic impact, particularly when it affects the working-age population (Parker et al., 2023); older patients often have comorbidities that complicate its management (Hashemi et al., 2024); and digital literacy is higher in this age group, impacting available interventions (Eurostat, 2024).

Figure 1. *Diabetes according to age group in Sweden (NDR, 2024)*



*Histogram by age. Primary care, year 2020. This data includes all diabetes patients, 98% of whom have T2D.

Immigrants are the target of the intervention. Indeed, Sweden's population has grown by 20% since 1995, mainly due to immigration (NDR, 2020). Moreover, immigrants make up the largest proportion of residents in Stockholm's socioeconomically disadvantaged suburbs, where T2D prevalence is significantly higher than in the country overall (Al-Murani et al., 2019). Additionally, recent research in Sweden indicates that immigrants (born outside Europe) are the T2D patient group most associated with poor medication adherence (Ekenberg et al., 2024).

2.3.3. Previous interventions

The Swedish National Board of Health and Welfare regularly reviews the current healthcare offered and identifies ways to improve it, with the most recent reviews for diabetes carried out in 2011, 2015, and 2018 (Socialstyrelsen, 2025). Advancements in medical technology, science, and the pharmaceutical industry and policy improvements contribute to this innovation. The regional structure of healthcare leads to regional differences. A selection of previous interventions aimed at improving treatment adherence can be found in Appendix D.

3. Our Approach

This report draws on interviews with stakeholders (see Appendix F), publications and national data to form a stakeholder analysis (Section 4). Then, the patient journey was mapped and analysed through Activity Theory and Installation Theory. This narrows down the scope of the analysis to newly diagnosed patients. Reasons for medication non-adherence were integrated into the analysis (Section 5), informing interventions to improve medication adherence (Section 6).

4. Stakeholder Analysis

Stakeholder analysis is a systematic framework for identification of key actors, their behaviours, intentions, relationships, interests, and the influence or resources they contribute to decision-making (Brugha & Varvasovszky, 2000). This study will apply stakeholder analysis to first map macro-level participants within the healthcare system, followed by micro-level, specifically the management of T2D patients.

Stakeholders can be classified based on their organisational positioning: *internal stakeholders*—who operate within the organisation; interface stakeholders—who engage with the external environment; and *external stakeholders*—typically other organisations who may contribute to, compete with, or hold a vested interest in the organisation's operations

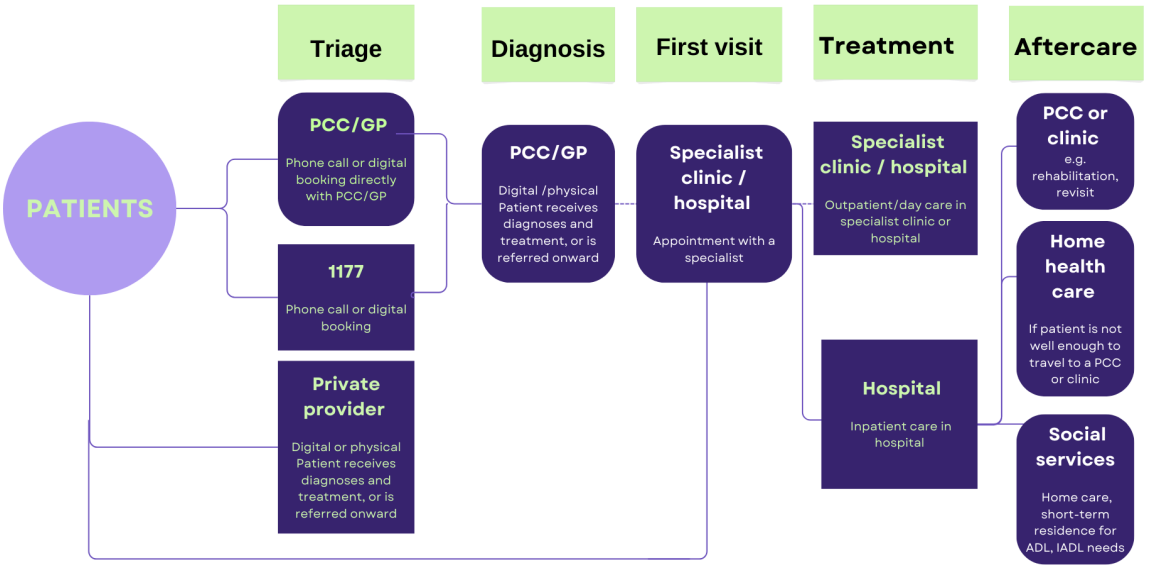
(Fottler et al., 1989; Blair & Fottler, 1990; Brugha & Varvasovszky, 2000). In this analysis, *internal stakeholders* encompass medical personnel responsible for T2D diagnosis and management, while *external stakeholders* encompass the broader Swedish healthcare system, defined in detail in next section. Additionally, this analysis identifies a supportive *social network* comprising close family members, peers, co-workers, fellow patients and broader online patient community. This subgroup is hard to neatly classify, which is why we position them between the T2D patient and internal stakeholders (Figure 3).

4.1. Swedish Healthcare overview

The Swedish healthcare system is decentralized across three levels: *national*, *regional*, and *municipal*. Responsibility for healthcare services primarily lies with 21 regions and 290 municipalities, resulting in geographical variations in service organisation and delivery. Governed by the Ministry of Health and Social Affairs (Socialstyrelsen), the system operates within a broader framework of social protection, with predominantly tax-based financing and universal coverage for residents and workers (Janlöv et al., 2023).

The publicly financed healthcare system covers a wide array of services, for example, public health and prevention, primary care, specialised inpatient and outpatient care (Figure 2). Additionally, citizens benefit from subsidies for outpatient pharmaceuticals and medical devices (Janlöv et al., 2023). For a detailed description of each functional unit, please refer to Appendix A and B.

Figure 2. *Patient pathways for elective care (Janlöv et al., 2023)*



Notes. ADL: activities of daily living; PCC: primary care centre; GP: general practitioner; IADL: instrumental activities of daily living.

4.2. The Swedish Health care for T2D patients

Diabetes care in Sweden is structured around national guidelines that emphasise a multi-professional approach to managing T2D. In practice the majority of individuals with T2D receive care at primary care centres, where they are managed by a diabetes responsible physician (diabetes specialist), alongside a diabetes specialist nurse (diabetes nurse). If necessary, other healthcare professionals, such as podiatrists, and physiotherapists, may also be involved (Hadziabdic et al., 2020).

For patients with severe T2D or diabetes-related complications, specialist care is provided at in-hospital diabetes clinics. These clinics offer advanced treatment and continuous monitoring for high-risk individuals, typically under the supervision of specialists in endocrinology (Hadziabdic et al, 2020).

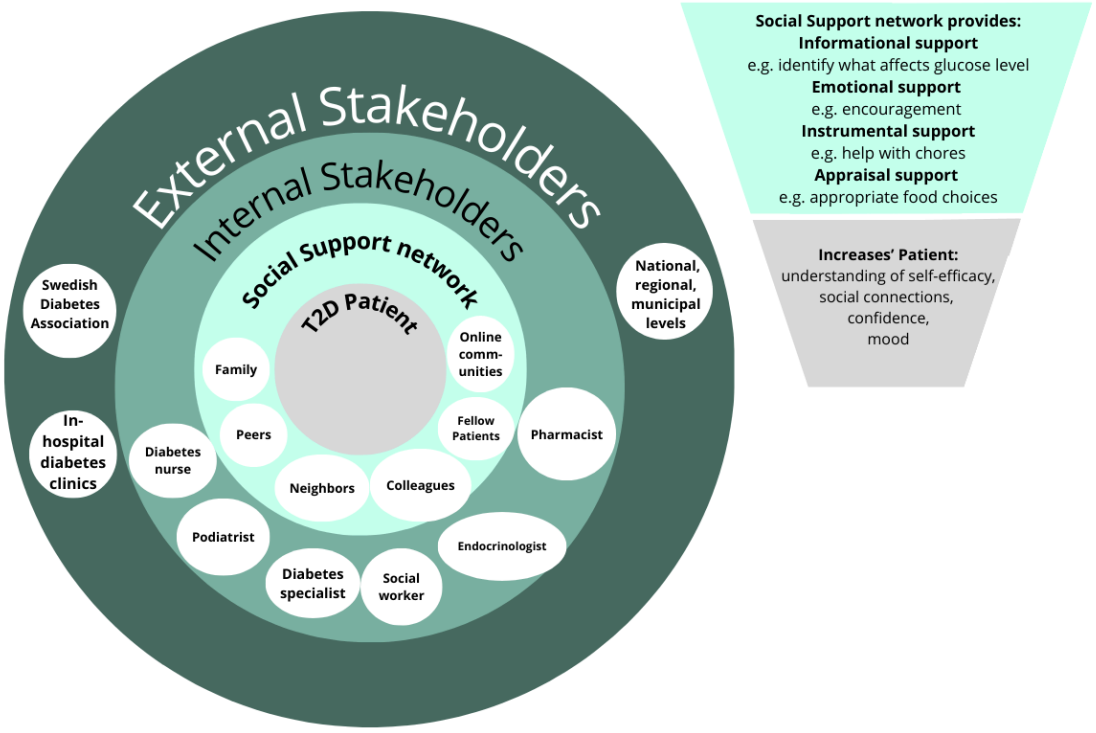
A fundamental aspect of diabetes care in Sweden is the emphasis on patient involvement and self-care. Treatment plans are developed in collaboration with patients, taking into account their quality of life and the risk of complications. Patients are expected to take an active role in managing their condition, which includes adhering to lifestyle modifications, monitoring their health, and following prescribed treatments (Hadziabdic et al., 2020). Most self-management of diabetes takes place within the family setting, making supportive family interactions essential. Encouraging open communication and collaboration in managing diet, medications, and blood glucose monitoring plays a crucial role in effective care. However, some patients encounter non-supportive behaviours, such as visible frustration or a reluctance from family members to share the challenges of living with diabetes (Bennich et al., 2017).

