Blood Glucose Control with Diabetes Center Web Application

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***Abstract*-This paper presents a new approach and concept of dealing and fighting with chronic diseases such as diabetes. Diabetes Centre functions as a specialized social network relying primarily on collecting and sharing of huge amounts of data related to diabetes among patients, medical and research institutions, but is actually much more than that. It's a package of tools, surveys, questionnaires and information materials that helps us to understand better this serious disease. Based on the overlap of data in the database, it is possible to group the positive and negative external factors (food, recreation, stress etc.) and make certain conclusion how they influence on the movement of glucose in blood. Understanding, controlling and dosing of external factors is crucial and the most important part of patient's everyday life. Patients who used Diabetes Centre extensively for at least ten days, showed great results and significant improvement in normalizing glucose levels in blood.**

Keywords- Diabetes Centre; Blood Glucose; External Factors; Data Analysing

I. INTRODUCTION

Over a past few decades, diabetes has established as one of the most dangerous threats of modern society, responsible for millions of death cases every year with predictions to increase. It is obvious now that diabetes presents epidemic threat of global proportions. If we take a look at the statistical numbers, we can easily perceive that things are getting worse and worse. More than 371 million people have diabetes. The number of people with diabetes is increasing in every country, as the number of death cases. Half of people with diabetes don't even know they have it, and when they find out it's usually already too late to prevent further health complications. Half of people who die from diabetes are under the age of sixty, and just in 2012, 4.8 million people died because of diabetes. These are all very shocking and devastating results, and we must ask our self's, what are we doing wrong, because things are not going better.

We believe that the whole approach to this subject is wrong and the present health system is not able to deliver satisfying results. However, scientists are showing some small advance in fields of organ transplantations and beta cells research, but that is just not enough. What we need is permanent solution for those hundreds of millions people with diabetes, and we need it as soon as possible. It's a global problem and we need a global platform for dealing with this issue, and that is exactly one of reasons for creating Diabetes Centre. Imagine 371 million people plus medical and research institutions all around the world working together, collecting and sharing data completely transparently. That would be a huge army of researcher's learning from each other. Now, we possess technology to accomplish that, and people are educated how to use web applications, all that is left is to get united and start researching.

Let's get back to basics once again just to make things clearer. So, what is actually diabetes? Diabetes is a chronic disease which occurs when pancreas stops completely or partially producing hormone of insulin, or when body can't effectively use produced insulin. More interesting, diabetes is also a disorder in which the immune system attacks the beta cells of pancreas responsible for producing insulin. Why is this happening? What is the cause? And, the most important - how to cure it? Modern science still has got no answer. This is where Diabetes Centre takes part. Although the main goal of this project is to teach patients how to control external factors in everyday life to regulate blood glucose, it has potential to discover answers on the above-mentioned questions by analysing a huge detailed amount of data.

II. IMPORTANCE OF EXTERNAL FACTORS

As we briefly wrote in an introduction there are several very important things we must take in consideration when dealing with diabetes, because in roughly 99% of situations when diabetes occurs, patients and doctors do not know how and why it happened and patients remain diabetics for a life time. First are external factors like food, workout, stress, minerals, vitamins and alternative medication like herbal teas, meditation, yoga and so, as they directly impact on movement of glucose in blood and that's why it is important to track these data. Second is patient's medical and personal history to figure out what has triggered diabetes.

Healthy nutrition is crucial for good health generally, and so is for diabetes. People with diabetes must have special focus on controlling intake of carbohydrates. With that said, food with high glycaemic index (bread, pasta, potato, sweets etc.) should be consumed as minimal as possible. On the other hand, food with low glycaemic index (all vegetables, most fruits, boiled meat etc.) should be consumed in everyday meals. Certain kinds of vegetables and fruits (beans, carrot, dandelion,

blueberry, nut etc.) even contain substances that regulate blood sugar levels. The story with food is not yet over. We must consider how food is being prepared. There is a huge difference between fried and boiled food. Frying destroys most nutrients while boiling preserves most of nutrients important for human body and organism. Oil used in preparation of food plays a bigger role in human health than most people think. Pumpkin seed oil, linseed oil and olive oil should be used in preparation of food because they contain healthy substances like omega 3 fatty acids important for recovering beta cells of pancreas and other positive effects. Sparkling and sweet juices should also be replaced with simple water, mineral water, tea or natural juices.

