

Original Paper

Text Messaging and Type 1 Diabetes Management: Qualitative Study Exploring Interactions Among Patients and Health Care Professionals

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Abstract

Background: The diffusion of information and communication technologies (ICTs) in type 1 diabetes (T1D) management has generated a debate on the ways in which ICTs can support the patient-provider relationship. Several studies have focused on text messages. Most of the literature proposes quantitative analysis of the impact of text messaging on the clinical conditions of patients and/or their satisfaction with the technology, while the qualitative studies have focused mainly on patients' perceptions about strengths and weaknesses of this technology.

Objective: In contrast to past studies, we adopted a qualitative approach for the in-depth examination of patient-health care professionals' interactions in text messaging.

Methods: The study focused on the use of the Trento Cartella Clinica del Cittadino Diabetes System (TreC-DS), a digital platform with a built-in messaging system, in two diabetes centers, integrating message analysis with interviews with patients and health care professionals. Each center focused on a specific patient profile: the first one focused on pregnant women with T1D and the second one focused on adult patients with poorly controlled diabetes.

Results: The main results of the study were as follows: (1) Health care professionals and patients perceived the messaging system as useful for sharing information (ie, pregnant women for prescriptions and adults with poorly controlled diabetes for advice); (2) The content and communication styles of the two centers differed: in the case of pregnant women, interactions via text messaging were markedly prescriptive, while in the case of adult patients with poorly controlled diabetes, they were conceived as open dialogues; and (3) Conversations were initiated mainly by professionals; in the cases considered, it was mainly the diabetes center that decided whether a messaging conversation was needed.

Conclusions: The results show how the features of interactions of text messaging changed based on the patient profiles in two different centers. In addition, in both diabetes centers that were involved, the system seems to have laid a foundation for a closer relationship between patients and health care professionals.

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KEYWORDS

mHealth; text messaging; type 1 diabetes; diabetes in pregnancy; qualitative research

Introduction

Type 1 diabetes (T1D) is an autoimmune disease characterized by deficient insulin production in the body that tends to develop in childhood. T1D self-management can be challenging for patients and their relatives, including the following daily tasks [1]: self-monitoring blood glucose levels, managing insulin treatment, observing the symptoms of hypoglycemia (eg, constant hunger, tiredness, and blurred vision), and conducting other activities meant for preventing diabetes complications (eg, self-monitoring foot health and screening for eye complications).

The diffusion of information and communication technologies (ICTs) in health care has generated a polycentric debate on how ICTs can support patients with diabetes, providing services that empower them in self-management (eg, electronic logbooks or reminder functions for medications), enable communication with health care professionals (eg, messaging systems and rule-based alarms), and offer information on self-management (eg, tutorials for blood glucose tests). In particular, this debate has addressed issues such as the clinical impact of ICTs [2-9], the effects of ICTs on the patient-professional relationship [10,11], and their consequences on the workload of hospital staff [12-15].

The existence of a specific strand of studies on ICTs and diabetes is due to some characteristics of this illness, such as the significant workload required of patients and the vital role of patient education [16]. For this reason, although the use of messaging systems in health care is a topic already investigated with regard to other conditions [17-21], various contributors have focused explicitly on the role of text messaging in supporting and educating patients with diabetes. These studies often focus on the impact of text messaging on clinical outcomes and on the self-care capabilities of diabetic patients [22-27]. Other researchers have paid attention to patients' perceptions of the usefulness of text messaging [28-31], privileging quantitative techniques to assess users' satisfaction. Finally, another group of studies has adopted qualitative techniques to explore patients' perceptions regarding strengths and weaknesses of text messaging [32-37]. These works underline that text messaging is perceived by patients as a tool that is useful for resolving nonurgent issues with health care professionals [32], accessing and managing their own clinical data [37], receiving information and analytics for self-management [33,36], and feeling monitored [34,35]. Qualitative studies have also performed in-depth analysis of the factors perceived by patients that discourage the use of text messaging, such as their unfamiliarity with digital devices [21] or slow responsiveness of professionals [24].

As Holtz and Laukner argue [38], studies on text messaging have several limitations. The reports of provider interactions with diabetic patients through text messaging are limited and poorly documented, while health care professionals' perceived usefulness and the integration of mobile apps in organizational workflows are underinvestigated. This work intends to contribute to fill in the first gap, adopting a qualitative approach for documenting and examining, in depth, the interactions of patients and health care professionals via text messaging.

We consider the case of the Trento Cartella Clinica del Cittadino Diabetes System (TreC-DS), a digital platform with a built-in messaging system that supports communication between health care organizations and T1D patients. The study investigates the use of the messaging system in two diabetes centers in the Province of Trento, Italy. These two diabetes centers used the TreC-DS to support patients who would benefit from strict monitoring: pregnant women with T1D and adults with poorly controlled diabetes.

In the next section of this paper, we introduce the TreC-DS and the methods used to gather and analyze data. The findings, preceded by an overview analysis of the frequency of message exchanges, are organized into two subsections, one for each diabetes center. We conclude with some final remarks about the use of text messaging in T1D management and discuss limitations to this study.