Strong *social support networks* are essential for improving diabetes management and overall well-being. Social support extends beyond family members to include peers, friends, neighbors, colleagues, fellow patients, and online communities, all of which can play a vital role in providing encouragement and shared experiences. Positive social support has been linked to better adherence to medication, diet, exercise, and improved clinical outcomes (Kadirvelu et al., 2012).

The Swedish Diabetes Association (Svenska Diabetesförbundet) is the largest diabetes organisation in Sweden, representing approximately 22,000 members and covering all types of diabetes. Its primary mission is to advance diabetes research and spread awareness, striving for a healthier life and a future without diabetes (Svenska Diabetesförbundet, 2023). It is a critical *external stakeholder* as it enables patients by providing education, resources, and advocacy to improve diabetes care. It also offers emotional and practical support through local organisations and online networks, and provides specialised programs for youth with diabetes.

Besides a curated online network offered by Svenska Diabetesförbundet, meta-analysis research by Elnaggar et al. (2020) shows that Facebook groups proved particularly valuable, offering a multimodal space for accessing content, developing skills, tracking progress, and organising meetings for diabetes patients. These groups also serve as a resource for patients and caregivers to learn about blood glucose devices and receive technical assistance. Private groups foster community support by spreading awareness, providing technical help, and offering emotional encouragement. Patients often trust peer advice, especially on lifestyle changes. Similarly, blogging can help reduce isolation and social media can support the management of the condition (Elnaggar et al., 2020). While digital health communities have shown positive results in supporting diabetes care, their effectiveness is tempered by risks such as misinformation, privacy concerns, and distractions from advertisements (Elnaggar et al., 2020). These platforms can be valuable for providing emotional support, but patients must remain cautious about the accuracy of medical information shared online.

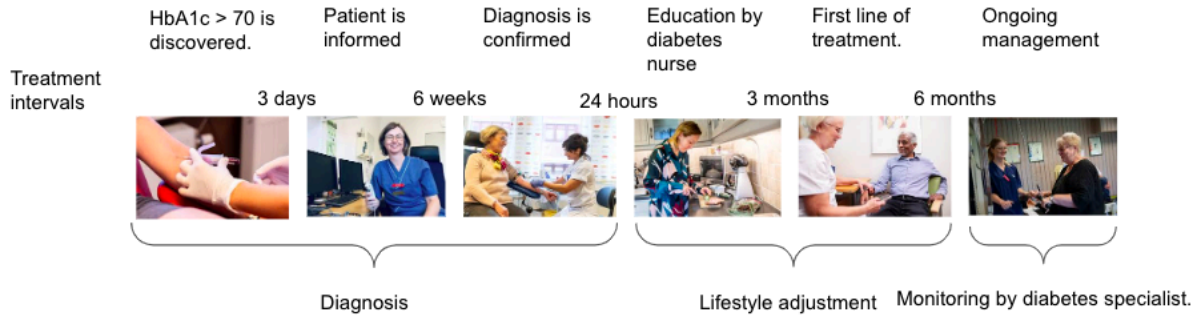
Figure 3. *Stakeholders and Benefits of Support in T2D Management in Sweden*



4.3. The operational process of T2D

The treatment journey for T2D patients is derived from the activity grid (see Appendix E) and is illustrated in Figure 4.

Figure 4. *Breakdown of a T2D treatment.*



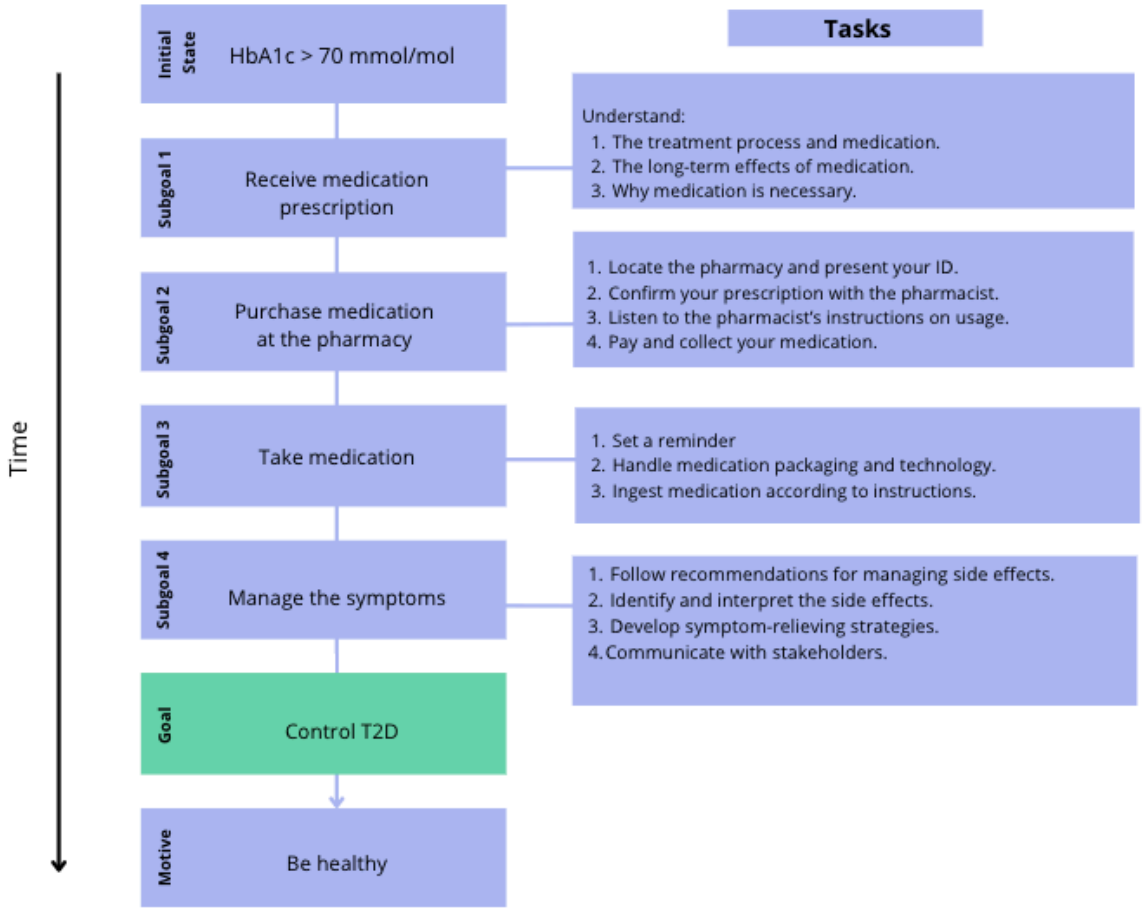
Most T2D cases are discovered accidentally through blood tests, as patients rarely experience early symptoms and all blood samples measure HbA1c. If HbA1c is greater than 70 mmol/mol, the diabetes specialist at the patient's primary care centre contacts the patient by phone to arrange a second test within six weeks. A second result confirming HbA1c >70 mmol/mol leads to a formal T2D diagnosis, which the diabetes specialist communicates to the patient by phone. An appointment is then scheduled with the diabetes nurse, who provides diabetes education and lifestyle guidance, collects data for the NDR, and addresses the patient's questions.

The patient has three months to implement lifestyle changes. After this period, they receive a notice for a follow-up appointment with the diabetes specialist and must provide a blood sample three weeks prior. If HbA1c remains >70 mmol/mol, the patient is prescribed oral medication, often Metformin. The dosage is gradually increased over two weeks for adjustment. The information is provided verbally and supplemented by pharmaceutical leaflets during the appointment.

Finally, the patient receives a biannual appointment notice, alternating between the diabetes nurse and diabetes specialist. A blood sample is required three weeks prior to each appointment.

Figure 5 presents the patient's journey to reach the goal of medication adherence, showing the effort required from the patient to navigate through the conditions that they encounter, as guided by the Activity Theory (Lahlou, 2017).

Figure 5. *Patient activity grid of medication adherence*



Note. See Appendix C for a description of medication purchases in Sweden.

4.4. Reasons for poor medication adherence

The above is the standard journey that a patient may go through. However, not all individuals succeed in adhering to medication recommendations.

Polonsky and Henry (2016) suggest poor medication adherence is influenced by various factors, one of which is patients' beliefs regarding their medications. Patients tend to adhere more closely to their medication regimens when they can tangibly perceive the outcomes to be positive and relatively immediate, which reinforces their belief in the medication's necessity. Conversely, beliefs about long-term risks can lead to lower adherence and hesitation in starting new medications. Among T2D patients from immigrant backgrounds, these concerns can be shaped by different cultural factors, such as reliance on prayer (Althubyani et al., 2024). In Sweden, foreign-born individuals are also reported to have less diabetes knowledge than those born in Sweden (Pettersson et al., 2018).