Another important thing for human health and people who have diabetes is workout. Simple exercises like walking, running, sit-ups, push-ups or similar, are allowing body to use insulin more effectively but can also rapidly lower glucose level in blood which leads to hypoglycaemic state or even coma. That is why diabetics should always be cautious and carry with them something sweet (small chocolate, sugar candy etc.).

An undetermined amount of stress can be a trigger for many different health disorders such as diabetes. In stressful situations our body secretes a hormone of the adrenal gland – adrenalin. Because of increased secretion of adrenalin there is a slight increase of blood glucose during stress. This is normal process how our body functions, but when we are exposed to high levels of stress over a longer period of time, increased concentrations of adrenaline causes an ever-present hyperglycaemia (high level blood glucose).

Minerals and vitamins are a first line of defence against viruses, bacteria and other free radicals, allowing human body to function normally. But what happens when there's to low or to high level of minerals or vitamins in our body. Both high and low level of minerals and vitamins can cause serious health complications. Deficiency of minerals like magnesium and chromium, and vitamins like B6, B12, C, D and E causes diabetic neuropathy (blindness, kidney failure, nerve system damage etc.). Lack of minerals and vitamins is often found at people with diabetes.

Through the history alternative medicine has been part of various religions and cultures all over the world. From the aspect of today's modern medicine, alternative medicine is old, unreliable and unproved, yet when modern medicine is out of solutions (especially in cases of chronic diseases like cancer and diabetes) alternative medicine becomes a last hope for sick patients. Herbal preparations, meditation and acupuncture are just a few of many ways to treat chronic disease like diabetes. Certain plants contain substances that can normalize blood glucose levels and patients which consumed these plants for a time period of minimum two weeks, showed great results in stabilization of blood glucose levels. The state of spirit is connected with the state of physical body, and so training of spirit with some way of meditation lowers the level of stress and with that also blood glucose levels.

Patient's medical history can also point to what triggered diabetes. In many situations strong bacterial infections can cause health disorder in which immune system is to irritated and starts attacking friendly beta cells.

Because of all mentioned in this chapter, it's obvious how important it is to track records about external factors. It will help us to understand diabetes more in depth, and it will possibly bring us closer to the answer of this serious disease.

Fig. 1 Importance of external factors

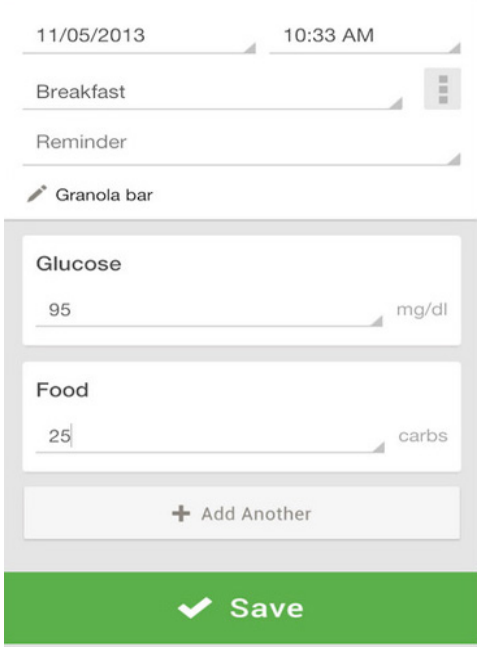
III. COMPARISION OF APPLICATIONS AND FUNCTIONALITIES

Diabetes Centre is not the first application for recording data about blood glucose, of course, but provides functionalities that are not included in any professional application related with diabetes till this moment. In order to show shortcomings of other applications in comparison with Diabetes Centre we will use user interface images of three most respected applications (Glucose Buddy, On Track Diabetes and Si Diary) related with diabetes.

The most noticeable difference between applications is in the entry of data after measuring blood glucose. While other applications take five to seven parameters, Diabetes Centre takes thirteen. This shows that Diabetes Centre is much more focused on collecting detailed data related to the measured blood glucose level.

