Challenges in Applying Standard Telemedicine Solutions in the Home of Type 2 Diabetics

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ABSTRACT

Approximately 5.5% of the Danish population is diagnosed with type 2 diabetes mellitus. Of these, a minor group requires regular visits from homecare nurses, to assist with daily medication and insulin injection. In this study we analyzed the deployment of a standard telemedicine platform in the home of seven patients and followed them through a 3 month field study. We found that the enrolled patients did achieve an increased empowerment and self-awareness about their own health conditions. However, the standard telemedicine solution had several short comings, which could lead to reporting errors. Based on our findings, we developed a proof-of-concept prototype to illustrate the ideal solution for this group of patients. This included features such as automatic transfer of weight and blood sugar data, video capture of an insulin monitor for verification of the correct dosage of insulin. Also, an overview of previously taken measurements and storage of these in a telemedicine database was implemented to eliminate the identified challenges.

Keywords

Telemedicine, diabetes mellitus, self-care, empowerment, pervasive healthcare.

1. INTRODUCTION

A society with an increasingly aging population due to better living conditions and treatment options makes it necessary to be innovative and think in new ways compared to alternative treatments in the primary- and secondary healthcare sector in which telemedicine is a technology in-progress. In Denmark, approximately 5.5% of the population is diagnosed with diabetes mellitus type 2, which corresponds to 307.000 cases. Of these, a minor group requires regular visits from homecare nurses, to assist with daily medication and insulin injection. This is called the "insulin route", as the homecare nurses must take this route on a daily basis, which takes up many nurse resources [1-3].

Aarhus Municipality chose to start a telemedicine pilot project in cooperation with Lokalcenter Tranbjerg in Aarhus, in order to gain experiences with this patient group and how telemedicine may be used to save staff resources while securing sufficient data quality and the quality-of-treatment. Thus, the purpose of the pilot project was to replace the insulin routes for citizens with diabetes using telemedicine.

The aim of this study was to clarify whether the implemented solution from the provider ViewCare complies with the users' needs at Lokalcenter Tranbjerg, and whether it is feasible to improve any deficiencies of the existing solution. This is evaluated through using a clinical proof-of-concept prototype developed as part of the study.

2. METHODS AND MATERIALS

The study was diveded into an analysis phase, focusing on the chosen standard telemedicine solution from the company ViewCare, an implemenation phase, as well as an evaluation phase [4].

2.1 Analysis Phase

The health technology assessment (HTA) method was chosen as the approach for analyzing the feasibility of deploying the ViewCare solution at the test sites. This method assumes various foci: technology, citizens, organization, and socioeconomics [5,6]. The HTA required several methods to be used, including field studies with observations and semi structured interviews at both the home of the patients, and the office of the home nurses. Specifically, we conducted semi-structured interviews with four citizens with type 2 diabetes and four nurses, all of which were familiar with ViewCare's solution. Furthermore, we conducted two observational studies of actual daily use [7].

2.2 Implementation Phase

Based on the findings from the HTA we designed and implemented a proof-of-concept prototype which we hypothesized could overcome the identified challenges with the existing standard telemedicine solution.

2.3 Evaluation Phase

The evaluation of the developed clinical proof-of-concept prototype was performed as a usability test to evaluate the prototype together with the end users, a patient and a nurse, in the home of a patient, as a simulated session.

3. VIEWCARE SOLUTION

Viewcare supplies a range of integrated telemedicine services to facilitate different patient groups, including Chronic Obstructive Pulmonary Disorder (COPD) and diabetics. At the center of the ViewCare solution is the Virtual Call Center (VVCC) front-end and back-end, for supporting video based communication between patient and healthcare staff in a secure environment. They support H.323 Video, SIP, PSTN, or a combination herof. Furthermore, blood glucose levels may be transferred over the connection to the healthcare staff, and stored in a central database repository.The platform is a ViewCare touch screen enabled computer, with network capabilities.