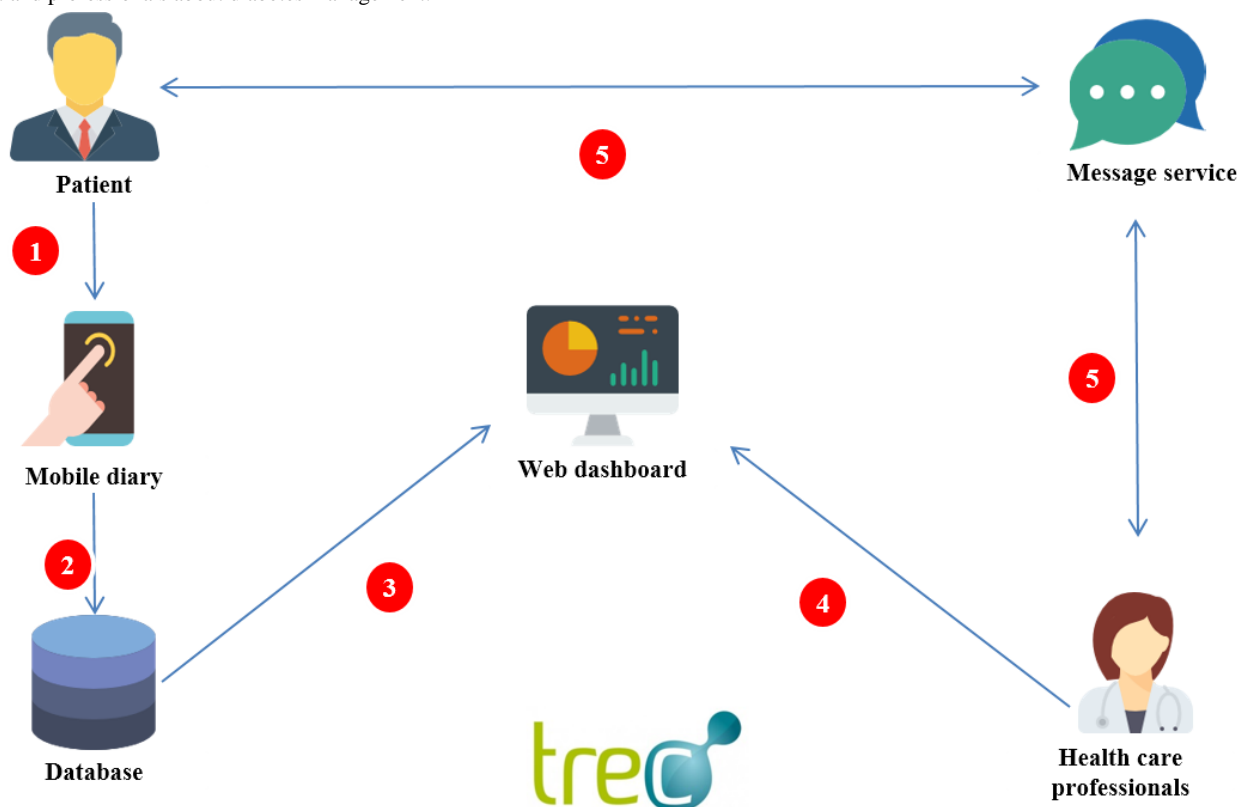
Methods

The TreC Diabetes System

The Trento Cartella Clinica del Cittadino (TreC), a citizen-controlled clinical record system, was introduced to the Province of Trento in 2010 with the aim of empowering Italian citizens to manage their own health, facilitating their communication with health care institutions and the management of health information [39]. The platform has two TreC services: *basic* and *composite*. The former consists of data management and other common Web-based functions, and the latter includes higher integrated functions, such as a structured health diary and monitoring tools for specific pathologies [40].

The TreC-DS was developed to deliver mHealth services to citizens with T1D and to diabetes centers (see Figure 1). A mobile phone app enabled patients to keep track of all their diabetes information (eg, measurements, therapy, symptoms, and diet); it also included functions to support decision making (ie, a carbohydrate-count feature, a bolus calculator, graphs, and trend-tracking indexes). Through a Web-based dashboard, health care professionals (ie, doctors and nurses) could monitor patients' data remotely. Finally, the platform had a built-in messaging system that worked as a secure text-messaging service between patients and professionals.

Figure 1. A conceptual model of diabetes patient home monitoring: (1) daily diary compilation; (2) data stored in a central database; (3) data displayed on a dashboard; (4) health care professionals from the diabetes center access patient dashboards to evaluate patient problems; (5) conversation between patient and professionals about diabetes management.



Clinical Trial

This work is a part of a trial aimed at quantifying the effectiveness and acceptability of the TreC-DS for T1D patients. The trial was approved by the Research Ethics Committee of the Health Authority of the Autonomous Province of Trento, and written consent was obtained from the participants. The consent forms were included among other signed documents upon registration of the clinical trial at Ministero della Salute Direzione Generale dei Dispositivi Medici del servizio Farmaceutico e della Sicurezza delle Cure (DGDFSC) (trial number 0032830-P-22/04/2014).

The trial involved three diabetes centers in the Province of Trento. Each center focused on a particular patient profile and involved 10-15 patients:

1. The *Diabetes Center-Pediatrics* selected 15 children and adolescents who had poorly controlled diabetes, had a recent diagnosis, or used an insulin pump.
2. The *Diabetes Center-Adults* chose 15 patients with poorly controlled diabetes.
3. The *Diabetes Center-Pregnancy* selected 10 pregnant women with pre-existing T1D.

During the definition of the clinical trial protocol, these diabetes centers targeted patient profiles that would, according to the involved health care professionals, benefit from the stricter monitoring and frequent reminders about correct disease management that the platform could provide.

While the evaluation of the trial focused on the self-management practices of patients, changes in organizational practices arising

from the introduction of the new technology to the diabetes centers and changes in the patient-professional relationship were also examined [11]. Here we present part of the results yielded from this research project, focusing on the use of the messaging system utilized by the Diabetes Center-Adults and Diabetes Center-Pregnancy, which were chosen for their frequency of use, integration of analyses of these messages, and interviews between health care professionals and patients. Characteristics of patients from these centers are summarized in [Table 1](#).

Data Gathering

The use of the TreC-DS was explored through the analysis of text messages exchanged between patients and professionals via the system. The messages consisted of analyses of patient data, as well as inquiries and comments on insulin therapy, diet, and diabetes self-management. We analyzed 396 conversations within message threads exchanged between the patients and centers.

After a preliminary analysis of message exchanges, we conducted semistructured interviews with health care professionals and patients (see [Textbox 1](#)).

We interviewed all patients selected by the Diabetes Center-Pregnancy, except one that did not consent to the interview, as well as the first 8 patients to give their availability who were selected by the Diabetes Center-Adult with the aim to have comparable numbers of interviewed patients from each center. Patients were interviewed at home. Interviews lasted 45-60 minutes and were transcribed verbatim. All health care professionals involved in the clinical trial were interviewed. The main topics of the interviews are summarized in [Table 2](#).

Table 1. Characteristics of patients and their use of text messaging.

Diabetes center and patient number	Gender	Age in years	Number of conversations with professionals via text messaging	Interviewed
Pregnancy				
1	Female	38	17	Yes
2	Female	32	16	Yes
3	Female	26	4	No
4	Female	37	9	Yes
5	Female	38	6	Yes
6	Female	28	20	Yes
7	Female	32	9	Yes
8	Female	36	12	Yes
9	Female	22	21	Yes
10	Female	33	9	Yes
Adults				
1	Male	39	27	Yes
2	Male	23	13	Yes
3	Male	41	5	No
4	Male	40	15	Yes
5	Male	49	17	Yes
6	Female	27	18	No
7	Female	37	17	Yes
8	Female	20	23	Yes
9	Male	32	22	No
10	Male	50	25	Yes
11	Female	50	19	Yes
12	Male	29	25	No
13	Male	42	36	No
14	Male	21	4	No
15	Male	31	7	No

Textbox 1. Target populations involved in the interviews.

<p>Diabetes center and Interview participants</p> <ul style="list-style-type: none"> • Adults <ul style="list-style-type: none"> • 8 patients • 2 doctors (diabetologists) • 1 nurse • Pregnancy <ul style="list-style-type: none"> • 9 patients • 1 doctor (diabetologist) • 1 nurse

Table 2. Interview guide.

Interview topics	Interview subtopics	
	Patients	Health care professionals
Patient-professional relationship (before TreC-DS ^a)	<ul style="list-style-type: none"> • Disease onset • Self-management practices • Use of self-tracked data 	<ul style="list-style-type: none"> • Education at onset and during clinical encounters • Use of patient-tracked data
Use of TreC-DS	<ul style="list-style-type: none"> • Collection and data analysis • Use of text messaging • Relationship between the use of TreC-DS and other care practices • Changes in relationship with professionals 	<ul style="list-style-type: none"> • Use of patient-tracked data • Use of text messaging • Relationship between the use of TreC-DS and other organizational practices • Changes in relationship with patients
General evaluation of TreC-DS	<ul style="list-style-type: none"> • Usefulness of TreC-DS • Intention to use TreC-DS after the trial 	<ul style="list-style-type: none"> • Usefulness of TreC-DS • Intention to use TreC-DS after the trial

^aTreC-DS: Trento Cartella Clinica del Cittadino Diabetes System.

