

Intelligent Diabetes Assistant: Using Machine Learning to Help Manage Diabetes

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Abstract

We believe that machine learning can be used to help diabetics and care providers manage diabetes by predicting the effect that behaviors have on blood glucose. This when coupled with telemedicine could help care providers provide better individualized therapy more frequently. Currently, diabetics might get 15 minutes of interaction with a health expert during a checkup, and in that amount of time the physician must quickly evaluate the patient's health to offer therapy advice. The Intelligent Diabetes Assistant (IDA) addresses this problem by remotely collecting data, instantaneously sharing that data with a physician, and automatically processing the data to reveal important patterns. The system makes data collection more efficient for the patient, and it will make data analysis more efficient for the care team. We have conducted a two week longitudinal study tracking the lifestyle, nutrition, and blood glucose readings of 10 diabetics using IDA.

1. Introduction

The incidence rate of diabetes in Qatar is 15%, and globally diabetes has reached the point of being an epidemic with over 200 million diabetics[1]. In an ideal setting, the treatment plan for managing diabetes involves a support team.

The management plan [for diabetes] should be formulated as an individualized therapeutic alliance among the patient and family, the physician, and other members of the health care team[2].

With such a large population of diabetics in Qatar, the physicians and care providers are constrained by time. This limits their ability to form an ideal individualized therapeutic alliance. IDA improves the practical management of large numbers of diabetics by simplifying data collection

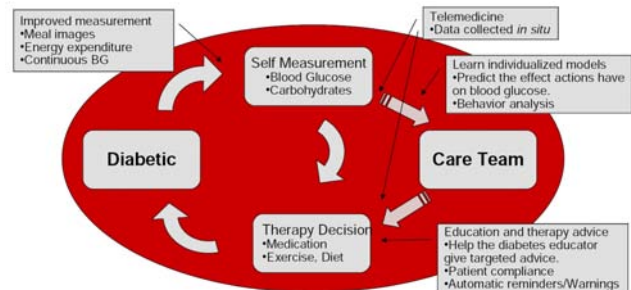


Figure 1. The Intelligent Diabetes Assistant improves diabetes management by incorporating better measurement, communication, and processing.

for the patient, sharing the data between the care team and patient, and assisting both patient and care team with analysis to improve the patients lifestyle management. Many studies have demonstrated that lifestyle management can improve the health of diabetics[3, 4].

2. System Description

The typical pattern for diabetes management rarely incorporates the care team of physicians and dietitians, but with IDA, the care team could frequently monitor a diabetics behavior and health. Figure 1 displays the adjustments that IDA makes to a typical management pattern. Figure 1. The Intelligent Diabetes Assistant improves diabetes management by incorporating better measurement, communication, and processing. IDA improves data measurement by collecting quality data related to nutrition, medication, exercise, and blood glucose. The data are collected from the patient using a mobile phone and with an armband that measures exercise. The patient can enter blood glucose, images of meals, medication doses, text messages and audio messages into a custom mobile application written using Java

(J2ME). The user interface is very simple to understand and logical to use. The data are then transmitted instantly to a secure MySQL database server. A custom web interface has been developed to allow the patient or care provider to access, interact with, and process the data. The web application has three primary interfaces that allow the patient or care provider to view and analyze data. The first is a data plot that displays all the collected data on a time-line. This lets the user visually identify patterns in the diabetics management in order to improve therapy. For example a dietitian could view an image of the patients meal with a plot of the effect the meal had on the patients blood glucose. 2 displays an image of the data plot interface.



Figure 2. Screen capture of the data plot interface.

The second interface is designed to allow a dietitian to evaluate the nutritional content of a meal based on an image of the meal. The interface displays an image of the meal and an area to search a food database. Foods are identified and the total nutritional content of the meal is calculated. 3 displays this interface.

The final interface allows the user and care provider to send text messages between the web interface and the mobile phone. This allows for instant feedback from the care provider. Combined, these three interfaces provide the care team with better information to monitor the patients health and the means to communicate advice.

3. Data Collection

The system has been used by 8 diabetics to collect data for two weeks with the approval of the Hamad Medical Corporation Research Committee (#7017/07). The subjects collected blood glucose measurements, meal images, medication doses, and energy expenditure. The subjects included 6 male, 4 female ranging from 37 to 56 years old. The data



Figure 3. Screen capture of the nutrition analysis web interface.

collected are currently be used to evaluate methods for automatically identifying patterns to suggest therapy modifications to improve patient health.

4. Discussion

Regarding using the system, patients have been able to learn to use the data collection software after a 15 minute training session. The software is designed to be simple to use to minimize the inconvenience that daily measurement might cause. One initial finding is that the patients and dietitian find that collecting meal images improves the patients understanding of nutrition and how it affects blood sugar. We are looking into methods for quantifying this observation, but we believe it is a result of having patient specific meal information during education sessions. The patient learns based on their own dietary patterns. Finally, the data collected by IDA gives the care team a detailed sample of the patients behavior. This could lead to improved therapy advice because it is based on data that better represents the habits of the patient.

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