Figure 1 - The ViewCare telemedicine solution supports a video based secure connection to be established. Also, it allows data to be exchanged from connected devices; a cabled blood pressure device and a cabled glucometer.

4. RESULTS

4.1 Health Technology Assessment

We found that telemedicine technology chosen by Aarhus Municipality affects both citizens and the organization in a positive way. Telemedicine is percieved by both staff and patients as a sutiable alternative to existing nursing care efforts and may therefore contribute to positive changes for the individuel patient with regard to controlling their own disease, while at the same time saving staff ressources. The patients reported feeling that the more active role resulted in an increased state of self-concisiousness, supporting augmented self-care and empowerment [8].

4.2 HTA interview findings

The existing technology was percieved as easy to use by both the patients and healthcare. Also, participants found that additional features was nessecary in order to provide a secure solution, including automatic transfer of healthcare data from the patient platform to the nurse platform.

4.3 HTA observational findings

Furthermore, we identified an increased risk of misreading the patients blood sugar levels and the adminstered insulin dosage during the video conference sessions. This was in part due to the patients having shaky hands and thus difficulties in holding the blood glucose meter and the insulin pen sufficiently still in front of the camera. Thus, as the existing solution relies on transferring and validating data via the video connection, this could result in frequent misreadings and a low resulting data quality.

4.4 Clinical Proof-of-Concept Prototype

Based on the findings from the HTA, we designed the TeleBetes clinical proof-of-concept prototype in order to evaluate the feasibility of such a solution. The TeleBetes prototype makes it possible to perform nursing services at a distance through a videoconference, in line with the ViewCare standard telemedicine solution, and related types of telemedicine platforms such as Intel Healthguide, Bosch Health Buddy, and the Tunstall TeleHealth Monitor.
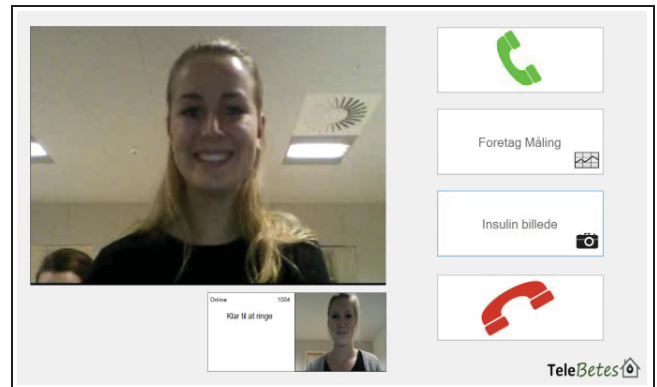

Figure 2 – With Telebetes it is possible to establish a video connection between a citizen and a nurse based on a secure and standardized component architecture, based on OpenCare and OpenTeleCare.

The Telebetes solution was designed to support automatic transfer of weight and manual entry of blood sugar during, before, and after, a video conference. Also, it supports the individual patients and staff and allows them to access historic data through a HL7 and web services enabled telemedicine database, Net4Care. TeleBetes is based on software and hardware components from the OpenTeleCare, CareStore, and Net4Care projects.
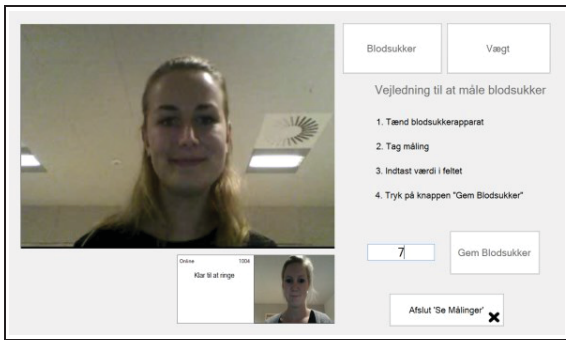
Figure 3 - During a video conference the citizen can perform a weight- or blood sugar measurement where written instructions are available