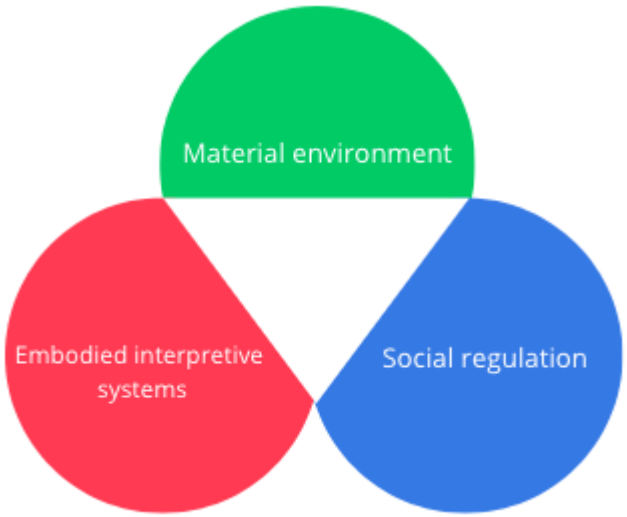
The interview also indicates that inadequate health literacy is a barrier to medication adherence. Health literacy—which refers to the ability to "obtain, process and understand health information and services necessary to make appropriate health decisions" (Sørensen et al., 2012, p. 3)—can influence health beliefs, attitudes towards medication, and ability to communicate with healthcare professionals, all of which impact medication adherence (Bailey et al., 2014). Studies on T2D patients from immigrant backgrounds show they often struggle more than native patients to understand and use health information due to language barriers and short consultation times, which hinder information sharing and support provision from healthcare professionals (Asiri et al., 2023; Tørris & Nortvedt, 2024).

Other contributors to non-medication adherence include patient-specific demographic characteristics, including younger age and lower educational level, and the perceived burden associated with accessing and taking medicine (Polonsky & Henry, 2016).

5. Application of Installation Theory

Installation Theory (Lahlou, 2017; Figure 7) provides a framework for understanding an individual's behavioural outcomes within a specific setting. Installations refer to environments with expected behaviour from individuals, with the installation both enabling and regulating certain behaviours. Each installation consists of three key components: material environment, embodied interpretive competencies, and social regulation. The interconnectedness of these elements forms a "bundle," which channels behaviour.

Figure 6. *The Three Components that Determine Behaviour according to Installation Theory*



Installation Theory was implemented to analyse the behavioural bundles of T2D according to the four subgoals previously identified to reach medication adherence, allowing for structured bottom-up behaviour analysis. Table 1 outlines this analysis.

The first layer in Installation Theory is the **material environment,** which consists of objects that are entities relevant to an actor's actions (Lahlou, 2017). For T2D management, the affordances of physical objects inform, support, and constrain the treatment. These affordances include items such as, note-taking tools, medication, medication leaflets, and information technology infrastructure.

The second layer consists of **embodied interpretative systems**, which dictate which actions, made possible by material affordances, are realized. Not all potential actions are performed; instead, behaviour is shaped by human cognitive and interpretative capacities (Lahlou, 2017). In the context of T2D treatment, this includes understanding medical information provided by healthcare professionals, levels of trust developed between a patient and healthcare professionals, remembering to take prescribed medication, and perceived inconvenience, among many factors.

The final layer is **social regulation**, which determines whether the actions enabled by material affordances and embodied competencies are appropriate and executed (Lahlou, 2017). In the context of medication adherence for T2D, this includes formal guidelines for medication, social expectations for how to manage side effects, knowledge about pertinent questions to ask medical personnel, cultural norms and religious teachings that affect treatment-related perceptions, and reliance on online and offline group communities. These factors can impact patient adherence to treatment.

This approach to problem analysis, grounded in Installation Theory, informed the design of targeted interventions that are embedded and adapted within the existing healthcare context to achieve lasting impact, as emphasised by Lahlou (2017).

Table 1. *Application of Installation Theory for T2D medication treatment*

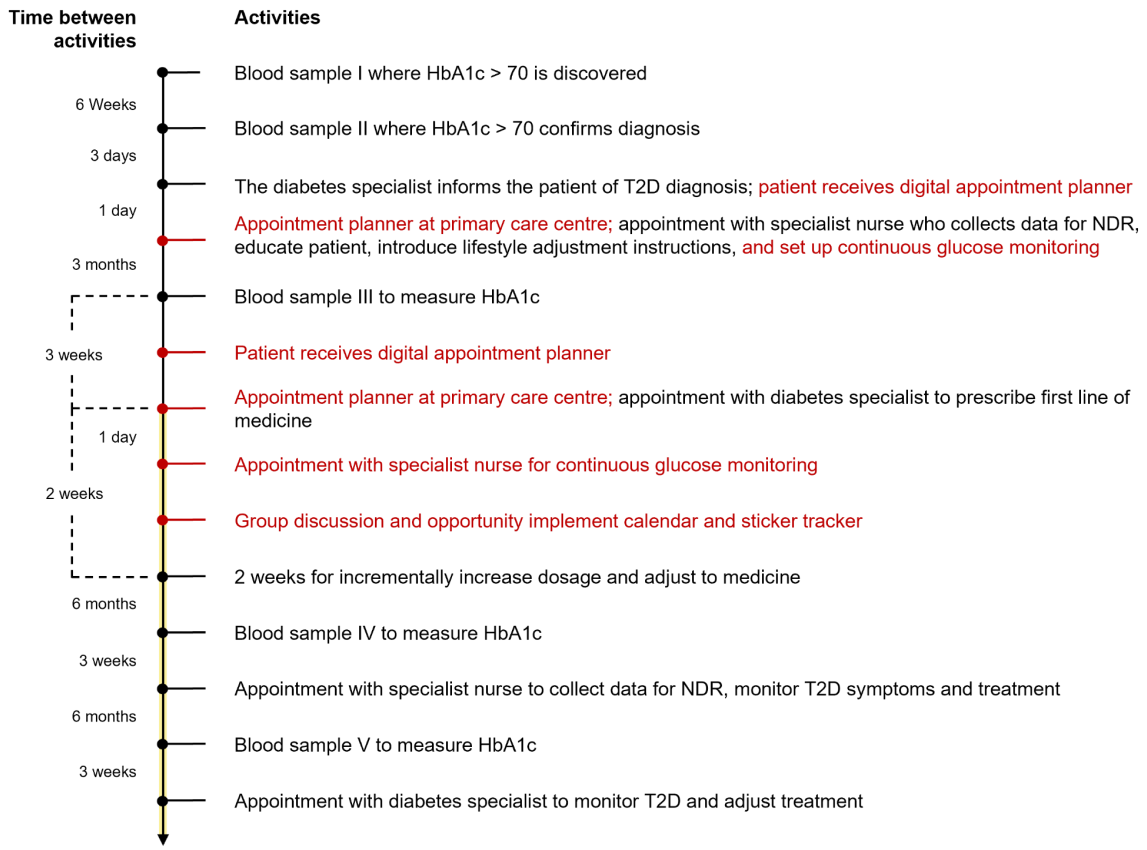
Subgoal	Material environment	Embodied interpretative systems	Social regulation
Subgoal 1 Receive medication	Patient should bring pen and paper/digital device to take notes. Patient receives an information leaflet from pharmaceutical companies. Patient records kept in NDR. Diabetes-related leaflets and marketing materials can influence patient beliefs about medication.	Understand what the diabetes specialist says. Have prepared questions to ask about. Understand what support other than medicine to ask the diabetes specialist for. Ask questions. Patient's previous experiences with health care professionals may influence their level of trust in medical recommendations.*	Adhere to specific instructions and guidance from a diabetes specialist. Grounded in a sense of accountability, agree on follow-up appointments. Policies limiting consultation duration hinder healthcare professionals from providing comprehensive information and support for patients. Draw on peer experiences and shared strategies to support medication adherence and T2D

		Perceived treatment efficacy and medication beliefs.	management, while also considering the influence of implicit and explicit cultural norms and religious teachings on treatment decisions.*
Subgoal 2 Purchase medication	Visit a pharmacy. Provide identification documents, such as an ID card. Information on medication costs and digital payment options (e.g., contactless payment, mobile apps) to facilitate the purchasing process, if applicable (Appendix C). Collect medicine.	Locate the pharmacy. Answer the questions from pharmacists Stay cooperative in case a pharmacist asks if it is your first time taking the medication. Patients experiencing noticeable symptoms might be more motivated to obtain and follow the prescription strictly.* Perceived accessibility to pharmacy.	Understand the social cues in a pharmacy (e.g., when the pharmacist asks questions). Follow the professional guidance from a pharmacist. Sweden's healthcare subsidizes medications making them equitable and affordable. Family members may ensure logistical support in obtaining medication timely.
Subgoal 3 Take medication	Some patients set a digital reminder. Ingest medication. Take with food. Avoid alcohol. Access to CGM to track how medications affect glucose levels.	Remember to take the medication. Understand the dosage and instructions correctly. Routine and habit formation to integrate the regularity of medication timing. Familiarize with the patient information leaflet attached to the medications. Negative sensory and physical reactions (e.g., gastrointestinal). Handle medication packaging and technology. Perceived inconvenience of taking medication.	Take time away from social interactions to take medication. Reminders and encouragement from family members. In a support group, follow the norms and prescribed treatments.
Subgoal 4 Manage side effects	Stay hydrated by drinking water. Take supplements if necessary. Within the medication packaging, an easy-to-follow guidance on side effects management. Contact healthcare professionals over email/phone to report severe side effects.	Recognize the importance of hydration and consuming small amounts of water as needed. Learn to identify and interpret the side-effects. Develop symptom-relieving strategies such as using antacids or other remedies. Seek more advice from healthcare providers to minimize discomfort. Perceived inconvenience of coping with side effects. Understand medicine package leaflets detailing common side effects.	Follow recommendations for managing side effects. Workplace colleagues may accommodate meal breaks or medication schedules to limit discomfort from side effects. Online and in-group communities may share self-care behaviours. Swedish reimbursement policies may provide access to alternative medications or symptom management treatments (e.g., probiotics for gut health).