(a)

(b)



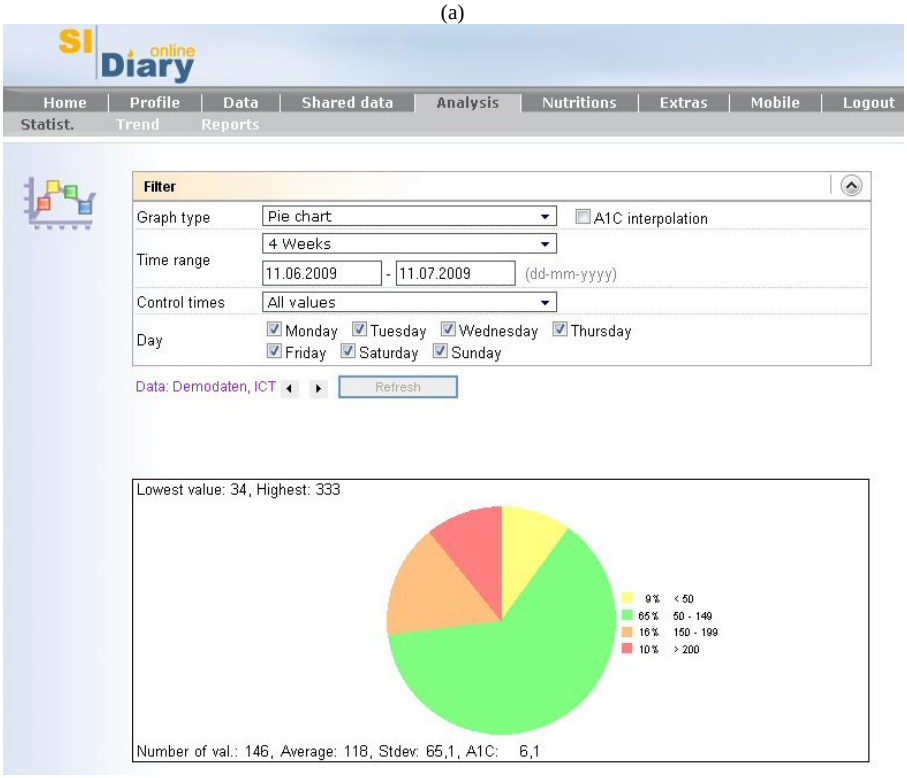
(c)

Fig. 2 Comparison of data entry forms - Glucose buddy android/IPhone application (a), On Track Diabetes android application (b) and Diabetes Centre web application (c)

Diabetes Centre data collection process may require a little more time when entering data in relation to other applications, but these detailed data allows a lot more possibilities in analysing of data. Other applications can only provide graphical presentation of data analyse for overall and an arbitrary period of time based on daily measured blood glucose values, time of measurement, food and exercise in general. Diabetes Centre on the other hand includes all mentioned and extends data analyse with following functionalities. Data analysis for every type of food consumed, each exercise performed, every alternative used, each level of stress and each medication. Because of low data input, many applications are able to present only basic data while Diabetes Centre can show a wide spectrum of data.

Diabetes Centre provides even more functionalities for data analysis but in separate web form for tracking medication, HbA1c (the average blood sugar level between the last two to three months obtained by extraction of blood) and weight data.

(a)



(b)