The interviews focused on reconstructing the ways in which patients and professionals used the different features of the TreC-DS, including text messaging, during the trial. In addition, during the interviews we investigated elements not directly connected with the use of the system. This latter focus was investigated, since it is assumed that the ways in which people use and incorporate a new technology into their daily lives are shaped by social circumstances, such as patients' attitudes toward their illnesses, pre-existing relationships and practices, and emerging social representations about the new technology [41].

Data Analysis

Overview

Data gathered were coded using template analysis, through which “the researcher produces a list of codes (‘template’) representing themes identified in their textual data. Some of these will usually be defined a priori, but they will be modified and added to as the researcher reads and interprets the texts” [42]. Preliminary categories based on the interview outline and literature analysis were used to segment the texts [32-38].

Message Analysis

At the end of message analysis, we created two general categories. The first category was labelled “communication style of the health care professional-patient interaction,” which was concerned with how much the interactions between professionals and patients were prescriptive or open. The second one was labelled “contents of the health care professional-patient interaction,” which was concerned with topics of the text messages. The contents of the conversations (ie, the message threads) were subdivided into the following subcategories:

1. Therapy: management of glycemia through insulin therapy.
2. Diet: management of glycemia through food intake.
3. Education: general rules for self-management.
4. Motivation: reinforce adherence to treatment.

5. Context: gathering information regarding patients' daily lives (eg, exceptional events and comorbidities) that could affect diabetes management.
6. Technical issues: problems that emerged in data tracking.

Conversations often covered multiple topics at once. In these cases, we coded the single conversation more than once.

Interview Analysis

Interviews were also analyzed using template analysis. The purpose of this second step of analysis was to explore patients' and professionals' use and social representations of the TreC-DS, enriching the content of the categories described above. During the analysis of the interviews, another category emerged, which was labelled “representations about text messaging.” This last category concerned the meaning given to text messaging by both patients and health care professionals (eg, how the system improved doctor-patient communication or self-care capabilities).

Results

Overview

We conducted a preliminary analysis of the frequency with which the patients and diabetes centers used the TreC-DS messaging feature during the trial. We focused on two topics: the direction of each conversation (ie, who initiated the interaction) and the shared content of the messages using the categorization described above. Regarding the direction of conversation (see Table 3), there were no remarkable differences between the messages from the two diabetes centers. In both cases, the majority of the conversations were initiated by the center; the percentage of center-initiated messages was somewhat higher among the adult patients with poorly controlled diabetes (231/273, 84.6%) than it was among the pregnant patients with diabetes (100/123, 81.3%).

Table 3. Direction of text-message conversations.

Diabetes center	Conversations, N	Direction of conversation, n (%)	
		Diabetes center to patient	Patient to diabetes center
Pregnancy	123	100 (81.3)	23 (18.7)
Adults	273	231 (84.6)	42 (15.4)

Table 4. Text-message conversation content.

Diabetes center	Conversation content, n (%)					
	Education	Motivation	Insulin therapy	Diet	External context	Technical issues
Pregnancy (N=156 conversations)	0 (0)	14 (9.0)	80 (51.3)	22 (14.1)	25 (16.0)	15 (9.6)
Adults (N=341 conversations)	24 (7.0)	104 (30.5)	94 (27.6)	27 (7.9)	25 (7.3)	67 (19.6)

In contrast, if we consider the content of the conversations (see [Table 4](#)), many differences can be observed between the Diabetes Center-Pregnancy and Diabetes Center-Adults groups. In the Diabetes Center-Pregnancy group, more than half of the content (80/156, 51.3%) of the conversations focused on therapy. This focus can be explained by the pregnant women's need to keep their glucose values within a fixed range by the center. Exchanges regarding these patients' external context (25/156, 16.0%) and diet (22/156, 14.1%) were quite frequent, likely for the same reason. In contrast, in the Diabetes Center-Adults group, the conversations were mainly comprised of motivational content (104/341, 30.5%) aimed at pushing patients with poorly controlled diabetes to achieve good results in the self-management of blood glucose levels. Messages concerning insulin therapy (94/341, 27.6%) and technical issues (64/341, 19.6%) were also frequent; the high percentage of technical issues is probably due to the sporadic access of adult patients to their hospital ward (ie, one or two face-to-face visits in a year). Drawing on our qualitative analysis of text-message exchanges and interviews, we will illustrate the ways in which the patients and health care professionals used and represented the built-in messaging system.

Diabetes in Pregnancy

T1D has several potential negative effects on the fetus, including overgrowth [43], the development of congenital malformations [44], and premature death [45]. To avoid these negative events, doctors generally recommend strict control over blood glucose levels and over the patient's lifestyle.

The goal of pregnancy was so important that I began to take many more medical exams and check-ups. [Before the pregnancy] I spent two or three years under strict control and, in the end, I entered the pregnancy with good blood sugar levels. [Patient 1, Diabetes Center-Pregnancy]

I'm always scared to do what comes into my head arbitrarily, even when I know these injections can be managed autonomously. [Patient 7, Diabetes Center-Pregnancy]

A stricter monitoring of clinical parameters may begin before the pregnancy and continue until childbirth, during which time women may partially renounce their autonomy. The temporary loss of autonomy is justified by both the clinical risks and the

loss of relevance of self-management skills due to the physiological changes related to pregnancy. Therefore, the relationship between patients and their diabetes center changes dramatically. While health care professionals shift from an approach based on the empowerment of patients to a more prescriptive one, patients usually accept, and often openly appreciate, this change. In this context, the TreC-DS is represented by both professionals and patients as a technology that is useful for supporting diabetes center-patient communication remotely during a stage of illness in which communication is vital.

Without doubt, it [the use of TreC-DS] is a time-consuming activity...However, the quality of care has changed. If we see the patient after two weeks with the system, it is not like it is when we see a patient after two weeks without the system. It is resuming something that, actually, has never stopped. [Nurse, Diabetes Center-Pregnancy]

The relationship with the ward was not as strong as it was previously: the visits, instead of being held once a week, were held twice a month. Nevertheless, weekly advice about therapy still arrived. I felt well monitored, and it [the TreC-DS] has been a great tool. [Patient 4, Diabetes Center-Pregnancy]

The TreC-DS was represented by both patients and health care professionals as a system that improves the quality of care. By using it, the diabetes center could monitor patients strictly, request additional information, send prescriptions, and have more-focused conversations during the face-to-face visits with patients, having already acquired information about the patient's health status from the TreC-DS. For the patients, the system improved the quality of care and reduced the frequency of face-to-face visits, while ensuring continuous interaction with the diabetic center by receiving prescriptions and advice through the system.