6. Solution Proposal

Medication beliefs and inadequate health literacy are two drivers of medication non-adherence. Analysis of the T2D treatment journey reveals three opportunities where these factors can be addressed to improve medication adherence. The first occurs after the patient receives the diagnosis. The second arises after the consultation when medication is prescribed. The third appears during long-term treatment, as sustaining adherence can be difficult. These moments provide crucial opportunities for targeted interventions to support adherence, which are illustrated in Figure 7.

Figure 7. *Where to Implement Interventions*

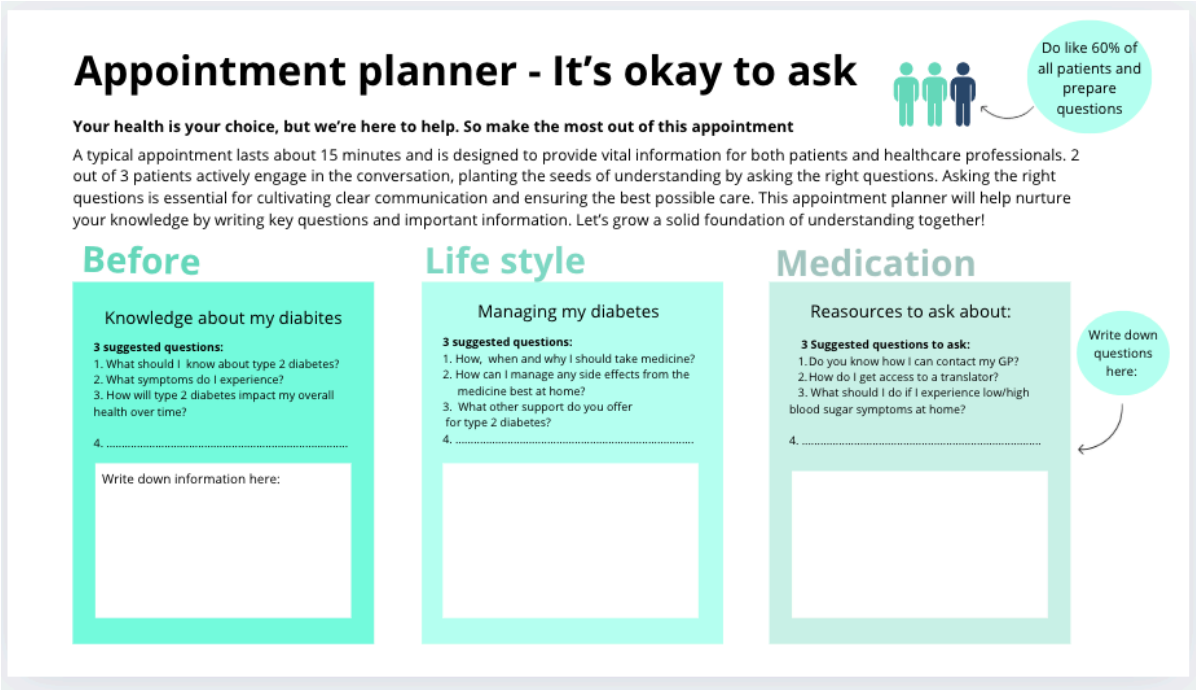


Note. Red indicates proposed interventions. Yellow indicates where medication non-adherence can occur.

6.1. Appointment Planner

To increase the effectiveness of medical consultations, we propose an appointment planner: a structured informational leaflet designed to support patients in preparing for their appointments and improve their engagement. Upon scheduling an appointment, the system will automatically distribute the planner via email or post in the patient's preferred language, with physical copies available in waiting areas to ensure accessibility. The planner will offer structured prompts for key questions to address with the diabetes nurse and diabetes specialist, guidelines for compiling relevant health information, and essential discussion points to facilitate a more informed and productive consultation (Figure 8). Support from social networks, such as family members, can help patients proactively consolidate potential questions.

Figure 8. *Appointment Planner*



The leaflet includes a dedicated section on medication (third box), even though no medication is prescribed when the patient first uses the leaflet. Indeed, this section serves two purposes: first, to inform the patient early about the possibility of needing medication if

lifestyle changes are not successful; and second, to facilitate the discussion during the diabetes specialist appointment when medication is prescribed.

Additionally, to further enhance its effectiveness, the leaflet leverages metaphors, Cialdini's principles of persuasion (1999), and how individuals process information. The core of metaphors is understanding and experiencing an abstract concept in terms of a concrete concept (Lakoff & Johnson, 1980) and they have the power to shape how individuals perceive and approach real-world problems (Thibodeau & Boroditsky, 2011). Therefore, the leaflet employs two types of metaphors: structural and orientational. Regarding the first one, the garden metaphor—a concrete concept—is used to illustrate medical illiteracy, making an abstract concept more comprehensible and accessible. Regarding the second one, the “authority is up” metaphor is followed by placing the text at the top of the leaflet. This leverages the cognitive association between authority and vertical spatial positioning, reinforcing the persuasiveness of the argument (Schubert, 2005; Fiske, 1992, 2004; Cialdini, 1999).

The effectiveness of the appointment planner is further enhanced through the implementation of social proof, defined as "the responses of referent others" (Cialdini, 1999, p.1244). Social proof is a powerful persuasive tool, as individuals tend to look to others to guide their behaviour (Cialdini, 1999). Implemented in the leaflet *“Do like 60% of all patients and prepare questions*”, it encourages the patient to imitate other patients’ behaviour.

Finally, the appointment planner organises the 12 bullet-pointed questions into three distinct groups to optimise information delivery. Indeed, this structure accounts for the limitations of immediate memory, which constrain humans’ ability to receive, process, and remember information (Miller, 1956). However, this cognitive bottleneck can be mitigated by breaking information into smaller, more manageable chunks.

By integrating metaphors, persuasion principles, and cognitive processing insights, the appointment planner serves as a structured intervention to address medical illiteracy and

therefore medication adherence. Thus, the appointment planner functions as an intervention within the material environment designed to enhance patients' embodied competences.

6.2. Group Discussions

After the diabetes specialist prescribes medication, the patient undergoes a two-week adjustment period. As they may experience initial side effects of the medicine, this period can be challenging for the adherence. To support the patient during this phase, we propose a second intervention: during the appointment, the diabetes specialist invites them to a single organised group discussion session, which provides essential information about the medication, its role in diabetes management, and the importance of adherence. The aim of these discussions is to address medication beliefs, enhance their health literacy and therefore medication adherence. Based on the stakeholder analysis, the service will be provided by the National Diabetes Association, whose broader network ensures sufficient participation, unlike previous municipal-level interventions that struggled with low numbers (Socialstyrelsen, 2018).

This solution proposal chose the group format to leverage the power of internal group dynamics. Lewin's WWII research (1943) illustrates this well, as housewives who participated in group discussions were more likely to adopt offal than those who simply received information about its nutritional and economic benefits. Similarly, group interactions can help T2D patients develop a deeper understanding of their condition. Research shows that discussions are an active learning method that fosters deeper, higher-order learning (Pollock et al., 2011), which can improve health literacy. In addition to enhancing knowledge, the moderator will emphasise the importance of following medication prescriptions to directly support adherence. Indeed, when individuals take part in a group discussion and collectively form a shared mental representation (e.g. medication adherence is important), they are more likely to commit to following it (Bertoni, 2021).

Regarding group composition, there are some factors to consider. Firstly, group size matters, as larger groups risk disengagement (Davies, 2009). Research suggests an ideal size of 3-5 members (Davies, 2009; Chiriac & Granstrom, 2012); therefore, we propose groups of five.

Secondly, cultural background is a crucial factor to consider, as cultural values significantly shape the thinking of individuals (Schiefer, 2013). Immigrants experience both their heritage culture and the culture of their host country (Berry, 2005), whereas non-migrants (i.e. Swedish) are socialized within a single cultural context. Moreover, since immigrants come from a variety of countries (Statistics Sweden, 2024), they not only have a different cultural background from Swedish individuals, but also from one another. This diversity can create challenges in learning groups (Jackson et al., 2014). Consequently, to foster a socially comfortable environment, groups should be culturally homogeneous when possible (Kimmel & Volet, 2012).

Thirdly, how the space is organised—the setting—can serve as a signal to participants of how group interactions are expected to unfold (Del Rio & Luppi, 2010). Different settings exist, varying in suitability depending on the objectives. Therefore, for the aim of our discussions, we propose a circular seating arrangement, as it allows everyone to see each other, eliminates corners where individuals might withdraw, and thus encourages active participation from all members (Bertoni, 2021).

Finally, the moderator. Based on the stakeholder analysis, this role should be assigned to the diabetes nurse, as they are responsible for patient education and serve as the primary point of contact. Group facilitation can be exercised through different styles, each of which has a distinct impact on the group's climate, cohesion, level and type of participation, and overall productivity (Del Rio & Luppi, 2010). In this context, the diabetes nurse must be culturally competent, which is the ongoing ability to work effectively with

diverse groups through awareness, knowledge, skills, and respect for cultural differences and similarities (Suh, 2004).