It is possible to see an overview of the citizen's measurements and storage of these in a Danish national health database, Net4Care. The projects objective was to develop and evaluate an open telemedical solution which enables an infrastructure exchanging medical data across the country compared to the the existing ViewCare solution [10].
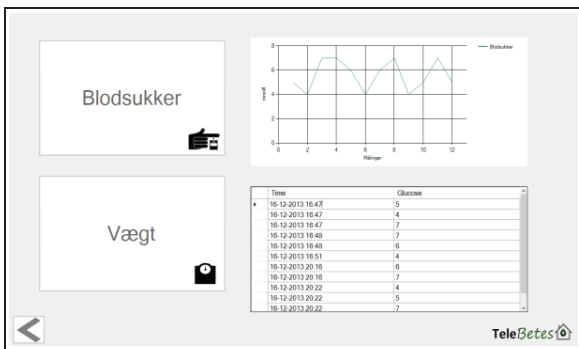

Figure 4 - Both the citizen and nurse are able to watch a history of previous medical measurements in terms of weight and blood sugar in cooperation with the Danish health database Net4Care

An insulin monitor is constructed so the nurse can verify the correct insulin dosage. This is solved by a monitor where the insulin pen is placed and a picture can be taken and send to the nurse.
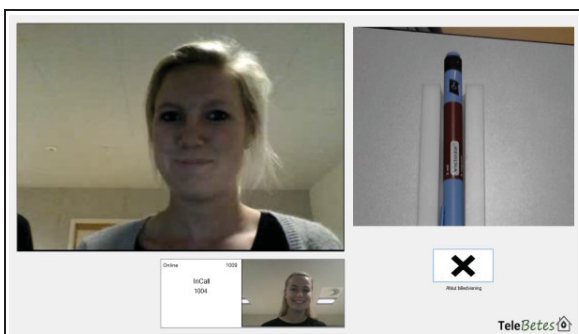

Figure 5 - Here the nurse can see a picture of the insulin stick in order to safely read read the insulin dosage taken by the patient to verify it's correct during a videoconference. Also, it

is possible to store the image at the patient and the staff platform, for future documentation purposes.

These features are all implemented in the clinical proof-of-concept prototype 'TeleBetes' to eliminate the identified challenges.

3.4 Findings from usability evaluation

TeleBetes was well received by both the citizen and the nurse test user as a tool for telehomecare. Minor technical issues were identified by the test subjects, including a lack of feedback in form of text messages and response time on different actions.

5. DISCUSSION

It appears to be important to assertain that all relevant values transmitted via a video link are easily readable by the homecare nurses, allowing them to document the correct blood sugar level and weight, and verify that the insulin dosage was correctly adjusted, for such data that are transmitted via a video link.

We also found that the homecare nurses today must rely on post-it notes for registering patients blood sugar and weigh levels, due to the existing systems not being able to integrate witht the existing patient record system, and not being able to transmit the data via the existing connection already employed by the video link. It is interesting to note, that the compnay behind the ViewCare solution did send personal support workers to the home of each patient for setting up the systems. As a result of this, there is a very real challenge with regard to reporting errors. These errors could lead to misdiagnosis and treatment errors. Some of the parameters were apparently supported by the system, but not implemented even after four months of actual testing, while other factors were not supported, including the registration of the adminstered insulin dosage via the pen.

Because of the limited number of test sujects we cannot draw any valid conclusion of how ViewCare's solution might work in the future at Lokalcenter Tranbjerg. Thus, this study provides a limited set of qualititave findings as a case study contribution.

With the TeleBetes prototype the project introduced means for overcoming several of the identified challnges. The functionality of the prototype can easily be applied to existing telemedicine solutions, including the ViewCare solution currently used.

TeleBetes is based on open source components from OpenCare Project (9), the Net4Care project (10), and the CareStore project (10). These all aim at enabling the sharing of data with other healthcare systems, minimizing the complexity and time in the development process of proof-of-concept prototypes.

Although our results provide a good indication of the challenges facing telemedicine and the potential of meeting these challenges with the suggested functionality, it would be beneficial to obtain more data on actual use for a longer period acquiring data from a larger patient cohort

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