The general representations of the system seemed to affect the communication styles of the messages, as shown in the conversation below between Patient 5 and the Diabetes Center-Pregnancy:

Hello. We checked your glucose values, and we noticed that they tend to increase both before dinner and when you wake up. In the afternoon, when you

have a snack, try to increase your intake of NovoRapid [short-acting insulin] to 3 units; in the evening, you should increase your Levemir dosage [long-acting insulin] to 17 units. See you soon! [Diabetes Center-Pregnancy, message sent to patient]

Good morning. Lately when I wake up, my glucose values are in the 120-138 range before breakfast. I usually take 6 units of Levemir at 11 p.m. In your opinion, do I need to increase my insulin dosage from 6 to 7 units? Thanks, and see you soon! [Patient 5, question posed to Diabetes Center-Pregnancy]

Good morning. Your insulin treatment plan has been changed in the following manner: take 4 units of NovoRapid at breakfast, 7 units at lunch, and 7 at dinner; take 8 units of Levemir before bed. [Diabetes Center-Pregnancy, in response to patient's question]

The reported messages, although they contain different directions, are characterized by a prescriptive communication style. The patients with "bad" glycemic values, whether directly observed by health care professionals or reported by the patients, received therapeutic prescriptions, as shown in the conversation below between Patient 7 and the Diabetes Center-Pregnancy:

Good morning. I need information about something that happened this afternoon: 2 hours after lunch, at 5 p.m., I measured my glycemic value at 188. Therefore, I walked for an hour and a half. Then I took a vitamin supplement and two candies labelled "without sugar." At 8 p.m., my glycemic value was 197! I do not understand. Why have my blood sugar values not decreased? In 3 hours, my values have remained high, even though I walked a lot. [Patient 7, question posed to Diabetes Center-Pregnancy]

Hello. The walk was a good idea. You should always check the carbohydrates indicated on packages of food such as candy. The inscription "without sugar" means that the candy does not contain any added sugar, but it still does contain sugar. [Diabetes Center-Pregnancy, in response to patient's question]

Nutrition was an area of autonomy that was rarely touched. However, the professionals did discuss the sugars contained in foods and how to handle them, whether through insulin therapy or physical activity. The communication style was less prescriptive on this topic, but the advice of the ward was generally considered authoritative.

Hello! Maybe you did not read the message written by the doctor. We are waiting to receive your blood sugar values, including those from the last few days. [Diabetes Center-Pregnancy]

Given the high attention of the diabetes center on diabetic women in pregnancy, messages similar to the one above were quite common. Through these messages, the center aimed at continuous monitoring of patients; however, monitoring was only accepted for the duration of pregnancy.

No! After the pregnancy, I would not use the system every day. Right now, I have a goal I care about, and I am alert to everything. But after the pregnancy, I

would feel really sick [using it]. [Patient 10, Diabetes Center-Pregnancy]

The women with diabetes who were interviewed agreed that continuous use of the TreC-DS would be unacceptable and too onerous after pregnancy. Therefore, the suspension of diabetes self-management was interpreted as temporary. Some patients claimed that if they were not pregnant, they would not use the system at all, while others favored a more limited use of the system. For the latter, the system was represented as useful for sending specific data to the diabetes center, allowing them to receive feedback from professionals about their self-management strategies.

Poorly Controlled Diabetes

In the medium-to-long term, patients with poorly controlled diabetes may develop serious health issues, such as cardiovascular diseases [46,47], retinopathies [48,49], or renal diseases [50,51]. Therefore, health care professionals have included adults with a history of poor self-management in the study, with the aim of monitoring them remotely.

My history with diabetes started out badly. When I was hospitalized, I was barely saved. From that moment on, I began to have practical issues with diabetes management: my life is fast-paced and stressful, and for a long time, I did not accept my illness. I approached the Diabetes Centre of Trento, which I frequented for some time, but then I abandoned it. Then, several years ago, I realized that I had to regain control over my life. [Patient 7, Diabetes Center-Adults]

The above excerpt exemplifies why many patients experience difficulties accepting their illness and reconciling it with their social and work lives. Consequently, friction often arises between these patients and health care organizations. The TreC-DS was adopted by patients who had tried several times to improve their self-management capabilities after being alerted by a diabetes center that, in the future, their health conditions could become worse. The patients' histories were marked by various failures, and the system was an opportunity to regain control over their condition.

Over the last few years, diabetes management has changed dramatically. We have to monitor our patients, explaining to them, "Be careful: for injections, you now have to use a needle." Other times, it can happen that [we need to intervene]. [Doctor, Diabetes Center-Adults]

I greatly appreciated that clinicians and nurses were monitoring me...[Name of nurse] is very active; she gives me suggestions and, if I am in doubt, she answers my questions...and she does so on the basis of the values that I have input into the system! [Patient 5, Diabetes Center-Adults]

Both for professionals and patients, the TreC-DS was useful for improving diabetes center-patient relationships, renewing and expanding the self-management skills of patients. From the professionals' perspective, poor control of diabetes occurs largely because patients have developed a bad relationship with

their illness and because they have gaps in knowledge of diabetes. Given these assumptions, the system is useful for monitoring patients, acquiring information about their self-management capabilities, and giving them information and advice.

Yet the patients emphasized that through the TreC-DS, they felt constantly monitored, receiving messages with useful “tricks” for improving their self-management capabilities and feedback on trends in their blood glucose levels. For many of these patients, the system made face-to-face visits less necessary, reducing their frequency. After the introduction of the TreC-DS, patients rapidly shifted from a state characterized by poorly controlled diabetes to one characterized by daily interaction with a diabetes center, receiving feedback and advice.

While you had the flu, you managed your blood sugar values excellently! I hope that you'll get well so that you can celebrate the New Year. Happy New Year! Goodbye. [Diabetes Center-Adults]

When the nurse writes me a message saying “Well done!” I like it, even if I don't know who is talking to me. I don't care; I know that, in any case, it is someone knowledgeable. [Patient 9, Diabetes Center-Adults]

The system was useful for patients to receive feedback on their self-management skills. As noted previously, the majority of the conversations contained motivational messages sent by the health care department, with the aim of praising patients for the achievement of good blood glucose values. Another aim was to reassure patients who did not reach their clinical goals. The health care providers seemed interested in being noticeable to patients, pointing out to patients that they were monitoring them remotely and encouraging them to track their values daily. It was difficult for these patients to learn self-management skills; for the professionals, the use of the TreC-DS helped to support these patients on their journey.

Hi! Do you know “the rule of 15” for hypoglycemia management? When you have lowblood glucose levels, you have to adjust them with 15 grams of sugar, and after 15 minutes, you have to recheck your blood sugar values: if they are under 100, you have to take 15 grams of sugar again... [Diabetes Center-Adults]

Encouraging messages were often followed by educational ones that provided general rules about diabetes management, such as in cases of incorrect patient behaviors observed remotely by health care professionals. Unlike the observations in the case of diabetes in pregnancy, the goal was not to drive patients remotely through prescriptive guidelines, but rather to provide them with advice and rules meant to improve their self-management skills. Consequently, messages concerning insulin therapy and diet took the form of suggestions that the patient could accept, refuse, or follow partially.