To conclude, when the patient receives the phone call from the diabetes specialist, they are encouraged to bring a close family member, partner, or friend to the group discussions. This not only enhances the social network members' health literacy, but also strengthens their ability to support the patient's condition management and medication adherence. At the end of each session, participants will also receive a take-home toolkit. This includes a calendar for tracking medication intake and reminder stickers to be placed around the home, serving as visual cues for reminding. Overall, the group discussions aim to enhance patients' embodied competencies, by leveraging social norms and increasing support.

6.3. Family support

To improve medication adherence, we propose leveraging family support. Patients' personal social networks have proven effective (Pamungkas et al., 2017). These networks are part of this study's stakeholder structure, namely, the social support network. Indeed, family members can provide social support (e.g. offering encouragement about frustration with the treatment regimen, knowledge) or instrumental support (actions that increase the patient's physical capacity to take medication; e.g. reminding patients to carry medication, carrying medication themselves in case the patient forgets) (Mayberry & Osborn, 2012). It is also important that family members avoid non-supportive behaviours, such as focusing conversations solely on diabetes, as this can make patients feel reduced to their illness (Pesantes et al., 2018).

This highlights the importance of involving family members/close companions in medical appointments (i.e. both the diabetes nurse and diabetes specialist responsible for T2D) and group discussions to educate them on the condition and effective support strategies. Therefore, we recommend that when confirming the diagnosis, the diabetes

specialist also encourages the patient to bring a family member/close companion to the diabetes nurse appointment and any subsequent medical consultation.

Furthermore, we propose providing family members access to a tool for tracking the patient's medication adherence. This can encourage patients to track their own medication adherence while also providing family members the opportunity to send reminders when the medication is not taken. The tracking can be implemented using the calendar and reminder stickers provided during the group discussions. The calendar displays each day of the week with two checkboxes—one for breakfast and one for dinner—aligned with the medication schedule. Patients are encouraged to mark each box after taking their medication, thereby creating a visible record of adherence. The calendar is to be placed on the refrigerator to remind patients of their medication whenever they access food, aligning with the designated intake times. This placement also allows family members to monitor adherence and, if necessary, to remind patients to take their medication. In addition to the calendar, reminder stickers serve as a tool to reinforce medicine adherence. These are designed to be placed in strategic locations throughout the home, such as on the mirror, in the bathroom, in the bedroom. By positioning them in areas frequently visited as part of daily routines, patients receive repeated visual cues reminding them to take their medication.

6.4. Continuous glucose monitoring (CGM)

We propose the use of a digital solution, continuous glucose monitoring (CGM), to further support patients with medication adherence. A CGM device (Janapala et al., 2019; Rodbard, 2016) involves a small sensor worn on the abdomen or arm that continuously measures glucose levels in the interstitial fluid and offers a close estimate of blood glucose levels at any given time. The data is wirelessly transmitted to compatible devices (e.g. dedicated display device, smartphone applications, smartwatches; see Figure 9 for an example), allowing for 24-hour tracking of glycaemic fluctuations. An individual can wear a sensor for 7 to 15 days before requiring a replacement sensor. While wearing a sensor

continuously may cause some discomfort, studies indicate that most users find CGM comfortable and non-intrusive (Al Hayek et al., 2020; Janapala et al., 2019).

Figure 9. *FreeStyle Libre 2 Continuous Glucose Monitoring (CGM) System: Sensor and associated smartphone application*

One advantage of using CGM is that it enables patients to better understand how different self-management strategies, including taking medication correctly, can impact glycaemic control through real-time feedback (Ajjan et al., 2024). This increased awareness reinforces adherence by making the impact of treatment more tangible (Clark et al., 2024), thus addressing any doubts about its necessity or effectiveness that may cause non-adherence. Secondly, using CGM can establish a baseline for newly diagnosed patients (Ajjan et al., 2024), allowing doctors to make more precise dosage adjustment and relieving patients' concerns about excessively high dosages. A further advantage of CGM is its potential for remote data sharing. Many CGM devices, such as the Dexcom and Freestyle Libre systems, are part of dedicated digital ecosystems that allow nominated friends/family members to access glucose trend graphs and receive real-time glucose level alerts (Akturk

et al., 2021). This feature enables the patient's supportive social network, including long-distance loved ones, to provide timely support such as reminders about taking medication correctly. Some CGM systems such as Freestyle Libre support multiple languages (Abbott, n.d.), helping to mitigate language barriers for immigrant patients.

In Sweden, the NDR currently recommends the CGM for people with type 1 diabetes or insulin-treated T2D who require multiple injections and are prone to frequent hypoglycaemia or extreme hyperglycaemia (Socialstyrelsen, 2018). However, emerging evidence suggests that non-insulin-treated T2D patients can benefit from CGM (Balata et al., 2025), with experts encouraging for CGM to be introduced in routine T2D care (Ajjan et al., 2024). Using CGM for our target group of newly diagnosed T2D patients aligns with international and Swedish national recommendations to prioritise early glycaemic control (Davies et al., 2018; Socialstyrelsen, 2018).

Ajjan et al. (2024) recommend intermittent CGM use, starting with a 14-day period after diagnosis and then for another 14 days every three months or during treatment changes. This intermittent use may also make any discomfort be perceived as more bearable. Thus, we propose introducing CGM during the first appointment with a diabetes nurse after diagnosis. After medication prescription, the primary care centre should schedule for the patient to come collect CGM equipment for the second usage period. For subsequent use, the primary care centre reception should schedule a message inviting patients to book a CGM collection every three months after the device is last returned. During each collection, a diabetes nurse should assist the patient with sensor insertion and ensure relevant digital applications and devices are set up. Multilingual user guides should be sent automatically through email and SMS once equipment collection is registered. All equipment should be returned at the primary care centre reception. This primary care centre-based collection and return arrangement aligns with current procedures for type 1 diabetes patients (Sveriges Kommuner och Landsting, 2017).

Given that CGM can be costly (Shi et al., 2024; Socialstyrelsen, 2018), we recommend that the public healthcare system covers the first two 14-day periods, with subsequent CGM usage offered through the external stakeholder layer, such as Swedish Diabetes Association. CGM is a part of a broader digital diabetes management ecosystem, its benefits are detailed in Appendix G.

7. Discussion and Limitations

Managing T2D in Sweden as an immigrant involves navigating many challenges and available options. By applying Installation Theory and Activity Theory and examining the stakeholders involved in T2D management, interventions to improve medication adherence and overall care were derived. However, it is crucial to recognize the potential limitations of the proposed interventions.

A limitation of the group intervention is the potential for low attendance due to practical barriers such as work schedules or health-related constraints. Moreover, some individuals may experience discomfort in discussing their condition in a group setting due to stigma, privacy concerns, or other reasons. There is also a risk of limited engagement, as participants may choose not to actively contribute to the discussion, thereby reducing the intervention’s effectiveness in enhancing health literacy and medication adherence.

The appointment planner has several limitations. First, introducing a leaflet increases the administrative burdens (e.g., printing and distributing them)—burdens that might be considered too high in the public healthcare system—impacting the overall care offered. Second, patients might not engage with the appointment planner due to the cognitive effort required to process its content. A similar digital intervention, "*My Guide to Safe Care*" (see appendix D), has been tested and failed due to unknown reasons, a missed opportunity to make necessary adaptations to this leaflet.

Regarding family support, not all patients may have supportive family members available or willing to participate, potentially excluding those who are socially isolated. Additionally, the use of physical tools like calendars and stickers relies on consistent engagement, which may decline over time as patients or family members forget or lose interest. Therefore, a digital health application solution could have addressed these limitations, but we did not fully explore it.

A limitation to CGM usage is regulatory challenges. Additionally, there are concerns regarding patient accessibility and digital literacy, particularly among immigrant populations who may face language barriers despite the availability of multilingual user interfaces. Lastly, cost implications for healthcare systems and individual patients could affect scalability, as CGM devices and sensors remain relatively expensive compared to traditional self-monitoring methods (Sveriges Kommuner och Landsting, 2017).

An intervention's success depends on long-term execution and is strengthened by organisational adaptations, which these interventions have yet to fully address. However, consideration of the installation layers has improved their sustainability and adaptability.

A key limitation of this report is that the analysis draws on studies not exclusively focused on immigrant populations. Therefore, it may not have fully captured the specific disparities in healthcare experiences between immigrants and native-born individuals. Furthermore, immigrants are a highly diverse group. Thus, treating immigrants as a single target population group risks overlooking differences in adherence-related behaviours across contexts, potentially reducing the effectiveness of the proposed interventions. That said, we partially accounted for this diversity by proposing multilingual materials and cultural-based group solutions.

Lastly, a broader concern emerges regarding the potential consequences of segmenting healthcare services through targeted interventions. When tailored programs for specific groups, such as immigrants, are deprioritised or underfunded compared to

mainstream healthcare delivery, they risk becoming substandard in both quality and effectiveness (The Lancet, 2021). This, in turn, may reinforce systemic disparities rather than bridging them. However, it remains essential for healthcare systems to address the diverse needs of individual patients, ensuring that those requiring additional support receive adequate and equitable care.

Despite some limitations, the report offers insights that are relevant for Swedish policy makers and public healthcare officials striving to maintain Sweden's position as a global leader in healthcare delivery.