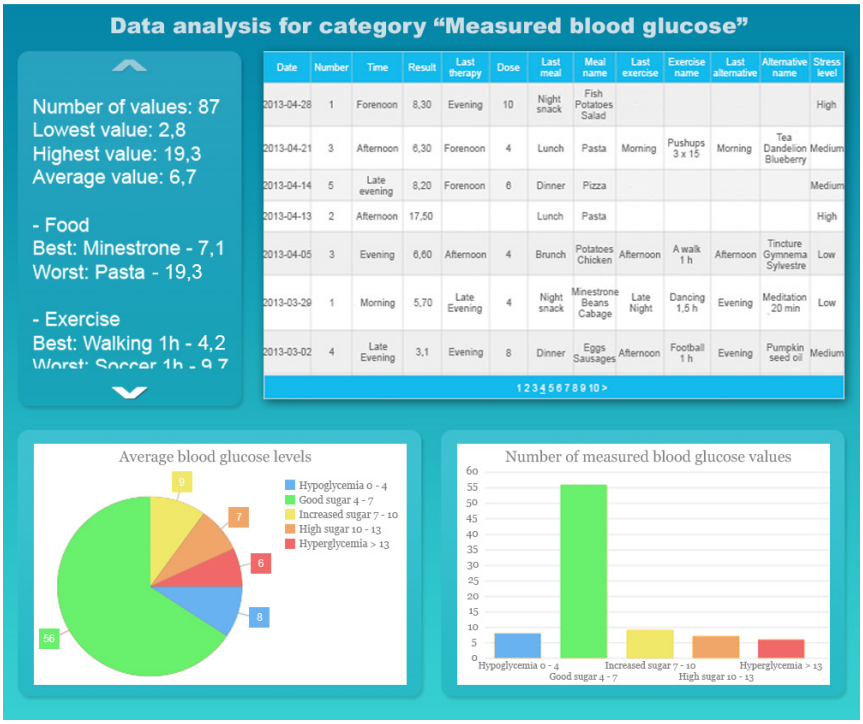


Fig. 3 Comparison of web forms for data analysis between Si Diary web application (a) and Diabetes Centre web application (b)

Depending on the drug and treatment plan from past or present, user can select detailed analysis to show only data related to selected drug and treatment plan. New and generated data contains information (which medication dosage had the best or the worst impact on blood glucose levels in combination with external factors) in tabular and chart form. The ultimate goal of this data analysis is to minimize the use of drugs and replace their usage with healthy nutrition, exercise and alternatives.

By selecting a certain measured HbA1c record new data is generated for time period of seventy five days before date of measurement with information about what had an impact on selected HbA1c record (medication dosage and external factors). The ultimate goal of this data analysis is to spot acceptable individual blood glucose measurements in order to make a better treatment plan.

Many people with diabetes have problems with maintaining satisfactory body weight. Type 1 diabetes often causes a loss of body weight, while type 2 diabetes often causes overweight. Both situations are problematic and they should be carefully monitored. By selecting a certain measured body weight new data is generated for time period between selected body weight and body weight before with all information (drugs and treatment plan details, food). The main objective here is to establish which food was consumed in which quantity, and the method of therapy exercise and alternative used in given time period.

IV. SHARING – ISSUES AND POSSIBILITIES

One more difference between Diabetes Centre and other applications but so important that deserves chapter for itself is as title says - sharing.

Although we live in a time of data sharing for a quite some time, all possibilities are still not used as they should, especially in medical purposes. While we witness a sharing of pictures, videos, music and stories on social level daily, somehow we still need to visit a doctor to pick up a simple prescription or deliver examination papers. This is not just stressful and time consuming but also and unnecessary, particularly for those who live out of the city or far from doctor. Issue of a data sharing doesn't consider only a waste of our daily time, but it also touches on problem of transparency. Why? Well, when someone is diagnosed with diabetes and he or she ends up in hospital, therapy with drugs starts immediately to lower blood glucose as soon as possible. Drugs, regular meals, education about disease, blood tests and examinations last for about a week or two, but in the end patient is out of hospital with a few papers and must live rest of life with diabetes. This is the moment where connection between patient and hospital stops in most situations till next blood test and examinations. However this is wrong approach especially because today we possess technologies that can help us in better communication and networking.

Fig. 4 Diabetes Centre Web Application Schema

Diabetes Centre provides a connection between hospitals, research facilities and patients on daily basis. What this essentially means, is that patients have complete insight in all healing procedures and therapy plans (drugs dosage, regulations of meals, blood tests etc.) of hospitals and research facilities just as they have insight in all patients data (food, exercises, alternatives, stress etc.) and mutual data sharing. Of course, each participant can easily block sharing of data because of private concerns, but the idea is to share all data related with diabetes openly so that all participants can learn faster and search for solutions. Diabetes Centre is a huge database with high level of data entry, based on which overlapping data tells what is doing right and what is doing wrong in treatment of diabetes.

V. CONCLUSION

Diabetes Centre web application has been tested by 24 persons in period of 3 months and all participants showed a decrease and stabilization of the blood glucose levels. The most important fact is that all participants started with high usage of medications for regulation of blood glucose (insulin or pills) but at the end of testing most of participants (19) significantly reduced medication usage and managed to regulate blood glucose levels with external factors.

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