Hi! Have you checked your blood sugar values? I noticed that you are not taking the 8 units of Humalog

[short-acting insulin] I prescribed for you because you need more insulin. Try taking 10 units of Humalog in the morning, 10 units in the middle of the day, and 10 units in the evening. Try this out for a few days, and let me know how it goes. [Diabetes Center-Adults, message to patient]

Okay, but for the middle of the day, I'd like to stay at 8 units of Humalog because I don't eat much. [Patient 6, message to Diabetes Center-Adults]

Okay. This is up to you. [Diabetes Center-Adults, in response to patient's message]

The above conversation reveals that the patient only partially accepted the nurse's recommendations on modifying her insulin therapy, maintaining that before lunch, she would preserve the pre-existing plan. The suggestions provided by the diabetes center, following the analysis of data tracked in the TreC-DS, were renegotiated by patients in light of their eating habits and living conditions.

Discussion

Principal Findings

This paper analyzed how the TreC-DS, an mHealth platform with a built-in messaging system, was used by two diabetes centers to assist two types of patients with T1D. The main findings of this study are summarized in [Table 5](#).

Sharing Information for Resolving Different Problems

Health care professionals and patients thought of the messaging system and the overall platform as useful for sharing information. Perceptions about text messaging were strongly influenced by the patients' histories and by the ways in which professionals and the patients themselves interpreted the patients' needs. On the one hand, for the women with T1D, pregnancy was a tough decision, as these patients were informed about the need for their diabetes to be under strict control during pregnancy; on the other hand, the adults with poorly controlled diabetes had a history of failure in diabetes management, and they gradually became aware of the clinical risks of this situation. Consequently, in the diabetes centers, the same system was considered a useful tool to address very different problems.

Constructing a Closer Relationship With the Patient

ICTs have long been associated with the standardization and depersonalization of patient-professional relationships [52]. Several recent studies, however, underlined how ICTs can foster more intimate relationships, where professionals better understand patients' clinical and emotional conditions and can provide personalized interventions [53,54]. Similarly, our results show how through a messaging system, a hospital department can continuously observe patients' data, guiding patients remotely in the management of diabetes. Despite some differences in the use of text messaging, in both diabetes centers, the messaging system was used by professionals to construct a closer relationship with patients and guide them to avoid clinical complications.

Table 5. Patient-health care professional interactions using text messaging.

Diabetes center	Content of message exchanges	Communication styles	Social representations about text messaging
Pregnancy	Most of the messages were about therapy (80/156, 51.3%).	Interactions were initiated mainly by professionals and were markedly prescriptive.	Useful for transmitting prescriptions from diabetes centers to patients. Face-to-face visits decreased and became more focused on patients' data.
Adults	Most of the messages were about motivation (104/341, 30.5%) and therapy (94/341, 27.6%).	Interactions were initiated mainly by professionals and were conceived as open dialogues.	Useful for empowering patients' self-management skills. Face-to-face visits decreased.

Emerging Asymmetrical Interactions

In our study, we showed how the conversations were mainly initiated by the health care professionals. Most likely, the shared perceptions of the system's use, interpreted from both sides as useful for transmitting information from professionals to patients, laid a foundation for asymmetrical interactions in which professionals analyze the data input by the patients. Clinicians and administrative staff often express concerns about using telemonitoring technologies because of the possible increase in patient requests [12-15]; however, in the considered cases, it is mainly the diabetes center that decides if a text message conversation is necessary, choosing when and how to begin a conversation with a patient.

Limitations and Future Work

This study aims to break new ground in the analysis on patient-provider relationships emerging from text-message exchanges. However, it suffers from some limitations that should be addressed by future research. Firstly, the study involved only two target groups of patients with TD1. More research is needed regarding the use of text messaging by other target groups of diabetic patients with different monitoring needs and different socioeconomic backgrounds. Secondly, the number of patients, the time frame of the trial, and, consequently, the workload are limited. The overall positive perceptions by health care professionals about text messaging should be reassessed in the prolonged care of a larger set of users. Thirdly, our work focused

on patient-health care professional interactions using text messaging without a systematic comparison of these interactions in the absence of text messaging. The lack of a baseline impeded the ability to make specific considerations regarding the consequences of text messaging on the workflow of the health care professionals. Future research on this topic would benefit from an analysis combining observational methods and performance metrics (eg, frequency of visits and the time spent by professionals for each patient) before and after the introduction of the technology.

Conclusions

In recent years, a debate has emerged on the role of ICTs in diabetes management. Some studies have focused on text messages. Most of the literature proposes quantitative analysis of the impact of text messaging on the clinical conditions of patients and/or their satisfaction with the technology. Qualitative studies have focused mainly on patients' perceptions about strengths and weaknesses of this technology. In contrast, we used qualitative techniques for documenting in-depth, patient-health care professional interactions using text messaging, combining message analysis and semistructured interviews. The results show how the features of interactions and perceptions of text messaging changed based on the patient profiles in two different centers. In addition, in both diabetes centers considered, the system seems to have laid a foundation for a closer relationship between patients and health care professionals.

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Conflicts of Interest

None declared.

References

1. International Diabetes Federation. IDF Diabetes Atlas. 8th edition. Brussels, Belgium: International Diabetes Federation; 2017. URL: <https://www.idf.org/component/attachments/attachments.html?id=1405&task=download> [accessed 2019-04-29] [WebCite Cache ID 780TAPJjh]
2. Kollmann A, Riedl M, Kastner P, Schreier G, Ludvik B. Feasibility of a mobile phone-based data service for functional insulin treatment of type 1 diabetes mellitus patients. *J Med Internet Res* 2007 Dec 31;9(5):e36 [FREE Full text] [doi: [10.2196/jmir.9.5.e36](https://doi.org/10.2196/jmir.9.5.e36)] [Medline: [18166525](https://pubmed.ncbi.nlm.nih.gov/18166525/)]
3. Cafazzo JA, Casselman M, Hamming N, Katzman DK, Palmert MR. Design of an mHealth app for the self-management of adolescent type 1 diabetes: A pilot study. *J Med Internet Res* 2012 May 08;14(3):e70 [FREE Full text] [doi: [10.2196/jmir.2058](https://doi.org/10.2196/jmir.2058)] [Medline: [22564332](https://pubmed.ncbi.nlm.nih.gov/22564332/)]