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Appendix

Appendix A. Functional description of different care units

Primary care	Addresses healthcare needs that can be prevented, assessed, treated, and rehabilitated without requiring specialised medical or technical resources (Janlöv et al., 2023)
Specialised care	Involves health and medical services that require specialised equipment or technologies unavailable in primary care settings (Janlöv et al., 2023)
Urgent and emergency care	The prioritization, diagnosis, and treatment of patients with acute somatic conditions, excluding psychiatric emergencies (Janlöv et al., 2023)
Pharmaceutical care	The responsible administration of drug therapy aimed at achieving specific outcomes that enhance a patient's quality of life (Hepler & Strand, 1990).
Rehabilitation / intermediate care	Rehabilitation is a multidisciplinary care process that assists individuals with health conditions (e.g. stroke, chronic low back pain, or cervical spinal cord injury) who are experiencing or at risk of disability, regain and maintain optimal functioning in their environment (Kamper et al., 2015; Meyer et al., 2011; Winstein et al., 2016).
Long-term care	A wide range of personal, social, and medical services that support individuals with functional or cognitive limitations in performing self-care and daily activities (Zimmerman & Sloane, 2007).
Services for informal carers	Informal caregivers voluntarily provide care for the elderly and individuals with functional impairments or long-term illnesses (Janlöv et al., 2023).
Palliative care	The active, holistic care of patients with advanced progressive illness, encompassing areas beyond oncology (Ajithkumar, 2011).
Mental health care	A state of well-being in which an individual recognizes their

	abilities, manages life's normal stresses, works productively, and contributes to their community (WHO, 2004).
Dental care	Includes routine general dental care, specialist dental services, and treatment for acute dental issues (Janlöv et al., 2023).

Appendix B. Detailed description of different care units

Primary care provides essential health and medical services to address common needs, ensure accessibility, and deliver preventive care tailored to individual patient conditions. The gatekeeping role of primary care varies by region, though patients can seek outpatient specialist care within their region's care options or from other regions. Primary care centres (PCCs) typically employ four to six general practitioners, supported by specialists, nurses, psychologists, counselors, and occupational therapists. In 2020, approximately 30% of regional primary care consultations were with physicians, 30% with nurses, 18% with physiotherapists, and 22% with other staff, including psychologists and assistant nurses (Janlöv et al., 2023).
Specialised care. In 2021, approximately 4.2 million patients received specialised inpatient or outpatient care. Specialised care is divided into two categories: outpatient (ambulatory and day care) and inpatient care. A significant portion of specialised ambulatory care involves consultations or day surgery, while day care encompasses day surgery and other treatments, including diagnostic procedures like endoscopy. Over recent decades, specialised care has shifted from hospital inpatient services to outpatient and day care, with a focus on concentrating highly specialised care and separating emergency from elective care. Advances in medical technology have also contributed to an increase in hospital-related home healthcare in some regions, complementing inpatient care (Janlöv et al., 2023).
Emergency care encompasses services provided in acute care hospitals as well as pre-hospital care, including ambulance routing and coordination. In 2016, 45% of inpatient admissions in Swedish hospitals were through emergency services (AHCSA, 2018b). Sweden has approximately 66 emergency hospitals, including seven regional/university hospitals, that offer 24/7 emergency services. The majority of the population is within a 30-minute travel time to the nearest emergency hospital (Janlöv et al., 2023).
Pharmaceutical care: The Swedish pharmaceutical market is divided into five main areas with distinct financing and payment systems: 1) Prescription pharmaceuticals within the national reimbursement scheme (64% of total expenditure), prescribed by physicians and collected by patients at pharmacies; 2) Prescription pharmaceuticals

outside the reimbursement scheme (3% of total expenditure), prescribed by physicians and collected by patients at pharmacies; 3) Over-the-counter pharmaceuticals (9% of total expenditure), sold without a prescription at pharmacies and retail outlets; 4) Pharmaceuticals for inpatient care (20% of total expenditure), administered by hospital and clinic staff; 5) Pharmaceuticals for communicable diseases, as outlined in the Communicable Diseases Act (2% of total expenditure), prescribed by physicians and collected by patients at pharmacies (Janlöv et al., 2023).

Rehabilitation and intermediate care typically follow a patient's discharge from the hospital. While regions are responsible for specialised hospital care, rehabilitation is often included in the core responsibilities of primary care centres (PCCs) in many areas. The trend of shorter hospital stays, faster discharge rates, and medical innovations has led to an increasing number of patients receiving rehabilitation or intermediate care at home. In most regions, municipalities are responsible for providing home-based health and medical care, including rehabilitation. The treating physician, in collaboration with municipal primary care, social services, outpatient providers, and the patient, develops a care plan to support continued rehabilitation (Janlöv et al., 2023).

Long-term care: Sweden has an extensive formal long-term care system. In 2020, expenditures for elderly care and care for individuals with functional impairments represented 2.7% and 1.5% of GDP, respectively. The majority of these costs are allocated to support in ordinary or special housing, focusing on activities of daily living (ADL) such as bathing, feeding, and dressing, as well as instrumental activities of daily living (IADL), including transportation, shopping, meal preparation, housekeeping, and medication management (Janlöv et al., 2023).

Informal carers: A national survey conducted in 2018–2019 found that 15% of the adult population regularly provides care, support, or assistance to someone close to them, with societal costs estimated at over SEK 150 billion (EUR 14 billion). This represents about 3% of GDP and roughly one-third of Sweden's healthcare expenditure (Ekman et al., 2022). While many informal caregivers offer their support voluntarily, informal care can also arise from gaps in the availability of healthcare and services, such as budget cuts, reorganization, staffing shortages, lack of coordination between providers, or difficulties in obtaining needs assessments for healthcare or social services.

Palliative care: It is estimated that annually, about 80% of those who die in Sweden could benefit from some form of palliative care (The Swedish Palliative Care Register, 2022). Although oncology is excluded from the definition of palliative care, cancer remains the largest diagnostic group in this field in Sweden. Other significant groups include heart and lung diseases, dementia, and stroke. Palliative care is generally provided within the healthcare sector (regions and municipalities) and varies in its organization. It may be delivered by specialised palliative care units in hospitals, hospices, nursing homes, or advanced multi-professional mobile teams in patients' homes. Most patients receive care from multiple professionals at the end of life, with physicians and registered nurses being the most common, along with counselors, physiotherapists, and occupational therapists in palliative teams (Janlöv et al., 2023).

Mental health care is an integral part of Sweden's healthcare system, excluding compulsory and forensic mental care. In 2015, the costs associated with mental illness were estimated to represent nearly 5% of Sweden's GDP, with almost one-fifth of the population affected by mental health issues, including substance abuse and addiction. The main areas of mental health care in Sweden include child and adolescent psychiatry, adult psychiatry, and forensic psychiatry. Most mental health care responsibility lies with the regions, encompassing primary care centres (PCCs), specialised care, and child and adolescent psychiatry. Primary care is typically the first point of contact for patients with mental health concerns. Digital consultations, including e-health services, telephone support, and traditional treatments via the internet, are increasingly important in mental health care delivery (Janlöv et al., 2023).

Dental care: In Sweden, patients have the freedom to choose their dental care provider, with both public and private operators competing in the market. The majority of dental care (approximately two-thirds) is for adults covered by the general state allowance for individuals aged 23 or 24 and older. Dental care is free until the year a person turns 23 (or 24 in some regions), and all children receive regular dental visits. Dental health in the population is improving, with 75% of individuals aged 16–84 reporting good or very good dental health in 2018. Swedish dental care focuses on prevention, with dentists typically scheduling regular check-ups or treatments every year or two. However, people with lower education, income, or those born outside the EU tend to have fewer intact teeth, poorer self-perceived dental health, and are less likely to attend regular dental visits (Janlöv et al., 2023).

Appendix C. Public vs private healthcare

The Swedish healthcare system has three types of healthcare providers: public healthcare, private healthcare providers paid by the public, and private healthcare. Generally, healthcare is paid for through taxes, and all citizens are entitled to public healthcare. However, if medical treatment is not considered a medical necessity, such as some types of plastic surgery, the cost falls upon the individual. Treatment for T2D is a medical necessity and is thus paid for in public health care (Öster, 2025).

While medically necessary health care is mainly financed by the public, patients generally pay a fee when going to a health care provider. How much a patient pays depends. Still, in Stockholm, a patient pays €15 per visit (Sveriges Kommuner och Regioner, 2025). This fee applies to all patients between 18 and 84 years old. However, if a patient spends over €86 per rolling 12 months, all costs are paid via taxes (Schöldéen, 2025). Similarly, patients pay for government-subsidized prescription drugs (Andersson, 2025). However, if costs exceed €244 per rolling 12 months, the medication is entirely paid by taxes. Finally, patients who fail to attend their medical appointments or reschedule them at least 24 hours in advance receive a penalty fee of €24 (Andersson, 2025).

Appendix D. A Selection of Historic interventions

Name	Intervention	Effectiveness
Diabetic School	Offer group-based educational programs to individuals with type 2 diabetes, supported by individuals with subject-matter expertise and teaching competence (Socialstyrelsen, 2018).	Too few patients per primary care unit. Only 3% of all primary care units offer group-based patient education that considers the cultural background of individuals with diabetes (Socialstyrelsen, 2015a).
Din skyldighet att informera och göra patienten delaktig or Your duty to inform and involve the patient.	*This booklet, written by the Swedish National Board of Health and Welfare, informs healthcare professionals about their legal duty to inform patients* (Socialstyrelsen, 2018).	
Min guide till säker vård, or *My Guide to Safe Care*, was written by the Swedish National Board of Health and Welfare	Offers patients advice on how to participate in their own care and treatment (Socialstyrelsen, 2018).	The guide is no longer available online.
	Another intervention is that licensed doctors undergoing further training to achieve specialist competence must meet the competence requirements, including communication skills, to proceed (Socialstyrelsen, 2015b).	