4. Grey M, Whittemore R, Jeon S, Murphy K, Faulkner MS, Delamater A, TeenCope Study Group. Internet psycho-education programs improve outcomes in youth with type 1 diabetes. *Diabetes Care* 2013 Sep;36(9):2475-2482 [[FREE Full text](#)] [doi: [10.2337/dc12-2199](https://doi.org/10.2337/dc12-2199)] [Medline: [23579179](https://pubmed.ncbi.nlm.nih.gov/23579179/)]
5. Kirwan M, Vandelanotte C, Fenning A, Duncan MJ. Diabetes self-management smartphone application for adults with type 1 diabetes: Randomized controlled trial. *J Med Internet Res* 2013 Nov 13;15(11):e235 [[FREE Full text](#)] [doi: [10.2196/jmir.2588](https://doi.org/10.2196/jmir.2588)] [Medline: [24225149](https://pubmed.ncbi.nlm.nih.gov/24225149/)]
6. Klasnja P, Pratt W. Healthcare in the pocket: Mapping the space of mobile-phone health interventions. *J Biomed Inform* 2012 Feb;45(1):184-198 [[FREE Full text](#)] [doi: [10.1016/j.jbi.2011.08.017](https://doi.org/10.1016/j.jbi.2011.08.017)] [Medline: [21925288](https://pubmed.ncbi.nlm.nih.gov/21925288/)]
7. Arnhold M, Quade M, Kirch W. Mobile applications for diabetics: A systematic review and expert-based usability evaluation considering the special requirements of diabetes patients age 50 years or older. *J Med Internet Res* 2014 Apr 09;16(4):e104 [[FREE Full text](#)] [doi: [10.2196/jmir.2968](https://doi.org/10.2196/jmir.2968)] [Medline: [24718852](https://pubmed.ncbi.nlm.nih.gov/24718852/)]
8. Wu Y, Yao X, Vespasiani G, Nicolucci A, Dong Y, Kwong J, et al. Mobile app-based interventions to support diabetes self-management: A systematic review of randomized controlled trials to identify functions associated with glycemic efficacy. *JMIR Mhealth Uhealth* 2017 Mar 14;5(3):e35 [[FREE Full text](#)] [doi: [10.2196/mhealth.6522](https://doi.org/10.2196/mhealth.6522)] [Medline: [28292740](https://pubmed.ncbi.nlm.nih.gov/28292740/)]
9. Farmer A, Gibson OJ, Tarassenko L, Neil A. A systematic review of telemedicine interventions to support blood glucose self-monitoring in diabetes. *Diabet Med* 2005 Oct;22(10):1372-1378. [doi: [10.1111/j.1464-5491.2005.01627.x](https://doi.org/10.1111/j.1464-5491.2005.01627.x)] [Medline: [16176199](https://pubmed.ncbi.nlm.nih.gov/16176199/)]
10. Maria Piras E, Zanutto A. "One day it will be you who tells us doctors what to do!" Exploring the "Personal" of PHR in paediatric diabetes management. *Inf Technol People* 2014 Oct 28;27(4):421-439. [doi: [10.1108/ITP-02-2013-0030](https://doi.org/10.1108/ITP-02-2013-0030)]
11. Piras EM, Miele F. Clinical self-tracking and monitoring technologies: Negotiations in the ICT-mediated patient-provider relationship. *Health Sociol Rev* 2017;26(1):38-53. [doi: [10.1080/14461242.2016.1212316](https://doi.org/10.1080/14461242.2016.1212316)]
12. Lamothe L, Fortin J, Labbé F, Gagnon M, Messikh D. Impacts of telehomecare on patients, providers, and organizations. *Telemed J E Health* 2006 Jun;12(3):363-369. [doi: [10.1089/tmj.2006.12.363](https://doi.org/10.1089/tmj.2006.12.363)] [Medline: [16796505](https://pubmed.ncbi.nlm.nih.gov/16796505/)]
13. van den Berg E, Kloppenborg RP, Kessels RP, Kappelle LJ, Biessels GJ. Type 2 diabetes mellitus, hypertension, dyslipidemia and obesity: A systematic comparison of their impact on cognition. *Biochim Biophys Acta* 2009 May;1792(5):470-481 [[FREE Full text](#)] [doi: [10.1016/j.bbadis.2008.09.004](https://doi.org/10.1016/j.bbadis.2008.09.004)] [Medline: [18848880](https://pubmed.ncbi.nlm.nih.gov/18848880/)]
14. Hanley J, Fairbrother P, McCloughan L, Pagliari C, Paterson M, Pinnock H, et al. Qualitative study of telemonitoring of blood glucose and blood pressure in type 2 diabetes. *BMJ Open* 2015 Dec 23;5(12):e008896 [[FREE Full text](#)] [doi: [10.1136/bmjopen-2015-008896](https://doi.org/10.1136/bmjopen-2015-008896)] [Medline: [26700275](https://pubmed.ncbi.nlm.nih.gov/26700275/)]
15. Vest BM, Hall VM, Kahn LS, Heider AR, Maloney N, Singh R. Nurse perspectives on the implementation of routine telemonitoring for high-risk diabetes patients in a primary care setting. *Prim Health Care Res Dev* 2017 Dec;18(1):3-13. [doi: [10.1017/S1463423616000190](https://doi.org/10.1017/S1463423616000190)] [Medline: [27269513](https://pubmed.ncbi.nlm.nih.gov/27269513/)]
16. Anderson RM, Funnell MM. Patient empowerment: Reflections on the challenge of fostering the adoption of a new paradigm. *Patient Educ Couns* 2005 May;57(2):153-157. [doi: [10.1016/j.pec.2004.05.008](https://doi.org/10.1016/j.pec.2004.05.008)] [Medline: [15911187](https://pubmed.ncbi.nlm.nih.gov/15911187/)]
17. Sittig DF. Results of a content analysis of electronic messages (email) sent between patients and their physicians. *BMC Med Inform Decis Mak* 2003 Oct 01;3:11 [[FREE Full text](#)] [doi: [10.1186/1472-6947-3-11](https://doi.org/10.1186/1472-6947-3-11)] [Medline: [14519206](https://pubmed.ncbi.nlm.nih.gov/14519206/)]
18. Petrie KJ, Perry K, Broadbent E, Weinman J. A text message programme designed to modify patients' illness and treatment beliefs improves self-reported adherence to asthma preventer medication. *Br J Health Psychol* 2012 Feb;17(1):74-84. [doi: [10.1111/j.2044-8287.2011.02033.x](https://doi.org/10.1111/j.2044-8287.2011.02033.x)] [Medline: [22107110](https://pubmed.ncbi.nlm.nih.gov/22107110/)]
19. Haun JN, Lind JD, Shimada SL, Martin TL, Gosline RM, Antinori N, et al. Evaluating user experiences of the secure messaging tool on the Veterans Affairs' patient portal system. *J Med Internet Res* 2014 Mar 06;16(3):e75 [[FREE Full text](#)] [doi: [10.2196/jmir.2976](https://doi.org/10.2196/jmir.2976)] [Medline: [24610454](https://pubmed.ncbi.nlm.nih.gov/24610454/)]
20. Cronin RM, Davis SE, Shenson JA, Chen Q, Rosenbloom ST, Jackson GP. Growth of secure messaging through a patient portal as a form of outpatient interaction across clinical specialties. *Appl Clin Inform* 2015;6(2):288-304 [[FREE Full text](#)] [doi: [10.4338/ACI-2014-12-RA-0117](https://doi.org/10.4338/ACI-2014-12-RA-0117)] [Medline: [26171076](https://pubmed.ncbi.nlm.nih.gov/26171076/)]
21. Badawy SM, Barrera L, Sinno MG, Kaviany S, O'Dwyer LC, Kuhns LM. Text messaging and mobile phone apps as interventions to improve adherence in adolescents with chronic health conditions: A systematic review. *JMIR Mhealth Uhealth* 2017 May 15;5(5):e66 [[FREE Full text](#)] [doi: [10.2196/mhealth.7798](https://doi.org/10.2196/mhealth.7798)] [Medline: [28506955](https://pubmed.ncbi.nlm.nih.gov/28506955/)]
22. Bin Abbas B, Al Fares A, Jabbari M, El Dali A, Al Orifi F. Effect of mobile phone short text messages on glycemic control in type 2 diabetes. *Int J Endocrinol Metab* 2015 Jan;13(1):e18791 [[FREE Full text](#)] [doi: [10.5812/ijem.18791](https://doi.org/10.5812/ijem.18791)] [Medline: [25745493](https://pubmed.ncbi.nlm.nih.gov/25745493/)]
23. Benhamou P, Melki V, Boizel R, Perreal F, Quesada J, Bessieres-Lacombe S, et al. One-year efficacy and safety of Web-based follow-up using cellular phone in type 1 diabetic patients under insulin pump therapy: The PumpNet study. *Diabetes Metab* 2007 Jun;33(3):220-226. [doi: [10.1016/j.diabet.2007.01.002](https://doi.org/10.1016/j.diabet.2007.01.002)] [Medline: [17395516](https://pubmed.ncbi.nlm.nih.gov/17395516/)]
24. Quinn CC, Shardell MD, Terrin ML, Barr EA, Ballew SH, Gruber-Baldini AL. Cluster-randomized trial of a mobile phone personalized behavioral intervention for blood glucose control. *Diabetes Care* 2011 Sep;34(9):1934-1942 [[FREE Full text](#)] [doi: [10.2337/dc11-0366](https://doi.org/10.2337/dc11-0366)] [Medline: [21788632](https://pubmed.ncbi.nlm.nih.gov/21788632/)]
25. Katz DL, Nordwall B. Novel interactive cell-phone technology for health enhancement. *J Diabetes Sci Technol* 2008 Jan;2(1):147-153 [[FREE Full text](#)] [doi: [10.1177/193229680800200122](https://doi.org/10.1177/193229680800200122)] [Medline: [19885191](https://pubmed.ncbi.nlm.nih.gov/19885191/)]