CGM	Healthcare professionals may offer continuous subcutaneous glucose monitoring with intermittent reading to individuals with type 2 diabetes who are treated with meal-time and basal insulin and experience recurring problems with hyper- or hypoglycemia (Socialstyrelsen, 2018).	Not offered to all individuals.
Apodos	Pre-packaged medicines organised according to dosage (time and amount) and sent home.	This system requires patients to have a cognitive disability to manage it (Interview).
Pillbox	Patients organise the medication in a box according to time and date (Interview).	This system is a initiative by the patient and not offered within the public healthcare system.

Appendix E. Activity grid

The following activity grid was created to treat T2D based on interviews (Appendix F) with two doctors. As noted in the stakeholder analysis, regional differences lead to slight variations in patient journeys depending on their location.

Activity	Actor	Actors motives & goals	What the Actor gives	What the Actor gets	Affordances	Rules	Skills	Comments
Patient contacts their primary care centre	Patient	The patient describes symptoms and logs into 1177 via app, website, or phone to secure an appointment	Information and time.	An appointment.	Phone.	The patient has to contact the healthcare.	Find the right primary care centre and contact them.	
Evaluation of patient contact.	Nurse	The nurse seeks to prioritize care based on need, allocating available resources accordingly.	Time and knowledge.	To promptly handle urgent cases, the nurse also determines the next point of care for the patient.	Computer and online journal.	Must be done within 24 hours.	Medical training and navigate software.	This is according to *Vårdgarantin* e.g. *the right to care* policy.

Activity	Actor	Actors motives & goals	What the Actor gives	What the Actor gets	Affordances	Rules	Skills	Comments
Medical assessment	Diabetes specialist	Diabetes specialists seek proof of illness to identify conditions and treatments, while patients expect a diagnosis. This process can be stressful for doctors due to time constraints.	Patient gives information to the doctor and the doctor asks questions.	Patient gets a referral to leave a blood sample.	Appointment can take place via primary care centre clinic/phone call or video phone call. Patient needs to bring an ID.	Appointment must be done within 72 hours, regardless of how urgent the case is. Each visit is between 15 to 30 minutes.	The Patient must be able to find the primary care centre office and answer questions.	This is according to *Vårdgarantin* e.g. *the right to care* policy..
Referral to leave blood sample.	Patient and nurse	The patient seeks a diagnosis, while healthcare aims to identify treatment quickly.	Patient gives blood to a nurse. This is done by a first to come first serve policy.	Material for analysis.	The patient must bring an ID to the primary care centre so the nurse can locate the referral in the electronic system and	Patient must give blood according to their referral after appointment.	Giving and drawing blood.	If a patient has an HbA1c >70, they may have T2D. Blood samples are inexpensive.

Activity	Actor	Actors motives & goals	What the Actor gives	What the Actor gets	Affordances	Rules	Skills	Comments
					draw blood using medical devices.			
Doctor responsible for T2D calls Patient	Diabetes specialist	The doctor informs the patient of elevated HbA1c to begin further investigation and potential treatment early.	The doctor sends a letter to the patient with the time for their next appointment, including a referral for a blood sample.	The patient gets a referral and information, which can be uncomfortable.	The patient and doctor need a phone, with the doctor requiring a valid phone number to make the call.	Doctor follows up on the blood sample.	Communicate with patients appropriately; phone calls from doctors are rare in Sweden.	Conversation: Hi! You were here and left some blood samples earlier, and we saw, among other things, that your long-term blood sugar levels are elevated. Which can correspond to age diabetes (T2D).
2nd blood sample	Patient	The patient leaves a new blood sample so that the doctor can confirm the	Patient gives blood.	Material for analysis.	The patient must bring an ID to the primary care centre so the nurse can	It must be done within six weeks. The patient has to leave blood at the	Draw blood.	Sweden has a digital journal system where all information about a patient can be located via

Activity	Actor	Actors motives & goals	What the Actor gives	What the Actor gets	Affordances	Rules	Skills	Comments
		diagnosis.			locate the referral in the electronic system and draw blood using medical device	given date as stated, according to their referral.		their social security number.
Information meeting	Diabetes nurse and patient.	The nurse informs the patient about T2D, covering its definition, causes, and ways to improve HbA1c levels	The nurse provides the patient with information, emotional support, and motivation to make lifestyle changes. This is a discussion, and information is passed on orally	The patient receives a phone call with the results and follow-up appointment details. The nurse provides information, collects data for the NDR, and enrolls the patient in an electronic diabetes management system.	Diabetes nurse on T2D and office at primary care centre.	Occur 24 h after 2nd blood sample.	Give information in a way Patient can absorb knowledge. Ask relevant questions and keep track of information.	If a Patient fails to attend their appointment they get charged a penalty fee. Dietary recommendations follow a government standard.

Activity	Actor	Actors motives & goals	What the Actor gives	What the Actor gets	Affordances	Rules	Skills	Comments
Lifestyle changes.	Patient	The patient strives to make lifestyle changes to avoid medication and achieve better health.	Time, energy and attempt to form new habits, including exercise and diet.	Better long term blood sugar levels.		Follow the diabetes nurse's recommendations.	Knowledge.	
Referral to blood sample.	Patient	Healthcare professionals want to follow up on lifestyle adaptations.	Patient gives blood.	Healthcare professionals get information on whether medication needs to be introduced.	A letter.	Patient must give blood according to their referral.	Remember the appointment.	
3 month blood sample	Patient	Patient gets confirmation on how successful the lifestyle changes were.	Assistant Nurse draws blood from Patient.	Follow-up on lifestyle.	The patient must bring an ID to the primary care centre so the nurse can locate the referral in the electronic	Patient must give blood according to their referral.	Giving and drawing blood	If a patient has too high HbA1c, medication is introduced.

Activity	Actor	Actors motives & goals	What the Actor gives	What the Actor gets	Affordances	Rules	Skills	Comments
					system and draw blood using medical			
Appointment with doctor responsible for T2D.	Patient and doctor responsible for T2D.	The specialist doctor prescribes the first line of treatment which is Metmorfin.	Before the patient arrives, the specialist reviews the blood sample and HbA1c. The specialist provides information on medication to the patient, who asks questions and takes notes. The doctor also checks the patient's feet for sensation, pulse, and circulation	The patient receives a prescription to purchase at the pharmacy for £6.14, while the doctor collects data.	Patient gets information sheet is from the medical company on Metmorfin.	Patient must meet with doctor or face a penalty fee.	The patient must take notes and ask questions to ensure understanding, while doctors must communicate in a way that the patient can comprehend.	

Activity	Actor	Actors motives & goals	What the Actor gives	What the Actor gets	Affordances	Rules	Skills	Comments
			loss.					
Buying medication	Patient and pharmacist	Patient wants to buy medication and the pharmacist wants to inform the patient.	Pharmacist informs the patient and finds the correct medication.	Patient gets medication.	Patient bring their ID to the pharmacy, so the pharmacist can access prescription. The patient gets information sheet is from the medical company on Metmorfin.	Pay for medication, if applicable.		Withdrawing medication can be embarrassing due to the public environment. A strategy patients use is saying, "I have taken this medication before," to prevent pharmacists from providing further information about the medication.

Activity	Actor	Actors motives & goals	What the Actor gives	What the Actor gets	Affordances	Rules	Skills	Comments
Medication starts	Patient	The patient initiates the medication regimen, ramping it up over 2 weeks. The objective is for the patient to acclimate to the medication to minimize potential side effects	Patient gives attention, time and effort to take medication as prescribed.	The patient experiences diarrhea and a lower HbA1c. For 90% of patients, the diarrhea improves over time.	Medicine.	Follow the prescription. The patient takes 1 tablet in the morning for the first 2 weeks. After that, the Patient takes 2 tablets daily, 1 in the morning and 1 in the evening.	Taking the medicine on time.	A challenge with medication is the lack of experienced symptoms, which demotivates patients to adhere. Patients can receive "Apodos," pre-packaged medicines organised according to dosage (time and amount) and sent home. This system requires patients to have a cognitive disability to manage it.

Activity	Actor	Actors motives & goals	What the Actor gives	What the Actor gets	Affordances	Rules	Skills	Comments
								Many patients use a pill box to manage medication.
Medical follow-up	Ophthalmologist and patient	The Patient's eyes are photographed to ensure everything is okay. The eye specialist is looking for complications with the blood vessels in the eyes which can cause blindness.	Patient gives time and trust to the ophthalmologist. The ophthalmologist gives expertise.	The ophthalmologist has the opportunity to treat patients early and monitor their progress. The patient receives confirmation of their well-being.	Medical equipment.	Patients must attend medical appointments every fifth year or face a penalty fee for missed appointments.	Understand why it is important to check eye health.	

Appendix F. Interviews

Interview 1 (Interviewee: Swedish doctor)

Interviewer: Thank you. Could you describe the typical patient journey from diagnosis to ongoing disease management and follow-up? What does it look like for a patient? What happens after they get their diagnosis?

Interviewee: Well, it's typically type 2 diabetes, or age-related diabetes, and sometimes it comes with symptoms like feeling thirsty, losing weight, urinating a lot, and the diagnosis is made that way. They often have quite high blood sugar levels, so sometimes it ends up that they need to go to the hospital's emergency room to restore their blood sugar levels, so it becomes a bit more of a dramatic event. However, many discover it by accident. You might have your blood sugar tested when you're there for a check-up on something else, and they find that your blood sugar is elevated, which corresponds with type 2 diabetes. Often, they'll receive the diagnosis over the phone after a day when the results come in, and you'll usually be booked in with a diabetes nurse for some general information. Something like that.

Interviewer: How does the phone call to the patient look like?

Interviewee: Well, in a typical case, when there aren't many symptoms, but they've found that your blood sugar is elevated by chance.
[R acts out a typical phone call]
So, yes, hello. You were in and had some tests done, and among other things, we saw that your long-term blood sugar is elevated, which could indicate age-related diabetes.
[R stops acting out the phone call]
Then, you always get the diagnosis after testing. You need to take two blood sugar tests, six weeks apart. /…/ If it looks the same, then you have type 2 diabetes, and you'll be booked in to either see a nurse or a doctor for more information and treatment. There isn't really a standardized process for that. However, what can be standardized is that you often get booked in with the diabetes nurse quite early on.

Interviewer: Mm. And what does the diabetes nurse do?

Interviewee: It's a district nurse with specialised training in diabetes, who goes through: What is the disease? What causes it? What can you do yourself to improve things?
It's a lot about diet and exercise, and then, in most cases, they'll start discussing treatment options.

Interviewer: Mm.

Interviewee: There's a group of patients who are right on the border of developing diabetes, and they can be motivated to change their lifestyle. At that point, they almost don't experience any symptoms. It's about genetics and the environment, but today, it's very much about the environment—overweight and sedentary lifestyle. So, many people with diabetes can become medication-free just by starting to exercise and eating according to Swedish dietary guidelines and calorie restrictions, losing weight. So, it's general information and maybe some supportive conversations at the diabetes nurse's office.

Interviewer: Mm. Is the information provided verbally or in writing?

Interviewee: It's verbal! And I'm pretty sure we have some brochures like that. Yes, we do. "For those diagnosed with type 2 diabetes," covering diet, how exercise affects weight loss, and some of the most common medications.

Interviewer: Mm. And what happens next? So, a patient meets with the diabetes nurse, has a conversation for information. What's the next step for the patient?

Interviewee: Well, diabetes care in Sweden is very good in that sense—it's very standardized. So, it's typically the health centres that handle the treatment of type 2 diabetes in about 99% of cases. Then, you see a doctor once a year, and you see a nurse once a year. So, there's contact at least once every six months, where you take tests for lifestyle habits, blood pressure, all that. So, a patient who has seen the diabetes nurse and maybe has blood sugar levels that are borderline for type 2 diabetes—this often becomes a time to make lifestyle changes, which are evaluated after three months with a new blood sugar level. If it's still poor, then the doctor usually starts medication. Metformin is commonly used, as it's good for treating type 2 diabetes and inexpensive. /…/

Interviewer: Mm. How does the collaboration between the patient and doctor work when choosing a medication?

Interviewee: Well, as I said, when it comes to medication, there aren't so many options for diabetes patients. In the beginning, you use Metformin—that's what you start with.

Interview 2 (Interviewee: Swedish doctor)

Interviewer: How does the process work for accessing medication?

Interviewee: Yes, I know. In Sweden, either the patient receives a prescription that they pick up at the pharmacy, or there's something called Apodos, which many older patients use if they have trouble getting to the hospital or pharmacy. With Apodos, the pharmacy packages the medication into dose bags for the patients, and all their medications are included. You open a bag at 8 AM on Monday, and all the medicines are there. Then at 12 PM, another bag with all the medicines for the next part of the day, so it's quite convenient.

/…/

Interviewer: How do other factors influence patient adherence to medication?

Interviewee: Well, it's actually really good. There are social factors that affect adherence as well.

Interviewer: Are there social factors, for example, like age care or family support?

Interviewee: Yes. Well, diabetes is not a stigmatizing disease, so most people handle it well. Social factors, I'm not sure. Socioeconomic factors, however, do play a role. I've noticed that people with higher education tend to have better adherence. I studied in Uppsala, where almost all patients have a higher level of education, and there's a noticeable difference in how informed the patients are.

Interviewer: Why is that?

Interviewee: It's called health literacy. People in Uppsala tend to understand the healthcare system better, knowing where to go if they have problems, how to contact healthcare providers, and so on. They also often read more about their condition online, which helps them know what symptoms to be concerned about and what treatment options exist. So they're more knowledgeable about long-term complications and understand them better.

Interviewer: How does age influence medication access?

Interviewee: Well, it's fairly similar for everyone, but younger patients are often encouraged more to exercise. They're more likely to be capable of exercising. And even though we can't cure diabetes, lifestyle changes can at least slow down the progression of the disease.

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Interviewer: Are patients today, or are patients recommended today, to use digital tools for the treatment of type 2 diabetes?

Interviewee: Well, I know that for type 1 diabetes, there are a lot of digital tools. For type 2, I don’t think so. No, I can't think of any.

Interviewer: Thank you. What tools are used for type 1 diabetes?

Interviewee: For type 1 diabetes, there are apps. It’s a bit more advanced, like an insulin pump that the patient controls themselves. That way, they don’t need something implanted. With an app, they can scan, and they have a meter, so they don’t need to prick themselves to measure blood sugar. Instead, they just scan it and can see exactly what their blood sugar is on their mobile, and they can even get a graph. There’s really good technology for that, which could also work for type 2 diabetes. But no, it's quite expensive, and for type 2 diabetics...Well, it’s not as urgent, with fluctuations being less extreme. So, typically, it’s enough to just check it occasionally.

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Interviewer: For type 1 patients who use these digital tools, have there been positive results, or what results have been seen in their treatment?

Interviewee: Yes, absolutely. They become more motivated because they are more involved in their own treatment. For diabetes, a lot depends on the patient. Lifestyle factors play a big role, and if they can check their blood sugar levels themselves, they’ll probably be more motivated to take care of themselves. For example, they can measure it themselves and think, "Oh, when I eat oatmeal for breakfast, my blood sugar goes up this much. But if I eat eggs for breakfast, it only rises this much." This allows them to adjust their diet in a better way. So, I definitely believe in digital tools, but for older patients, it might be harder for them to adapt to digital tools.

Interviewer: Why do you think it’s harder for older patients? What makes it difficult for them to embrace digital tools?

Interviewee: Well, it’s not uncommon for older people to experience cognitive decline. Maybe they start showing signs of dementia, or… Also, they’re just not used to technology. They grew up with the radio, and now they’re supposed to use a mobile phone.

Interview 3 (Interviewee: Patient, Asian British, early 20s)

An interview with T2D revealed several key factors influencing medication adherence.

Takeaway 1: Limited understanding of T2D as a potential barrier

During consultations, patient received only brief instructions on lifestyle changes and was told to take medication twice daily with meals. However, no explanation was provided on why the medication was necessary. Patient also had further questions regarding the proper medication regime but was avoidant about researching their condition on the Internet. Additionally, patient was concerned about the appropriateness of prescribed dosage, which they questioned if it could be too high for the first treatment plan. Thus, they sought clarification from medically trained relatives. This reliance on non-professional sources could contribute to misconceptions about the correct medication regimen and dosage, increasing hesitancy about the prescribed treatment.

Takeaway 2: Medication adherence strategies and implementation challenges

To ensure that medication was accessible when necessary, patient implemented a strategy of keeping medication in every bag to always have medication when leaving home. Patient had considered using digital reminders but did not implement this strategy because their irregular mealtime render this strategy unhelpful. At home, patient sometimes struggled with adherence. Specifically, their post-meal routines involved engaging in other activities, namely socialising with family, before going to their room to take medication; thus, medication was often taken 30 minutes after eating instead of immediately. This highlights that family engagement could play a stronger role in reinforcing adherence.

Takeaway 3: Tangible symptoms as a facilitator

Experiencing physical symptoms motivated patient to adhere to medication recommendations. Specifically, patient noticed that they had more energy, less pain, and less sweet saliva when they began taking medication. Additionally, patients experienced dizziness and painful headaches when they did not take medication at the appropriate time. Patient had cuts on their hands that would not heal properly and left noticeable marks, which served as a reminder of their T2D.

Takeaway 4: Social-related barriers

Patient expressed fears about being judged by others. Specifically, they reported avoiding eating and taking medication in front of colleagues, as many were experts in the

field of health and especially diabetes. Additionally, patient were concerned that fasting for Ramadan might impact their medication schedule.

Appendix G. Main advantages of digitally enabled diabetes care (MedTech Europe, 2024):

Enhanced health outcomes by reducing acute emergencies and long-term complications
Improved quality of life, offering greater peace of mind, autonomy, and well-being for individuals with T2D and their families
More efficient secondary prevention, resulting in fewer hospitalisations, reduced emergency services use, and improved management of comorbidities
Improved healthcare delivery efficiency by minimizing in-person visits, enabling providers to prioritize patients with more complex needs. Approximately 80 percent of routine care can be managed via telemedicine
Enhanced access to care by overcoming geographical barriers, allowing individuals with diabetes to connect with healthcare providers, though addressing the digital divide remains essential
Cost savings and improved resource allocation within healthcare systems by controlling expenses, including regular check-ups and comorbidity management.