26. Istepanian RSH, Zitouni K, Harry D, Moutosammy N, Sungeor A, Tang B, et al. Evaluation of a mobile phone telemonitoring system for glycaemic control in patients with diabetes. *J Telemed Telecare* 2009;15(3):125-128. [doi: [10.1258/jtt.2009.003006](https://doi.org/10.1258/jtt.2009.003006)] [Medline: [19364893](https://pubmed.ncbi.nlm.nih.gov/19364893/)]
27. Dobson R, Carter K, Cutfield R, Hulme A, Hulme R, McNamara C, et al. Diabetes text-message self-management support program (SMS4BG): A pilot study. *JMIR Mhealth Uhealth* 2015 Mar 25;3(1):e32 [FREE Full text] [doi: [10.2196/mhealth.3988](https://doi.org/10.2196/mhealth.3988)] [Medline: [25830952](https://pubmed.ncbi.nlm.nih.gov/25830952/)]
28. Rami B, Popow C, Horn W, Waldhoer T, Schober E. Telemedical support to improve glycemic control in adolescents with type 1 diabetes mellitus. *Eur J Pediatr* 2006 Oct;165(10):701-705. [doi: [10.1007/s00431-006-0156-6](https://doi.org/10.1007/s00431-006-0156-6)] [Medline: [16670859](https://pubmed.ncbi.nlm.nih.gov/16670859/)]
29. Tasker APB, Gibson L, Franklin V, Gregor P, Greene S. What is the frequency of symptomatic mild hypoglycemia in type 1 diabetes in the young?: Assessment by novel mobile phone technology and computer-based interviewing. *Pediatr Diabetes* 2007 Feb;8(1):15-20. [doi: [10.1111/j.1399-5448.2006.00220.x](https://doi.org/10.1111/j.1399-5448.2006.00220.x)] [Medline: [17341287](https://pubmed.ncbi.nlm.nih.gov/17341287/)]
30. Rossi MCE, Nicolucci A, Pellegrini F, Bruttomesso D, Bartolo PD, Marelli G, et al. Interactive diary for diabetes: A useful and easy-to-use new telemedicine system to support the decision-making process in type 1 diabetes. *Diabetes Technol Ther* 2009 Jan;11(1):19-24. [doi: [10.1089/dia.2008.0020](https://doi.org/10.1089/dia.2008.0020)] [Medline: [19132851](https://pubmed.ncbi.nlm.nih.gov/19132851/)]
31. Hanauer DA, Wentzell K, Laffel N, Laffel LM. Computerized Automated Reminder Diabetes System (CARDS): Email and SMS cell phone text messaging reminders to support diabetes management. *Diabetes Technol Ther* 2009 Feb;11(2):99-106 [FREE Full text] [doi: [10.1089/dia.2008.0022](https://doi.org/10.1089/dia.2008.0022)] [Medline: [19848576](https://pubmed.ncbi.nlm.nih.gov/19848576/)]
32. Ralston JD, Revere D, Robins LS, Goldberg HI. Patients' experience with a diabetes support programme based on an interactive electronic medical record: Qualitative study. *BMJ* 2004 May 15;328(7449):1159 [FREE Full text] [doi: [10.1136/bmj.328.7449.1159](https://doi.org/10.1136/bmj.328.7449.1159)] [Medline: [15142919](https://pubmed.ncbi.nlm.nih.gov/15142919/)]
33. Lyles CR, Harris LT, Le T, Flowers J, Tufano J, Britt D, et al. Qualitative evaluation of a mobile phone and web-based collaborative care intervention for patients with type 2 diabetes. *Diabetes Technol Ther* 2011 May;13(5):563-569. [doi: [10.1089/dia.2010.0200](https://doi.org/10.1089/dia.2010.0200)] [Medline: [21406018](https://pubmed.ncbi.nlm.nih.gov/21406018/)]
34. Wade-Vuturo AE, Mayberry LS, Osborn CY. Secure messaging and diabetes management: Experiences and perspectives of patient portal users. *J Am Med Inform Assoc* 2013 May 01;20(3):519-525 [FREE Full text] [doi: [10.1136/amiainl-2012-001253](https://doi.org/10.1136/amiainl-2012-001253)] [Medline: [23242764](https://pubmed.ncbi.nlm.nih.gov/23242764/)]
35. Hess R, Bryce CL, Paone S, Fischer G, McTigue KM, Olshansky E, et al. Exploring challenges and potentials of personal health records in diabetes self-management: Implementation and initial assessment. *Telemed J E Health* 2007 Oct;13(5):509-517. [doi: [10.1089/tmj.2006.0089](https://doi.org/10.1089/tmj.2006.0089)] [Medline: [17999613](https://pubmed.ncbi.nlm.nih.gov/17999613/)]
36. Dick JJ, Nundy S, Solomon MC, Bishop KN, Chin MH, Peek ME. Feasibility and usability of a text message-based program for diabetes self-management in an urban African-American population. *J Diabetes Sci Technol* 2011 Sep 01;5(5):1246-1254 [FREE Full text] [doi: [10.1177/193229681100500534](https://doi.org/10.1177/193229681100500534)] [Medline: [22027326](https://pubmed.ncbi.nlm.nih.gov/22027326/)]
37. Frøisland DH, Arsand E, Skårderud F. Improving diabetes care for young people with type 1 diabetes through visual learning on mobile phones: Mixed-methods study. *J Med Internet Res* 2012 Aug 06;14(4):e111 [FREE Full text] [doi: [10.2196/jmir.2155](https://doi.org/10.2196/jmir.2155)] [Medline: [22868871](https://pubmed.ncbi.nlm.nih.gov/22868871/)]
38. Holtz B, Lauckner C. Diabetes management via mobile phones: A systematic review. *Telemed J E Health* 2012 Apr;18(3):175-184. [doi: [10.1089/tmj.2011.0119](https://doi.org/10.1089/tmj.2011.0119)] [Medline: [22356525](https://pubmed.ncbi.nlm.nih.gov/22356525/)]
39. Eccher C, Piras EM, Stenico M. TreC: A REST-based regional PHR. *Stud Health Technol Inform* 2011;169:108-112. [Medline: [21893724](https://pubmed.ncbi.nlm.nih.gov/21893724/)]
40. Galligioni E, Piras EM, Galvagni M, Eccher C, Caramatti S, Zanolli D, et al. Integrating mHealth in oncology: Experience in the Province of Trento. *J Med Internet Res* 2015 May 13;17(5):e114 [FREE Full text] [doi: [10.2196/jmir.3743](https://doi.org/10.2196/jmir.3743)] [Medline: [25972226](https://pubmed.ncbi.nlm.nih.gov/25972226/)]
41. Storni C. Multiple forms of appropriation in self-monitoring technology: Reflections on the role of evaluation in future self-care. *Int J Hum Comput Interact* 2010 Apr 27;26(5):537-561. [doi: [10.1080/10447311003720001](https://doi.org/10.1080/10447311003720001)]
42. King N. Using templates in the thematic analysis of text. In: Cassell C, Symon G, editors. *Essential Guide To Qualitative Methods In Organizational Research*. Thousand Oaks, CA: SAGE Publications; 2004:256-270.
43. Lepercq J, Taupin P, Dubois-Laforgue D, Duranteau L, Lahlou N, Boitard C, et al. Heterogeneity of fetal growth in type 1 diabetic pregnancy. *Diabetes Metab* 2001 Jun;27(3):339-344. [Medline: [11431599](https://pubmed.ncbi.nlm.nih.gov/11431599/)]
44. Evers IM, de Valk HW, Visser GHA. Risk of complications of pregnancy in women with type 1 diabetes: Nationwide prospective study in the Netherlands. *BMJ* 2004 Apr 17;328(7445):915 [FREE Full text] [doi: [10.1136/bmj.38043.583160.EE](https://doi.org/10.1136/bmj.38043.583160.EE)] [Medline: [15066886](https://pubmed.ncbi.nlm.nih.gov/15066886/)]
45. Tennant PWG, Glinianaia SV, Bilous RW, Rankin J, Bell R. Pre-existing diabetes, maternal glycated haemoglobin, and the risks of fetal and infant death: A population-based study. *Diabetologia* 2014 Feb;57(2):285-294. [doi: [10.1007/s00125-013-3108-5](https://doi.org/10.1007/s00125-013-3108-5)] [Medline: [24292565](https://pubmed.ncbi.nlm.nih.gov/24292565/)]
46. Nathan DM, Cleary PA, Backlund JC, Genuth SM, Lachin JM, Orchard TJ, Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications (DCCT/EDIC) Study Research Group. Intensive diabetes treatment and cardiovascular disease in patients with type 1 diabetes. *N Engl J Med* 2005 Dec 22;353(25):2643-2653 [FREE Full text] [doi: [10.1056/NEJMoa052187](https://doi.org/10.1056/NEJMoa052187)] [Medline: [16371630](https://pubmed.ncbi.nlm.nih.gov/16371630/)]

47. Khunti K, Davies M, Majeed A, Thorsted BL, Wolden ML, Paul SK. Hypoglycemia and risk of cardiovascular disease and all-cause mortality in insulin-treated people with type 1 and type 2 diabetes: A cohort study. *Diabetes Care* 2015 Feb;38(2):316-322. [doi: [10.2337/dc14-0920](https://doi.org/10.2337/dc14-0920)] [Medline: [25492401](https://pubmed.ncbi.nlm.nih.gov/25492401/)]
48. Chaturvedi N, Sjolie AK, Stephenson JM, Abrahamian H, Keipes M, Castellarin A, et al. Effect of lisinopril on progression of retinopathy in normotensive people with type 1 diabetes. The EUCLID Study Group. EURODIAB Controlled Trial of Lisinopril in Insulin-Dependent Diabetes Mellitus. *Lancet* 1998 Jan 03;351(9095):28-31. [Medline: [9433426](https://pubmed.ncbi.nlm.nih.gov/9433426/)]
49. Nordwall M, Abrahamsson M, Dhir M, Fredrikson M, Ludvigsson J, Arnqvist HJ. Impact of HbA1c, followed from onset of type 1 diabetes, on the development of severe retinopathy and nephropathy: The VISS Study (Vascular Diabetic Complications in Southeast Sweden). *Diabetes Care* 2015 Feb;38(2):308-315. [doi: [10.2337/dc14-1203](https://doi.org/10.2337/dc14-1203)] [Medline: [25510400](https://pubmed.ncbi.nlm.nih.gov/25510400/)]
50. Andersen AR, Christiansen JS, Andersen JK, Kreiner S, Deckert T. Diabetic nephropathy in type 1 (insulin-dependent) diabetes: An epidemiological study. *Diabetologia* 1983 Dec;25(6):496-501. [Medline: [6363177](https://pubmed.ncbi.nlm.nih.gov/6363177/)]
51. de Boer IH, DCCT/EDIC Research Group. Kidney disease and related findings in the diabetes control and complications trial/epidemiology of diabetes interventions and complications study. *Diabetes Care* 2014;37(1):24-30 [FREE Full text] [doi: [10.2337/dc13-2113](https://doi.org/10.2337/dc13-2113)] [Medline: [24356594](https://pubmed.ncbi.nlm.nih.gov/24356594/)]
52. Pols J, Moser I. Cold technologies versus warm care? On affective and social relations with and through care technologies. *Alter* 2009 Apr;3(2):159-178. [doi: [10.1016/j.alter.2009.01.003](https://doi.org/10.1016/j.alter.2009.01.003)]
53. Oudshoorn N. Diagnosis at a distance: The invisible work of patients and healthcare professionals in cardiac telemonitoring technology. *Sociol Health Illn* 2008 Mar;30(2):272-288 [FREE Full text] [doi: [10.1111/j.1467-9566.2007.01032.x](https://doi.org/10.1111/j.1467-9566.2007.01032.x)] [Medline: [18290936](https://pubmed.ncbi.nlm.nih.gov/18290936/)]
54. Pols J. *Care at a Distance: On the Closeness of Technology*. Amsterdam, NL: Amsterdam University Press; 2012.

Abbreviations

DGDFSC: Direzione Generale dei Dispositivi Medici del servizio Farmaceutico e della Sicurezza delle Cure

ICT: information and communication technology

T1D: type 1 diabetes

TreC: Trento Cartella Clinica del Cittadino

TreC-DS: Trento Cartella Clinica del Cittadino Diabetes System

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